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The Canadian Minerals Yearbook 1962

Mineral Resources Division

Department of Mines and Technical Surveys, Ottawa

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Foreword

This Yearbook describes the mineral industry of Canada for 1962. The first part, General Review, is a detailed economic-statistical study of over-all developments in the industry. In revised form, following the General Review, are fifty-seven Mineral Reviews, preliminary copies of which have been issued as separate pamphlets during 1963. The Reviews deal with exploration and development, production, consumption, trade, and technical matters concerning specific minerals of current or potential importance to the Canadian economy. The text is supported by photographs, maps, graphs and tables and is supplemented by an index to companies. The Yearbook is the continuation of a series of annual reports dating back to 1886.

Most of the statistics on Canadian production, trade and consumption were compiled by the Dominion Bureau of Statistics. The statistics can be considered final unless otherwise indicated. Specific figures for companies were supplied directly by company officials or were obtained from annual reports. Market quotations are mainly from standard marketing reports issued in Montreal, London or New York.

The Department of Mines and Technical Surveys is indebted to all who contributed information, in particular to mine operators, oil and gas producers and others connected with the mineral industry.

W. Keith Buck
Chief
Mineral Resources Division

January 1964

General Review

A review of the mineral economy*

This summary of the Canadian mineral industry in 1962 has been prepared to introduce and to supplement the mineral industry review series consisting of individual reviews of each of 57 mineral commodities. The summary is in two parts: the first consisting of descriptive analyses of the year's developments; and the other consisting of statistical analyses set out in 59 tables. An introductory section in the first part provides a brief survey of the industry's progress and problems. This is followed by a summary of highlights for each of the principal mineral commodities and by an appraisal of developments in mining technology. Finally, an analysis is made of trends in 11 sectors of the industry, by referring to the statistical tables in the second part. Information is included throughout the summary to relate progress in the mineral industry to the Canadian economy as a whole.

PROGRESS AND PROBLEMS

The mineral industry has for many years been a dynamic and important part of Canada's economy. The industry's remarkable progress in recent years is evidenced by an almost threefold increase in the value of production since 1950. Continued growth is strongly dependent upon the growth of the Free World's industrial economy because much of Canada's mineral output goes into the export market. Mineral exports are, of course, particularly sensitive to trends in international trade which, in turn, are influenced by tariffs, quotas and subsidies, producer-consumer agreements of either national or corporate nature, distress sales, and by the formation of trading blocs. Consequently, both domestic and international trends are of importance in assessing mineral industry progress; in 1962 there were a number of significant developments at the national and international levels.

Increased resource development, production and exports characterized the Canadian mineral economy in 1962, with production being at an all-time high. This higher rate of activity was also reflected in increased capital expenditures. Although competition in world mineral markets is increasing as production capacity continues to outpace demand, the growth in mineral exports to the United States in 1962 more than counterbalanced the decline in demand for Canadian mineral products in overseas markets.

Resource Development and Production

Initiation of new mineral resource projects and expansion of a number of mineral enterprises across Canada provided evidence of a progressive and vigorous industry. Asbestos and copper properties were being developed in Newfoundland; iron ore in Labrador (Newfoundland), Ontario and British Columbia; base metal properties in New Brunswick; copper in the Eastern Townships of Quebec, and copper-zinc in the Matagami Lake area of northwestern Quebec. Construction of a 70,000-ton-a-year electrolytic zinc refinery at Valleyfield, Quebec, was scheduled for completion in 1963. It will be eastern

* By the Mineral Resources Division

Canada's first zinc refinery and will receive concentrates from the new mines in the Matagami area and some mines in Ontario. Exploration for nickel-copper deposits in northern Manitoba continued with encouraging results. Production of potash began at Esterhazy, Saskatchewan, and the further expansion planned will provide for the world's largest potash processing facility. Large-scale potash production in Saskatchewan and greatly increased sulphur recovery from the processing of natural gas in Alberta and British Columbia will make this region a leading world source of these minerals. Of particular significance to far northern mineral development was the start of construction of the 438-mile railroad from Grimshaw, in northern Alberta, to large high-grade lead-zinc deposits at Pine Point, on the south shore of Great Slave Lake in the Northwest Territories. Further evidence of mineral potential in northern Canada was provided by the discovery of a large iron occurrence in the Snake River area of the Yukon and by a gold discovery in the Contwoyto Lake area in the Northwest Territories, about 250 miles northeast of Yellowknife. The diversification of mineral industry activity, together with the completion of major iron ore projects in Labrador, and the commencement of potash production in Saskatchewan, marked 1962 as an outstanding year in mineral resource development.

Accompanying these and other resource developments, there was a 10-per-cent increase in the value of production from the 1961 total of $2,582.3 million to $2,845.0 million. The gain was well above the approximate 3 1/2 per cent increase in each of the two previous years but below the all-time record advance of 14 1/2 per cent in 1959. Table 1 shows that metallic mineral output rose almost eight per cent and accounted for over one half of total mineral output. Industrial minerals, including nonmetals and structural materials, rose almost five per cent and accounted for one fifth. Fuels increased by less than 20 per cent and made up more than one quarter of the value of all minerals.

Export Markets

Production increases are generally reflected by export increases because the export market has been taking about 60 per cent of the industry's total output in recent years. Production expansion depends specifically on the country's ability to compete in foreign mineral markets, and, in general, on economic and political trends throughout the world. The buoyant economy in the United States throughout most of 1962 led to a favorable increase in mineral exports to that country. However, adjustments in the economies of European countries and Japan following several years of rapid expansion resulted in a levelling off in mineral demand in keeping with the slower industrial growth. Under these circumstances the United States market took on increased importance. During the period 1950-60, the percentage of Canadian mineral exports accounted for by the United States market declined from 64.6 to 52.3 per cent. A reversal took place in 1961, and in 1962 that market accounted for 62.6 per cent of Canada's total mineral exports. Although greater export market diversification has been hoped for in recent years, the proximity of the large United States market and close corporate ties indicate that it will offer the best marketing opportunities in the foreseeable future. Because of the shipping distances, lack of corporate ties between Canadian producers and foreign consumers and the increasing availability of mineral supplies from developing countries in Africa, South America, and southeastern Asia, Canada must face keen competition in Europe and Japan.

Changes in markets for the major metals and for minerals as a group for selected years since 1950 are shown in the following table of exports in raw and semiprocessed forms.

DESTINATIONS OF MAJOR CANADIAN METALS AND MINERALS
(as percentages of export total of each)

		Iron Ore	Aluminum	Copper	Nickel	Lead and Zinc	All Mineral Exports
United States	1950	93	48	48	72	72	64.6
	1955	80	39	49	68	60	61.1
	1960	66	20	37	34	48	52.3
	1961	68	26	25	45	48	53.8
	1962	81	36	31	54	55	62.6
Britain	1950	5	38	37	18	15	23.0
	1955	9	47	32	19	31	24.7
	1960	18	30	33	26	32	21.3
	1961	14	30	36	30	27	20.6
	1962	7	28	29	26	27	17.1
Other countries of the European Free Trade Area*	1950	0	1	5	9	1	3.1
	1955	0	1	5	12	0	3.6
	1960	0	2	6	21	1	4.8
	1961	0	2	11	15	1	4.7
	1962	0	3	10	15	0	4.3
European Economic Community**	1950	2	2	5	1	11	4.9
	1955	7	6	10	1	8	6.6
	1960	10	20	14	13	8	11.0
	1961	11	12	15	5	13	9.0
	1962	6	10	11	2	9	6.5
Japan	1950	0	0	0	0	0	0.1
	1955	4	0	0	0	0	0.8
	1960	6	3	5	0	5	3.4
	1961	7	6	6	1	4	4.7
	1962	6	2	13	1	1	3.5
All other countries	1950	0	11	5	0	1	4.3
	1955	0	7	4	0	1	3.2
	1960	0	25	5	6	6	7.2
	1961	0	24	7	4	7	7.2
	1962	0	21	6	2	8	6.0

* Norway, Sweden, Denmark, Austria, Switzerland, Portugal.
** France, Germany, Italy, the Netherlands, Belgium, Luxembourg.

While changes have been taking place in market destinations, there have also been changes in the relative importance of the leading mineral exports. In recent years, aluminum, lead, zinc and asbestos have declined somewhat in relative importance while iron ore, crude oil, natural gas and nickel have gained. In 1962, there were further changes among the leading exports. Nickel constituted 16.7 per cent of the value of all mineral exports compared with 19.5 per cent in 1961; aluminum increased from 14.0 to 14.9 per cent. For other leading mineral exports, the comparison for 1962 and 1961 was as follows: iron ore, 11.4 and 8.1 per cent; fuels, 16.3 and 11.6 per cent; copper, 10.5 and 11.0 per cent; uranium, 8.6 and 11.0 per cent; asbestos, 7.0 and 7.5 per cent; and lead and zinc combined, 4.4 and 4.9 per cent. The major increase in the relative importance of the fuels was due to a rise of $78.2 million in crude oil exports and $30.7 million in natural gas exports. Seven metals, asbestos, and the fuels accounted for 90 per cent of all mineral exports in 1962.

Canada's mineral exporters in 1962 continued to face a rising supply surplus as new world sources were being brought into production. The world surplus situation was complicated by the several barriers to trade and by the existence of large mineral stockpiles in the United States. The new and potential sources of mineral supply continued, as in recent years, to outrun new market demand.

In terms of marketing forces affecting individual mineral commodities, Canadian exporters had to adjust to a variety of conditions in 1962. Demand in the United States for iron ore, nickel, copper and most other major metals was at a high level during most of 1962 as a result of the generally buoyant economic conditions which had prevailed since the beginning of 1961. The rise in steel output that had begun early that year continued until the spring of 1962. The market for iron ore was strengthened by inventory accumulation in expectation of a possible steel industry strike. Steel demand subsequently slackened but, due particularly to the continuing rising demand for durable goods in the transportation and the defence production industries, market growth for nonferrous metals continued into the second half of the year. Rising demand for mineral materials in the United States enabled Canada to increase its mineral exports by $264 million with the result that, although mineral exports overseas declined, there was a net increase in exports of over $177 million to $1,935.4 million. The rise in the value of exports to the United States was due in large part to the success of the crude oil and iron ore industries in finding larger markets in that country.

The decline of $87 million in exports to countries other than the United States resulted not only from greater competition from other sources of supply but also from a slowing down of economic growth in Europe and Japan. Steel production declined in Europe thereby reducing the market for iron ore, the additive metals and zinc. Japan reduced mineral imports as part of a program to correct balance of payments difficulties. During the latter part of the year, economic activity in the United States lessened reducing exports to that market for the year as a whole from the amount anticipated from earlier shipments. Further market resistance developed as a result of a substantial build-up in inventories. Following settlement of a labor-management dispute in the primary steel industry, the liquidation of steel stocks had a dampening effect on the demand for metals associated with steel manufacturing. Fortunately, new construction continued at a high level throughout the year partly counterbalancing other marketing setbacks.

Several developments in international mineral markets affected Canadian marketing opportunities. There was an intensification of a program of buying up surplus stocks of copper on the London Metal Exchange. In addition, by mid-1962 a worldwide cutback in output was instituted that affected several large producers in Africa, Canada and the United States. Without these two measures to reduce surpluses, Canadian marketing difficulties would have been much greater. The nickel industry was confronted with declining markets in the European and United States steel industries at a time when new production capacity was becoming operative. Markets were further restricted as the United States government switched from buying to selling from its nickel stockpile. These factors forced a 13-per-cent cutback by The International Nickel Company of Canada, Limited, commencing in October. Although Canadian iron ore shipments to the United States did not decline as much as shipments from other sources during the market contraction of the last half of the year, Canada did lose out to other suppliers in the European market. In fact, the continued decline of Canadian iron ore shipments to Europe in recent years points to difficult marketing problems for the future. Fortunately, gains in the Japanese iron ore markets have counterbalanced losses in the British market.

At the end of 1962 the export market for Canadian minerals appeared more favorable than at mid-year. Industrial activity in the United States appeared to be gathering momentum and an increase in mineral demand and in prices became evident. In overseas markets, inventory liquidation of metals was nearing an end and market demand showed improvement.

Mineral Prices

Most mineral exports were affected in 1962 by changes in world mineral prices and by a further decline of the Canadian dollar relative to foreign currencies. Prices of lead and zinc in Europe declined to a 16-year low for lead and a four-year low for zinc and then recovered; the averages were slightly below those of 1961. The United States price of zinc declined slightly in 1962; the price of lead declined sharply and subsequently improved somewhat. The Canadian zinc price remained constant at 11.5 cents a pound. The lead price fluctuated but in November settled at 10.0 cents a pound. Early in the year the Aluminum Company of Canada, Limited, reduced its overseas aluminum price slightly to 22.5 cents a pound, in line with prices abroad, and in June the Canadian price was increased slightly to 24 cents (Cdn.). The U.S. price remained at 24 cents (U.S.) a pound until December when it was reduced to 22.5 cents. The world price of nickel was reduced from 81.25 cents (U.S.) to 79 cents at mid-year. In the iron ore industry a downward adjustment of seven per cent in the price of Mesabi direct shipping iron ore took place prior to the 1962 shipping season. Although North American iron ore prices declined somewhat, unit values of iron ore rose because of the increasing proportion of high-grade concentrates and pellets being shipped. The average price of uranium paid to Canadian producers was about $10.50 a pound, but price declines can be expected particularly because a new British contract was signed at an average price of $5.05 (Cdn.). These downward trends in prices for some of the leading minerals in Canada's export trade were indicative of world surpluses and generally keener competition in international trade.

Other prices remained steady or increased moderately. Copper prices were stable at levels slightly higher than in 1961. The Canadian price rose to

31.5 cents a pound in May following devaluation. Silver prices began increasing at the end of 1961 with the announcement that the United States Treasury Department would end commercial sales at 91.3 cents a troy ounce from its free stocks; the price reached $1.26 in October, a 43-year high. Canada's gold price rose as a result of the decline in the value of the Canadian dollar in relation to the U.S. dollar. The average price was $37.41 in 1962 compared with $35.46 in 1961. In general, the Canadian dollar decline resulted in small domestic price increases, in terms of the Canadian dollar, for all mineral commodities selling on the export market.

Capital Investment

Capital investment in the mineral industry appeared to have reached a peak in 1962 with completion of a number of large projects, although other projects in the planning stages should provide for a resumption of the rising investment trend in the near future. An expenditure increase of almost $52 million in the iron ore industry in 1962 raised capital investment in the metals sector by $42 million despite declines for other metals. However, completion of two of the three major new mining projects in the Quebec-Labrador iron ore industry will lead to an investment decline in this industry in the immediate future. With completion of the third project in 1965, investment in the three projects including townsite preparation, railway construction and other related services, will be close to $1 billion.

In the copper industry, two new projects in British Columbia were in full operation following large-scale mining preparation. In Quebec three copper-zinc mining developments were almost completed and rapid progress was being made in New Brunswick base metal projects. A Newfoundland asbestos mine was being prepared for production by mid-1963 and a major potash project in Saskatchewan went into full production in 1962. These and other projects raised direct capital investment in the mining industry, excluding related facilities, from $448.8 million in 1961 to $477.2 million in 1962. A decline to $437 million was forecast for 1963 because of the completion of these major projects.

Although a near-term decline in capital investment appeared likely, exploration activity in 1962 was at a high level and ample funds were on hand for its continuance. One source is the large cash flow to uranium producers who, though not re-investing in uranium mining, are channelling idle funds into new mining and metal processing projects both at home and abroad. Exploration and mine development plans being considered throughout the industry at the end of 1962 indicated that capital investment in the mineral industry would continue to be a vital factor in Canada's economic growth.

Employment

The most important employment trends in the mineral industry in 1962 related to growth of the iron ore, nonmetallic minerals, petroleum and natural gas industries, and to declines in uranium, coal and gold mining, as well as to the production cutback in the nickel industry. Employment in the mineral industry, including metal mining, fuels, nonmetals, and nonferrous smelting and refining, accounts for about four per cent of total employment in the Canadian industrial composite. Manufacturing, based directly on the mineral industry, employs an additional 10 per cent of the total labor force. Employment in the mineral industry changed little in 1962. In recent years employment growth has been slow due to declines in some sections such as coal and gold, and to advances in labor-saving technology.

General Trends

The various mineral industry trends of 1962, for the most part favorable, reflected good progress in the Canadian economy at large. The Gross National Product increased eight per cent in value and mineral output rose ten per cent. The major stimulus to economic growth in 1962 came from the rise in exports and a large increase in purchases of goods and services by provincial and municipal governments. The mineral industry played an important role in the export expansion. Although the foreign exchange crisis caused some uncertainty in business outlook at mid-year, by the fourth quarter personal expenditures and plant investment began to rise. The favorable balance in merchandise trade was due in considerable part to mineral export increases and to declines in mineral imports, particularly fuels. Although there was an improvement in the current account deficit compared with the six preceding years, the financing of the balance of payments deficit remained a major problem. There was, however, a $155 million surplus in the balance on merchandise trade. This, and the improvement in the tourist account, resulted from the imposition of such fiscal measures as the setting of import surcharges ranging from five to 15 per cent on a wide range of items making up about two thirds of Canada's imports, plus a reduction in tax-free import allowances for returning Canadian tourists. These measures were preceded by the fixing of the Canadian dollar at the exchange rate of 92.5 cents U.S.

The Canadian mineral industry played an important role in many major economic developments in 1962, because of its large and rising production value, its one-third contribution to total merchandise exports, and its significant capital investment requirements. Possibly the best indicator of the industry's importance to the economy as a whole is illustrated by the $547 million increase in mineral exports during the period 1956-62. This was a major factor in raising the merchandise trade balance from a deficit of $728 million to a surplus of $155 million.

At the end of 1962, the mineral industry could look back to a successful year in which a mineral production record was set while exploration and property development were maintained at a high level. The broadened resource base made provision for a continuation of the production growth and general prosperity which has characterized the industry since the turn of the century and particularly since the end of World War II. An encouraging indication for the future is that new mineral discoveries are being made not only in hitherto undeveloped regions but also in long-established mining areas. The attention being given to technological research that would lead to lower costs and a more competitive position in foreign markets, and the emphasis on foreign market development, will stand in the industry's favor as it strives for larger and more diversified markets in a world in which mineral production capacity continues to outgrow the demand for most minerals.

MINERAL COMMODITY HIGHLIGHTS OF 1962

The mineral industry of Canada is generally considered in terms of three principal groups of mineral commodities: metals, industrial minerals or nonmetals, and fuels. The metals classification includes: iron and the ferro-alloy metals such as manganese and chromium, the precious metals such as gold and silver, the nonferrous metals such as copper and zinc, and the minor metals such as antimony and magnesium. The industrial minerals or nonmetals include two main sub-groups: nonmetallic mineral materials such as asbestos and sulphur, and construction materials such as cement, and sand and gravel. The fuels are coal, natural gas and its byproducts, and crude petroleum. There was production of 57 mineral commodities in 1962; the total value being $2,845 million, a gain of ten per cent over 1961.

Metals

The production value of metals in 1962 was $1,496 million, an eight-per-cent increase from 1961. The metals accounted for 53 per cent of total mineral production compared with 54 per cent the previous year. The leading metals were nickel, copper, iron ore, uranium, gold and zinc. The output value of these six was 91 per cent of all metals. Uranium production declined steeply and gold and nickel slightly while the other four had favorable increases as noted in Table 1. Production growth in metals is greatly dependent on Canada's ability to compete in export markets.

Aluminum

Primary aluminum output increased 4.1 per cent in 1962 to 690,000 tons which was 77.7 per cent of rated capacity. Five of the six Canadian smelters are owned by the Aluminum Company of Canada, Limited (ALCAN); four are in Quebec and one is in British Columbia. Canadian British Aluminium Company Limited operates a 90,000-ton-a-year smelter at Baie Comeau, Quebec, and plans an increase in rated annual capacity to 135,000 tons when markets warrant.

Exports increased to 576,000 tons from 487,000 tons in 1961. Canadian consumption was 145,000 tons. There was a 7.2 per cent rise to 168,000 tons in exports of primary aluminum to Britain and an 80 per cent rise to 212,000 tons to the United States. Exports of primary metal to the EEC declined for the third successive year, amounting to 54,000 tons in 1962.

ALCAN operated at 76 per cent of its rated annual capacity of 788,000 tons. The company is the world's largest marketer of aluminum in competitive export markets. The other major producers have been operating at higher rates than ALCAN because of their greater vertical integration of manufacturing and fabricating facilities. This condition has been changing in the last five years with emphasis being directed by ALCAN toward fabrication expansion rather than new smelter construction. Aluminium Limited, a group of production and fabricating companies of which ALCAN is the largest, continued its expansion of fabricating facilities in 18 countries. Canadian British Aluminium produced 95,000 tons of primary aluminum in 1962 which exceeds the company's rated annual capacity of 90,000 tons. The company sells 60 per cent of output under long-term agreements to British Aluminium Company, Limited the balance is sold mainly to Canadian fabricators.

Cobalt

Production of cobalt in 1962 amounted to 3.5 million pounds valued at $6,3 million. The increase of 299,000 pounds was mostly attributable to the opening of a new cobalt-producing section in the refinery of Sherritt Gordon Mines, Limited, at Fort Saskatchewan, Alberta. There has been no production of cobalt ores in Canada since 1957. Output in recent years has been obtained as a byproduct from the smelting and refining of nickel-copper ores from Sudbury, Ontario, and Lynn Lake and Thompson in Manitoba. For many years prior to the closure of the Deloro, Ontario smelter in 1961, it was also recovered as a byproduct of silver refining at the Deloro Smelting & Refining Company, Limited.

The International Nickel Company of Canada, Limited (INCO) recovers cobalt from its nickel refining operations at Port Colborne, Ontario, and at Clydach, Wales. The company reported production of 2.3 million pounds of cobalt in 1962 from the two refineries. High-purity electrolytic cobalt is produced at Port Colborne, and cobalt oxides and salts at Clydach. INCO also produces cobalt oxide at its Thompson, Manitoba, refinery as a byproduct in its nickel refining operations.

Falconbridge Nickel Mines, Limited, produces electrolytic cobalt from the refining of nickel-copper matte at its Christiansand, Norway, plant. Metal deliveries for 1962 were reported by the company to be 1.2 million pounds.

Sherritt Gordon Mines, Limited, produced 608,600 pounds of cobalt, up 417,500 pounds from 1961. The company recovered cobalt from nickel-cobalt calcine purchased from the General Services Administration in the United States as well as from the treatment of its Lynn Lake nickel-copper concentrates.

Cobalt Refinery Limited recovers small amounts of cobalt in the form of either black cobalt oxide or as a mixed cobalt-nickel oxide. These are byproducts of silver recovery operations in its plant at Cobalt, Ontario.

The Republic of the Congo (Leopoldville) is by far the largest producer of cobalt; its output in the past few years has amounted to about 60 per cent of the world's total. Canada ranks second to the Congo, producing about 11 per cent of the estimated 15,700 tons of cobalt.

Copper

Mine production of copper in Canada increased 4.2 per cent in 1962 to 457,400 tons. Refined copper production declined to 382,500 tons from 406,400 tons while domestic consumption of refined copper increased to 151,530 tons, up 9,718 tons from 1961. In 1962, eight new mines were brought into production, three mines were closed and seven were being developed. Ontario accounting for 189,000 tons of production in all forms was followed by Quebec with 147,400 tons and British Columbia with 54,500 tons. Although production in some provinces decreased, the large increase in British Columbia more than offset these declines.

At the end of 1962 Canada's reserves of copper ore were 692 million tons averaging 1.49 per cent copper. This estimate is in terms of measured and indicated ore and includes reserves at producing mines, prospects with announced production plans, and four other prospects with large indicated reserves.

Despite production curtailments by large producers in Africa, Chili, the United States and Canada, and strikes at some large mines in Chili, Peru and the United States, Free World production increased slightly to 4.1 million tons. Consumption and production were maintained in near balance by curtailment of production by large producers, support of the London Metal Exchange (LME) price through the purchase of excess offerings over demand, and a slight increase in United States consumption. Prices remained remarkably stable with the price of the United States producers and custom smelters remaining at 31 cents (U.S.) a pound throughout the year and the LME price fluctuating within narrow limits slightly below the United States price. Before devaluation of the Canadian dollar in May the price was 30 cents (Cdn.); after devaluation the price rose to 31.5 cents where it remained.

Canadian exports of copper in ore and matte rose to 89,400 tons. The increase of 46,500 tons from 1961 was almost entirely attributable to a rise in exports of copper in concentrates from British Columbia to Japan. Exports of copper in refinery shapes decreased 43,200 tons to 223,000 tons.

There are six copper smelters in Canada operated by five companies. INCO's two smelters at Copper Cliff and Coniston, both in Ontario, have rated annual capacities of 4.8 million tons of feed. That company is followed in order by Noranda Mines, Limited, at Noranda, Quebec (1.6 million tons); Falconbridge Nickel Mines, Limited, at Falconbridge, Ontario (650,000 tons); Hudson Bay Mining and Smelting Co., Limited, at Flin Flon, Manitoba (575,000 tons) and Gaspé Copper Mines, Limited, at Murdochville, Quebec (300,000 tons).

Copper refineries are operated by Canadian Copper Refiners Limited at Montreal East, Quebec, which has a rated annual capacity of 270,000 tons, and by INCO's Copper Refining Division at Copper Cliff, Ontario, which has a rated annual capacity of 168,000 tons. There were 42 mines from which copper was obtained in 1962 of which 17 were operated by three companies - INCO, seven; Falconbridge Nickel, six; and Hudson Bay, four. With exploration and development of copper properties being maintained at a high rate, it is expected that Canada will continue to increase its copper output and retain its third-ranking world position.

Gold

Notwithstanding a higher Royal Canadian Mint price for gold in 1962, there was a 6.6 per cent drop in gold production to 4.2 million fine troy ounces. Ontario remained the principal producer accounting for 58 per cent of the total followed by Quebec with 24 per cent.

Among Free World producers, Canada was second only to the Republic of South Africa. For 1962 the United States Bureau of Mines estimated total world production at 50.0 million troy ounces of which the Republic of South Africa produced 25.5 million ounces, Canada 4.2 million, the United States 1.6 million and Australia 1.1 million. U.S.S.R. production was estimated at 12.2 million fine troy ounces.

Canada's lower-grade and high-cost lode gold mines receive cost assistance under the terms of the Emergency Gold Mining Assistance Act which first came into effect in 1948. During 1962 there were 52 lode gold mines operating in Canada of which 42 received cost assistance. Lode gold mines accounted for 3.5 million ounces of 1962 production, base metal mines 625,800 ounces, and placer operations 57,800 ounces. A number of factors are causing a decline in Canadian gold production. Kerr-Addison Gold Mines Limited, the country's largest producer, has had disappointing results at depth; its output declined nearly 22 per cent from the previous year. Two other gold mines in Ontario mined out known ore reserves and closed down late in 1961. Although many large producers have been carrying out extensive exploration and development programs in order to maintain or open up ore reserves, results in some cases have been disappointing. Because of mining at increased depth, lower grade of ore available for mining, increased expenditures for exploration and development, and higher labor and material costs, operating costs have been steadily rising. In many cases, were it not for payments received under the Emergency Gold Mining Assistance Act, many mines would have been forced to close. The higher Mint price for gold has, of course, been of considerable assistance to the gold mining industry.

Iron Ore

The year-to-year decline in iron ore shipments since 1959 was sharply reversed in 1962 when shipments reached an all-time high of 24.4 million long tons, up 34 per cent from 1961. Output of all producing provinces was higher. The lower shipments and prices experienced by some companies were the result of increased competition in open-market sales and a generally stagnant, increasingly captive international market, particularly in Europe. The recent trend toward a better-grade shipping product with good physical properties continued. Most companies intensified their ore beneficiation programs to meet these market requirements.

During the year three mines in British Columbia and one in Labrador commenced production. A company started development of a property near Kirkland Lake, Ontario, for production in 1964 from a one-million-ton-a-year pellet facility. Another continued development of a large project at Wabush Lake in Labrador for production in 1965 from a six-million-ton-a-year, open-pit mine and processing facility. The designed productive capacity of iron ore mines and plants in Canada at the end of 1962 was about 38 million tons; this is expected to increase to about 45 million tons a year in 1965.

In Quebec a producer of high-grade concentrates that began shipments in 1961 increased production to 4.5 million tons in 1962, 3.3 million tons more than the previous year. There was a substantial increase in shipments of medium-grade ore from a company operating mines in Quebec-Labrador near Schefferville, Quebec, with shipments from the Labrador side of the boundary increasing sharply; the same company began shipments of high-grade concentrate from its new facilities near Labrador City, Labrador. A long-established producer of medium-grade ore in Newfoundland and one in the Steep Rock Lake area of Ontario experienced increasing difficulties in sales of merchant (non-captive) ore. In British Columbia, the number of high-grade concentrate producers increased during the year from three to six. Reserves of one of these producers were almost depleted at the end of the year and another suspended operations temporarily, pending refinancing.

Lead

On the basis of lead produced from domestic ores and on the recoverable lead content of ores and concentrates exported, Canada's output of 215,300 tons in 1962 was substantially below 1961 output of 230,400 tons. However, Canada's total mine output based on the lead content of ores and concentrates produced was 211,300 tons compared with 182,500 tons the previous year.

Of the 16 principal producers of lead in Canada, The Consolidated Mining and Smelting Company of Canada Limited (COMINCO), from its Sullivan and Bluebell mines in British Columbia, produced about 68 per cent of the country's total mine output of lead. Three other companies, together with COMINCO, accounted for 90 per cent of total mine output. Ore reserves at the mines of these companies are sufficient to maintain production at 1962 levels for many years. In eastern Canada new mines were opened in Quebec, Nova Scotia and New Brunswick. In New Brunswick construction of production facilities was begun by Brunswick Mining and Smelting Corporation Limited at its lead-zinc-copper deposits near Bathurst; production is scheduled to commence at a rate of 3,000 tons of ore a day in 1964. By the end of 1962, about 73 miles had been completed of the 438-mile railroad from Grimshaw, Alberta, to large high-grade lead-zinc deposits at Pine Point on the south shore of Great Slave Lake in the Northwest Territories. Production is scheduled to commence in 1966.

COMINCO operates Canada's only lead smelter and refinery, at Trail, British Columbia; its output was 152,200 tons compared with 171,800 tons of 1961. COMINCO treated most of the lead concentrates from mines in British Columbia and Yukon Territory at its Trail plant. The remainder was treated in the United States at plants in Idaho (Bunker Hill Company) and Montana (American Smelting and Refining Company). Producers of ore and concentrates in other parts of Canada shipped their lead concentrates to smelters in Western Europe and the U.S.A.

Canada's export pattern has remained virtually unchanged in recent years. Britain and United States together received almost four fifths of all primary lead exports in 1962. Belgium and West Germany received 44 per cent of Canada's exports of lead concentrates in 1962 compared with 51 per cent the previous year.

On October 1, 1958 the U.S. government imposed annual quotas on imports of unmanufactured lead and zinc; these remained in effect throughout 1962. Under the quotas, Canada's quarterly allotments are 7,960 tons of lead metal and 6,720 tons of lead in concentrates. These quotas have been filled each year.

The International Lead and Zinc Study Group, of which Canada is a member, held two meetings in 1962 at Geneva, Switzerland. During the October meeting, the Group concluded that the statistical position for both lead and zinc was better than foreseen at the previous May meeting and that lead requirements for 1962 were expected to exceed new supplies by about 82,000 tons.

Magnesium

Dominion Magnesium Limited, the only Canadian producer, reported increased smelter production for the fourth consecutive year and an increase in its plant capacity at Haley, Ontario, from 8,000 to 10,000 tons, of magnesium ingot a year. Production was 9,526 tons in 1962, according to the Company, with shipments correspondingly high at 9,458 tons.

Exports increased nine per cent to 6,571 tons of which 4,907 tons went to Britain and most of the rest to countries in Western Europe. Canadian consumption was 3,614 tons compared with 2,776 tons consumed in 1961. Canada imported magnesium from the United States mainly in the form of metal and semifabricated products which were valued at $870,400 (1,508 tons) and $417,400 (158 tons), according to the U.S. Department of Commerce.

World production in 1962 was estimated at 146,000 tons with the U.S., U.S.S.R., Norway and Canada in that order being the principal producers.

Molybdenum

Molybdenite Corporation of Canada Limited, with mine and plant at Lacorne, Quebec, was the principal producer of molybdenite (MoS_2) in Canada in 1962 and the only producer of molybdic oxide (MoO_3). Production increased for the third consecutive year with the molybdenum contained in MoS_2 concentrates and MoO_3 amounting to 817,700 pounds valued at $1.2 million. Trial shipments of MoS_2 concentrate were made from a property near Matachewan, Ontario. Noranda Mines, Limited, continued an appraisal of its Mount Boss property in British Columbia. It also continued an investigation of the recovery of MoS_2 as a byproduct of the copper operations of its subsidiary, Gaspé Copper Mines, Limited, at Murdochville, Quebec. Domestic consumption, 1.3 million pounds of contained molybdenum, was an all-time high for peacetime having been exceeded only in 1942.

Nickel

Canadian nickel production for 1962 was 232,200 tons valued at $383.7 million compared with 233,000 tons and $351,261,720 the previous year. Noteworthy events included initial production from Marbridge Mines Limited near Malartic, Quebec, and from Nickel Mining & Smelting Corporation in northwestern Ontario. Marbridge Mines is Quebec's first nickel producer. The Thompson, Manitoba, mine of The International Nickel Company of Canada, Limited (INCO) completed its first full year of operations in 1962; Falconbridge Nickel Mines, Limited, completed its nickel contract deliveries to United States government stockpiles; and North Rankin Nickel Mines Limited on the west side of Hudson Bay closed its mine upon exhaustion of ore reserves.

Nickel marketing was characterized by keen competition. Because of increased production and at the same time the cessation of nickel deliveries to United States government stockpiles, supply was greater than demand for the first time in many years. There was little change in sources of supply to world markets. Canada and New Caledonia supplied nearly all of the Free World's nickel requirements - Canada supplying nearly 80 per cent of the total. The U.S.S.R. and Cuba supplied most of the requirements of the Soviet bloc countries. Minor production was reported in East Germany, Czechoslovakia and Brazil.

Exports of nickel in all forms was 210,200 tons: refined metal - 121,700 tons, matte - 77,400 tons, and oxide sinter - 11,120 tons. Exports in 1961 were 244,500 tons. In September, INCO announced a 13-per-cent reduction in nickel output, to become effective on October 1, that resulted in a cutback from 92 million pounds to 80 million pounds of nickel by the Company in the last quarter of the year. The reduction was necessary because of sufficient inventory build-up by the Company to meet industry demands, an imbalance between production and demand, and liquidation of part of the United States government stockpile.

Ontario continued to be the chief source of nickel with nearly all of the 166,600 tons supplied coming from the Sudbury area. INCO operated seven mines in the Sudbury area; Falconbridge Nickel Mines, Limited, operated five. Both companies prepared other deposits for production. INCO reported ore production from its mines in Ontario and Manitoba at 13.8 million tons in 1962 compared with 17.5 million tons the previous year; reserves in Ontario and Manitoba combined were 300 million tons having a nickel-copper content of 9 million tons. Falconbridge reported nickel deliveries of 61 million pounds in 1962. At the end of the year the Company had total reserves (developed and indicated ore) of 48 million tons grading 1.45% nickel and 0.80% copper.

Production from Manitoba in 1962 was 61,500 tons compared with 33,000 tons the previous year; this accounted for about 26 per cent of Canadian nickel production. The annual nickel production capacity of INCO's mining-smelting-refining facility at Thompson was increased to over 90 million pounds from 75 million pounds. Sherritt Gordon Mines, Limited, maintained ore reserves of its Lynn Lake, Manitoba, mine at 14 million tons that averaged 0.94 per cent nickel and 0.55 per cent copper; 1.3 million tons of ore were mined during 1962. Sherritt Gordon's Fort Saskatchewan refinery near Edmonton, Alberta, continued to treat concentrates from Lynn Lake.

Niobium (Columbium) and Tantalum

In 1962, St. Lawrence Columbium and Metals Corporation, the only Canadian producer of columbium concentrate, produced 972,000 pounds of columbium pentoxide (Cb_2O_5). The concentrates carried a maximum of 50 per cent Cb_2O_5 and had a mine value of $996,400. Shipments were 1 million pounds which made the Company the world's largest single supplier of columbium. Production started in 1961 at the Company's property at Oka, Quebec, 20 miles west of Montreal. Mill feed has averaged about 0.5 per cent Cb_2O_5; calculated ore reserves are over 62 million tons averaging 0.4 per cent Cb_2O_5 but these represent only a small part of the potential reserves, according to the Company. Several other companies have property holdings in the Oka area.

The Free World produced about eight million pounds of columbium and tantalum concentrates in 1962. The United States was by far the largest consumer. Now that sources of supply are adequate, research is being undertaken and wider applications are being found in the nuclear, electronic and steel industries.

Platinum Metals

Platinum metals production in Canada is a byproduct of the treatment of nickel-copper ores. Output in 1962 was 471,000 troy ounces valued at $28.8 million. Before 1961 all production came from mines in the Sudbury area of Ontario, but late in 1961 Manitoba became the second producing province when the Thompson operation of The International Nickel Company of Canada, Limited, began production of nickel.

Canada, the U.S.S.R. and the Republic of South Africa, in that order, are the major world suppliers. Estimated world production in 1962 was 1.2 million troy ounces. Canada produced 471,000 ounces, the U.S.S.R. 375,000 ounces and the Republic of South Africa 306,000 ounces.

Selenium and Tellurium

Selenium and tellurium are produced at Canada's two copper refineries as byproducts recovered from the bankhouse slimes resulting from the electrolytic refining of copper anodes. Selenium production from all sources was

487,000 pounds valued at $2.8 million in 1962 compared with 431,000 pounds of about the same value the previous year. Refined production in 1962 was 466,600 pounds; most of the production was exported, mainly to Britain and the United States. Free World production of selenium in 1962 was two million pounds.

Production of tellurium in all forms in 1962 was 58,700 pounds valued at $352,400; production of refined tellurium was 57,630 pounds. Free World production was 395,800 pounds in 1962.

Selenium is used in the glass, rubber, alloy-steel and electronics industries. Tellurium is one of the basic ingredients in alloys of gallium, bismuth and lead as used in thermoelectric devices for the direct conversion of heat into electricity and for cooling by the Peltier effect; its use in this application has been rising. It is also used in the rubber, grey-iron castings and certain nonferrous alloy industries.

Silver

Although production of silver in substantial amounts commenced at two mines in 1962 and several other producers completed their first full year's operation, mine production of silver declined to 30.4 million troy ounces from 31.4 million ounces. Most of the decline resulted from reduced lead production from which silver is obtained as a byproduct. Canada remains the world's second largest silver producer following Mexico.

Free World production of silver in 1962 was an estimated 207 million ounces. About 75 per cent was obtained from base metal ores, almost 25 per cent from silver or silver-cobalt ores, and a small amount from gold ores. Consumption at an estimated 368 million ounces in 1962 was considerably higher than production. Silver's use as an industrial metal has increased rapidly in the past decade. Consumption, including requirements for coinage and for decorative purposes, has for many years outstripped production. The deficit has been supplied by purchases from the United States Treasury Department's free stocks at a fixed price of 91.3 cents a troy ounce. On November 28, 1961, President Kennedy announced that sales of silver from the Treasury Department's free stocks would no longer be made. Following that announcement, world silver prices increased rapidly. On October 19, 1962, the Canadian price was $1.3175 a troy ounce, the highest in 43 years; at the beginning of the year it was $1.1012 and at the year-end, $1.3037. Comparable prices at the beginning and end of the year were $1.0475 and $1.2050 in the United States, and 88.250 and 103.620 pence in Britain.

United Keno Hill Mines Limited, with three silver-lead-zinc mines in the Mayo district of the Yukon Territory, continued to be the largest single source of silver. The principal producer of refined silver is The Consolidated Mining and Smelting Company of Canada Limited from its lead smelting and refining operations at Trail, British Columbia. The other producers of refined silver are Canadian Copper Refiners Limited at Montreal East, Quebec (from blister copper); The International Nickel Company of Canada, Limited, at Copper Cliff, Ontario (from nickel-copper ores); Hollinger Consolidated Gold Mines, Limited, Timmins, Ontario (from gold precipitates); the Royal Canadian Mint at Ottawa (from gold bullion); and Cobalt Refinery Limited at Cobalt, Ontario (from silver-cobalt ores).

Most of Canada's silver exports, both as refined metal and in ores and concentrates, continued to go to the United States. Belgium, Luxembourg and West Germany also import Canadian silver. These four customers received 17.9 million ounces or 97 per cent of Canada's exports in 1962. The United States received 16 million ounces of Canadian silver. Reflecting the higher silver requirements of the Royal Canadian Mint for coinage, Canada's imports of unmanufactured silver were at a high level, amounting to 15.1 million ounces.

Silver production in Canada will continue to rise because of increasing base-metal production from existing operations and because mines are being developed for production within the next few years. Important new sources include zinc-copper mines in the Matagami Lake area of northwestern Quebec, zinc-copper-lead mines in the Bathurst area of New Brunswick and, by 1967, the large high-grade lead-zinc mine at Pine Point in the Northwest Territories.

Titanium

The Canadian titanium industry is based mainly on the mining of ilmenite for the production of titanium dioxide slag which, in turn, is used to make titanium base pigments. Ilmenite is also used as a heavy aggregate for concrete and for the manufacture of ferrotitanium. It is mined in the Allard Lake and St. Urbain areas of Quebec. Most of the Allard Lake ilmenite, which constitutes nearly all of the production, is smelted at Sorel and produces slag containing 72 per cent titanium dioxide, a high quality pig iron (Sorelmetal) and a complex basic silicate that is used as a slag thinner in smelting. Most of the titanium dioxide (TiO_2) slag produced is exported, mainly to the United States, for use as the basic raw material in the manufacture of pigments. Some is also shipped to Canadian Titanium Pigments Limited at Varennes, Quebec, and, in 1962 shipments commenced to the new plant of British Titan Products (Canada) Limited at Ville-de-Tracy, Quebec. Capacities of the Canadian Titanium plant and the British Titanium plant are 25,000 and 22,000 tons of TiO_2 pigment a year, respectively.

The value of titanium shipped in TiO_2 slag, in ore and as heavy aggregate in 1962 was $11.6 million, over $5 million less than the Canadian production record established the previous year. The large decline in output was the result of a labor strike that closed the electric smelter at Sorel, Quebec, from August 28, 1962 to March 16, 1963.

Quebec Iron and Titanium Corporation (QIT) owns one of the world's largest known reserves of ilmenite - 150 million tons of measured and indicated ore averaging 35 per cent TiO_2 and 40 per cent iron; there are also very large reserves of inferred ore. QIT operates eight electric-arc smelting furnaces at Sorel with an ore-treating capacity of 1.1 million tons a year. More than 75 per cent of the refined TiO_2 and extended TiO_2 pigments consumed in Canada are used in the manufacture of paints, seven per cent in floor covering, three per cent in rubber and plastic, and 15 per cent in pulp, paper and miscellaneous products. About 250 tons of ferrotitanium are used each year by Canada's primary iron and steel industry. The United States, by far the largest producer and consumer of ilmenite, produced an estimated 807,000 tons in 1962.

Tungsten

In October 1962, Canada Tungsten Mining Corporation Limited commenced shipments of test quantities of scheelite (calcium tungstate) concentrates from its property in the Flat River area just east of the Yukon-Northwest Territories boundary, 135 miles north of Watson Lake. The Company reported indicated ore reserves of 2.6 million tons grading 2.4 per cent tungsten trioxide (WO_3). No tungsten had been produced in Canada since July 1958 when Canadian Exploration, Limited, closed its scheelite operations at Salmo, British Columbia.

During August and September, tungsten ore prices (i.e. scheelite and wolframite) were at their lowest levels in the United States and Europe since 1942. Toward the end of the year the price in the United States firmed slightly to between $8.50 and $9.00 a short ton unit of WO_3 for concentrate containing 65 per cent WO_3, landed at U.S. ports; the import duty of $7.93 was to be paid in addition to the landed price. Tungsten ore prices are depressed because of the large amounts of low-priced tungsten concentrates moving from Communist bloc countries, principally China, to European markets. The large amount of tungsten contained in United States stockpiles, sufficient to serve United States requirements for more than ten years at current rates of consumption, has a further retarding effect on resource development.

Uranium

Uranium production was lower in 1962 with deliveries totalling 8,430 tons of uranium oxide (U_3O_8) valued at $158 million compared with 9,641 tons valued at $196 million the previous year. The decline was due to further cutbacks in production by some companies that operated under the 'stretch-out' plan for uranium deliveries.

Ontario produced about three quarters of the Canadian total. Four mines were operated in the Elliot Lake district and two mines in the Bancroft area of southeastern Ontario. The remainder of production came from the Eldorado Mining and Refining Limited mine and Gunnar Mining Limited mine in the Beaverlodge Lake area of northern Saskatchewan. Production under existing government contracts, despite the 12,000-ton contract with the United Kingdom Atomic Energy Authority (UKAEA), is scheduled to decline steadily for the next nine years to 933 tons in 1971.

This contract between Eldorado Mining and Refining Limited, the Canadian crown agency, and the UKAEA for the delivery of 12,000 tons of U_3O_8 until 1970, was the most significant development in the Canadian uranium industry in 1962. In the contract Eldorado agrees to supply U_3O_8 at a basic price averaging $5.03 a pound plus various carrying charges; the contract also contains other clauses that would cover possible increases in basic cost levels and a premium for deferment of deliveries. Prices to be paid to Canadian producers under the 1962 contract with the UKAEA will range from about $4.10 a pound to about $7.10 depending upon cost of production at the various mines. Under all other contracts the average price paid to Canadian producers was about $10.50 a pound.

Reserves of uranium in Canada, the largest in the world, amount to about 300 million tons averaging 0.1215 per cent U_3O_8.

Because the chief demand for uranium has been for military applications and these needs have been largely met for some years ahead, the short-term outlook for Canadian uranium producers is not bright. Peacetime markets for uranium have not developed as rapidly as expected, particularly in the generation of nuclear electric power. It is believed, however, that with continued progress in the design of reactors for power plants, costs will be lowered and in time nuclear-developed energy will account for an increasing share of energy production. It is expected that demand for uranium for nuclear power reactors will reach significant proportions beginning about 1970.

Zinc

Production of recoverable zinc in all forms rose to a record 463,000 tons, 47,000 tons higher than in 1961 and 6.9 per cent above the previous record of 433,400 tons set in 1955. Zinc produced from concentrates amounted to 502,000 tons, about 59,000 tons more than in 1961.

Production of zinc concentrates in British Columbia was substantially higher in 1962 but the increase was, to a large extent, offset by the exhaustion of stockpiled zinc plant residues at the Trail smelter of The Consolidated Mining and Smelting Company of Canada Limited (COMINCO) at mid-year. Production in the Flin Flon area of Manitoba and Saskatchewan was eight per cent higher and Ontario production, because a higher grade of zinc ore was mined, increased about 22 per cent. A new mine was opened in Quebec which, together with increased output by most of the older producers, raised Quebec's total production about 31 per cent above that of 1961. Two new mines were opened in New Brunswick and one in Nova Scotia.

Production of refined zinc from Canada's two refineries - COMINCO's at Trail and Hudson Bay Mining and Smelting Co., Limited, at Flin Flon, Manitoba - totalled 280,000 tons compared with 268,000 tons in 1961. The 200-ton-a-day electrolytic zinc reduction plant at Valleyfield, Quebec, to be operated by Canadian Electrolytic Zinc Limited, is scheduled for completion late in 1963. Five mining companies that are financing the refinery's construction will supply the zinc concentrates. In 1962 most of the zinc concentrates from mines in eastern Canada were exported to smelters in the United States and Europe for recovery of sulphur. Some went first to roasting plants at Port Maitland, Ontario, and Arvida, Quebec.

Exports of refined zinc at 211,000 tons were only slightly higher than those of 1961. Exports of zinc in ores and concentrates totalled 242,400 tons with 195,000 tons going to the United States. Domestic consumption of zinc increased for all categories except brass, rising in 1962 to 68,000 tons from 63,700 tons the previous year.

In 1962 Canada was the second ranking zinc producer of the Free World. Mine output was exceeded only by the United States which had a total production of 555,000 tons of contained zinc. Canada, with 502,000 tons, was followed by Australia 339,000 tons, Mexico 269,000 tons, Peru 250,000 tons and Japan 212,000 tons. Leading producers of refined zinc were the United States with 938,000 tons, Canada 280,000 tons, Japan 270,000 tons, followed in order by Belgium, West Germany, Australia and France.

The United States import quotas on unmanufactured lead and zinc, imposed by proclamation dated September 22, 1958, remained in effect throughout 1962. Commercial imports were limited to 80 per cent of the annual average for the five-year period of 1953-57. The quota on imports of zinc ores from Canada is 33,240 tons of contained zinc per quarter; the zinc metal quota is 18,920 tons per quarter.

The fifth and sixth sessions of the International Lead and Zinc Study Group were held in Geneva, Switzerland in 1962. This Group, formed in May 1959, is composed of 25 producing or consuming countries, including Canada. At the fifth session, held in two parts in March and May, statistical analyses showed that world supply and demand of zinc was in near balance. At the sixth session in October a small but not significant surplus of supply over demand was forecast for the last half of the year. The forecast for the first half of 1963 predicted little change in the situation, although it was noted that consumption was growing more slowly than in previous years.

Industrial Minerals

The industrial minerals group, including nonmetallic minerals and construction materials, had a production value of $567.6 million, a 4.8-per-cent increase from 1961. This group accounted for 20 per cent of total mineral production, slightly less than in 1961. Asbestos is by far the most important of the nonmetallic minerals; its value in 1962 of $130.3 million set a new record and was 61 per cent of the nonmetallics output. Cement, sand and gravel are the leading construction materials; their output values were exceeded only by crude petroleum and five metals. As most of the commodities in the industrial minerals group are basic materials used in construction and in processing, their use reflects domestic industrial growth. With the exceptions of asbestos, sulphur, gypsum and titanium dioxide, they are generally not important in Canada's export trade.

Asbestos

The Canadian asbestos industry shipped 1.2 million tons of commercial fibre valued at $130.2 million in 1962 to establish a record for the third successive year. Canada remains the world's leading producer but its share of total output has declined from about 60 per cent in 1952 to under 45 per cent in 1962. Increased output from the U.S.S.R. and Southern Rhodesia accounts for the change. Free World production and demand was in near balance but new producers in 1963-64 will probably result in surplus capacity and production. It is believed that asbestos fibre output in 1962 in the U.S.S.R. was about the same as in Canada.

Over 90 per cent of Canada's production comes from mines in the Eastern Townships of Quebec. The remainder comes in about equal amounts from Matheson, Ontario, and Cassiar, British Columbia. Advocate Mines Limited continued preparations for bringing its property at Baie Verte, Newfoundland, into production in 1963. At a large asbestos deposit in the Ungava area of northern Quebec, resource and economic appraisals continued. The main zone was reported to contain over 15 million tons of asbestos averaging 11.3 per cent recoverable fibre; additional amounts were reported in other zones.

Gypsum

Mainly as a result of higher exports to the United States, shipments of gypsum increased eight per cent in 1962 to 5.3 million tons valued at over $9 million. The year was one of increased activity in the industry. Producers added new facilities to supply larger quantities of crude gypsum to the United States, and built or planned new processing facilities to make wallboard, lath, and plaster for the domestic market.

The Flintkote Company of Canada Limited began shipments of gypsum from its deposit in the Flat Bay area of Newfoundland to the parent company's manufacturing plants in eastern United States. The Bestwall Gypsum Company (Canada) Ltd. began shipments from its River Denys, Cape Breton Island, deposit in Nova Scotia, to eastern United States. Investigation of a deposit near Drumbo in southern Ontario and one north of Jasper, Alberta, continued. The latter would be of particular interest as a source of gypsum for product plants in Alberta and British Columbia. A gypsum products plant was being built at Clarkson, Ontario, the third of its kind in the province.

Potash

Potash production was resumed in August 1962 in Saskatchewan. Since 1958 when the first production was recorded by Potash Company of America near Saskatoon, the company has been rehabilitating its shaft so that mining might be resumed. Heavy inflows of water from porous, sedimentary formations above the potash horizon, that lies from 2,600 to 3,400 feet beneath the surface, have forced all companies to adopt unusual shaft-sinking methods to reach the high-grade potash horizon.

On September 1, International Minerals & Chemical Corporation (Canada) Limited (IMC) began shipments of bulk concentrates of muriate of potash (K_2O) from its mine and processing plant at Esterhazy, Saskatchewan. With a capacity of 1.2 million tons of K_2O equivalent a year, the Esterhazy facility is the largest potash-producing plant in the world. An increase in plant capacity to 1.8 million tons a year is planned. Potash Company of America has scheduled production from its operations near Saskatoon to begin in 1964 with initial plant capacity to be 600,000 tons of K_2O equivalent a year. Early in 1963, two other companies (Kalium Chemicals Limited and Alwinsal Potash of Canada Limited) announced they would construct potash mining and processing plants in Saskatchewan. Several other companies have done considerable work on their Saskatchewan holdings and hope to produce either by traditional shaft mining operations or solution mining techniques. At the end of 1962 there were 17 companies or interests holding potash land rights in Saskatchewan.

World production of potash in 1962 was estimated at 10.7 million tons of K_2O equivalent. Potash consumption has increased rapidly in recent years and although potash production capacity is being expanded in several countries, only the new projects in Canada and the United States will add significant quantities to the total supply. Canada alone appears able to contribute sufficient amounts to supply the steadily rising demands for this important fertilizer ingredient. World potash reserves in terms of K_2O content have been estimated at about 50 million tons with ores ranging in grade from eight to 25 per cent K_2O. Indicated potash reserves in Saskatchewan have been estimated at 17.7 million tons (K_2O content) with the average grade of ore being 25 per cent K_2O.

Trade in potash is widespread. The main sources to date have been western Europe, the United States, East Germany and the U.S.S.R. Europe is the main producer and consumer; United States production is nearly in balance with North American consumption.

Salt

Shipments of salt in 1962 at 3.6 million tons worth $21.9 million established a new record. About one half of Canadian production was in the form of rock salt mined at Pugwash, Nova Scotia, and Ojibway and Goderich in Ontario. It is used mainly for road salting and chemical processing. The remainder of Canada's production was obtained as evaporated salt from brine wells or as brine which is pumped directly to consuming chemical plants. Production for the latter purpose has been increasing steadily in recent years. Exports totalled $3.9 million, equivalent to 18 per cent of the value of production. Most exports went to the United States.

Developments in the industry in 1962 included the sinking of second production shafts at all three rock-salt mines and the placing on stream of the third fusion plant at Unity, Saskatchewan. In this process, fine evaporated salt is consolidated by fusion. Subsequent crushing provides a coarse salt for high-purity requirements such as food processing and water softening.

Sulphur

With a production capacity of over two million short tons of elemental sulphur a year, Canada, ranking second to the United States among world producers, is capable of supplying about 15 per cent of Free World requirements of elemental sulphur. Canadian production in 1962 comprised 695,000 tons of elemental sulphur, 257,000 tons as the content of pyrites, and 293,000 tons as the content of smelter gases.

Canada's rise as an important producer of sulphur has been the result of large-scale development of natural gas resources in western Canada, particularly in Alberta and British Columbia. Recovery of elemental sulphur in western Canada from sour natural gas amounted to 695,000 tons valued at $9.3 million in 1962; shipments the previous year were 395,000 tons which were 45 per cent above the 1960 total.

By the end of 1962, the 17 gas processing plants in western Canada that recover sulphur had an annual capacity of two million tons of refined sulphur. During 1962, recovery plants of Shell Oil Company of Canada, Limited, at Waterton and of Pan American Petroleum Corporation at Windfall, both in Alberta, came on stream; the Waterton plant with a 1,500-ton daily recovery capacity is the largest of its kind in North America.

Producers of elemental sulphur in western Canada must find new markets for their growing production. Success is being achieved in this direction with exports in 1962 going to Far East markets (India and Japan), Australia, and the northern states of central and western United States. The industry, aggressively seeking new markets, doubled its exports in 1962 but, generally, exports have lagged significantly behind production. Canada still imports large quantities of elemental sulphur from the United States for use in pulp and paper plants in eastern Canada. Domestic elemental sulphur has not been competitive because of the high cost of moving sulphur eastward by rail, but some marketing progress was made in eastern Canada in 1962, and imports were thereby reduced from 329,500 short tons in 1961 to 195,000 tons.

Sulphur production in all forms amounted to 1.2 million short tons in 1962 and was comprised of the sulphur content of pyrites (257,000 tons), sulphur content of smelter gases that is used to make sulphuric acid and liquid sulphur dioxide (293,000 tons) and elemental sulphur (695,000 tons).

Other Nonmetallics

Important developments also occurred in other commodities comprising the nonmetallic minerals industry. There was a $1 million expansion of the St. Canut, Quebec, plant of Canadian Silica Corporation Limited that increased capacity threefold to 300,000 tons of product a year. A premium-quality sand is finding increasing acceptance in the glass industries of the Montreal and Three Rivers area. It is also used in the manufacture of silicon carbide. Quebec Lithium Corporation continued to develop its lithium chemicals operations at Barraute in northwestern Quebec. Most of its output is sold in Britain where at the end of the year an 'anti-dumping' duty was applied to lithium carbonate imported from Canada. British Titan Products (Canada) Limited completed its 22,000-ton-a-year titanium pigment plant at Ville-de-Tracy near Sorel, Quebec. It is the second such plant in Canada; the other is operated by Canadian Titanium Pigments Limited at nearby Varennes.

Structural Materials

The structural materials category is composed of cement, sand and gravel, stone, clay products and lime. Cement production moved from tenth to ninth in value of output ($113.2 million) in the mineral industry in 1962 and was exceeded only by asbestos, sand and gravel, in the industrial minerals sector. A continuing high level of activity in home building, industrial construction, and road and rail programs resulted in record or near record output of the various structural materials. The cement industry at the end of the year had an annual production capacity in 19 plants operated by 11 companies of 9.18 million tons. There has been a continuing trend toward integration of the cement, concrete products and crushed stone industries for several years. Through purchase and amalgamation, integrated manufacturing and processing concerns have grown and to a considerable extent now dominate the construction materials industry.

Fuels

The production value of fuels in 1962 was $780.9 million, a 20-per-cent increase from 1961. Fuels accounted for 27 per cent of total mineral production value compared with 25 per cent the previous year. Production of natural gas and its byproducts has been growing rapidly; it was equivalent to 20 per cent of the fuels value in 1962. The value of crude petroleum has also increased considerably although its share of total fuels value has declined from about four fifths to slightly less than three quarters in recent years. Coal output has remained fairly constant but its proportion of fuels output value has been steadily declining; it was less than nine per cent in 1962.

Coal

The Canadian coal industry has undergone a long period of declining production during which severe readjustments have been made in an endeavour to meet strong competition from alternative fuels. Since 1959, output of all types of coal has been stabilized between ten and 11 million tons a year having a value between $69 million and $74 million.

Production in 1962 of 10.3 million tons valued at $69.2 million was very little changed from the 1961 output. For the past several years about 40 per cent of output has been obtained from surface operations (strip mines) and the remainder from underground. Nova Scotia, the largest producing province with about two fifths of Canada's output, obtains all its coal from underground mines. In the western provinces about two thirds is obtained from strip mines. One characteristic of Canadian coal mining is that most of the higher ranking coals are obtained from the relatively high-cost underground mines; the lower rank and lignite coals are generally obtained from strip mines. Almost 90 per cent of the higher ranking bituminous coal comes from underground mines and 90 per cent of lignite and sub-bituminous output is strip-mined.

Of the 21.9 million tons of coal consumed during 1962, 5.5 million tons were carbonized to produce coke which is used mainly in blast furnaces to make pig iron. It is also used in the foundries, in smelters for base-metal recovery, in chemical processing plants and for domestic heating. The main producers of coke in declining order of capacity are The Algoma Steel Corporation, Limited, The Steel Company of Canada, Limited, and Dominion Foundries and Steel, Limited, all in Ontario; Dominion Steel and Coal Corporation, Limited, at Sydney, Nova Scotia; Quebec Natural Gas Corporation at Ville La Salle, Quebec; and The Crow's Nest Pass Coal Company, Limited, at Fernie, British Columbia. Coke production from bituminous coal was 4.0 million tons in 1962, up only slightly from the previous year.

Imports of coal for all purposes were 12.6 million tons. Only 893,919 tons of coal were exported.

In the industrial market, coal is gaining increased recognition as a source of low-cost energy, and the increased number of coal-fired thermal electric plants being built in Canada in recent years is an indication of this recognition. The steel-making industry, through its reliance on coke in the manufacture of pig iron, is a substantial and growing market for coal. Coke production accounted for about 18 per cent of coal consumption in 1962.

In contrast to the industrial and coke-making fields, the market for coal for heating purposes by industry and homes continued to decline because of inroads made in these markets by oil and natural gas. The transportation market (railway, ships, bunkers, etc.) for coal, presently five per cent of the total, does not offer much hope for future growth either. For a bulk low-cost commodity such as coal, transportation and associated handling charges add very substantially to the market price in consuming areas. The main market areas are in central Canada, far from domestic sources; as a result, transportation subventions have been required on the movement of coal for many years to provide a selling price comparable with that of imported coal.

Natural Gas

Production of natural gas increased in 1962, as it has each year since 1956, at a rate greater than that of most other mineral commodities. Net new production of natural gas, excluding withdrawals from storage and gas flared and wasted, was 946,700 million cubic feet, an increase of 44.4 per cent from 1961. Alberta accounted for 81.4 per cent of net output, British Columbia 12.8 per cent, Saskatchewan 4.1 per cent and Ontario 1.6 per cent. Minor amounts were produced in New Brunswick and the Northwest Territories. Although several important discoveries were made in northeastern British Columbia that will probably lead to the development of additional large reserves, fewer gas wells were completed.

Some major advances in mining techniques that took place in Canada during 1962 are reviewed in this section. In addition to those mentioned, many significant improvements of an operating nature are continuously being incorporated in any mining plant. They generally do not gain the prominence given entirely new changes in techniques but they contribute largely to cutting costs, improving safety, and speeding operations.

Production and Mining Methods

The amount of ore mined and rock quarried has risen from 87.7 million tons in 1950 to 206.0 million tons in 1961, with further increases in 1962. The ratio of production from open pits to that from underground mines has also been rising as large iron-mining projects reach production and an increasing proportion of asbestos is won from open-pit mines. In metal mining operations in 1961, 29.3 million tons came from open pits and 64.2 million tons came from underground operations. Over 28 million tons of iron ore came from open pits. In the asbestos industry, in the same year, about 90 per cent of the 21 million tons of asbestos-bearing rock that was milled came from open pits. The reconversion to open-pit mining of the Jeffrey mine of Canadian Johns-Manville Company, Limited, at Asbestos, Quebec, exerted a strong influence in increasing the ratio of asbestos ores mined from open pits.

Amount of Ore Mined and Rock Quarried in Canada
Selected Years, 1950 to 1961
(millions of tons)

Ore Source	1950	1955	1960	1961
Metal mines	45.9	69.2	101.6	99.3
Non-metal mines	17.7	24.7	42.0	47.0
Stone Quarried*	34.1	38.8	55.8	59.7
Total (other than coal)	87.7	132.7	199.4	206.0

Source: Dominion Bureau of Statistics, General Review of the Mining Industry.
* Includes stone quarried for manufacture of cement and lime; does not include sand and gravel.

Ore Production from Metal Mines, 1960 and 1961
(millions of short tons)

	1960	1961
From underground	69.2	64.2
From open pit	24.8	29.3
Total*	94.0	93.5

Source: Company annual reports and personal communications.
* Totals do not correspond with Dominion Bureau of Statistics totals because of differences in method of compilation.

Other mining developments of major interest during 1962 included the start of operations by International Minerals & Chemical Corporation (Canada) Limited at Esterhazy, Saskatchewan, where potash mining was begun in the last quarter using the room-and-pillar method of mining. Potash is excavated by electrically operated, continuous mining machines with twin cutting heads. The cut made is an oval-shaped opening about 7 1/2 feet high and 13 feet wide; mined material is moved by means of shuttle cars and underground conveyors. Toward the end of the year it was announced that a company was proceeding with plans to recover potash, by solution mining, from the high-grade potash beds underlying much of southern Saskatchewan at depths of from 3,000 to 3,200 feet. In the nickel industry, the undercut-and-fill method of pillar recovery, and, replacement of some square-set stoping by undercut-and-fill stoping, that was adopted by The International Nickel Company of Canada, Limited (INCO) in 1961 continued to prove eminently satisfactory; it has resulted in improved safety, increased efficiency and a reduction in costs.

Drilling and Blasting

Interest continued in long-hole drilling for underground operations and a number of new mines including the Wedge (New Brunswick), Texada and Craigmont (British Columbia) and Mattagami Lake (Quebec) adopted the practice. A blast-hole method will be used at Matagami with scram drifts and draw points - 125 hp slushers with wide blades will pull broken ore directly into cars or into storage raises. Falconbridge reported improved efficiencies in cut-and-fill stopes by using wagon drills for angle drilling of uppers.

The drilling of long holes from three to six inches in diameter, by diamond drills or churn drills, for hydraulic fill lines or to accommodate hoisting cables became more common. Newfoundland Fluorspar Limited used churn drills to drill holes from surface to the backs of old stopes; the holes are lined with six-inch pipe and are used for introduction of fill to underground workings.

Wire-line diamond drilling and down-the-hole drilling techniques were being applied to drilling of horizontal and other holes underground. On the surface, air-cooled diesel engines were used to operate diamond drills. Surface exploration in remote locations by diamond drilling was being made more practical by the use of small compact drills and the introduction in 1962 of light drill rods of magnesium for relatively short holes.

Iron Ore Company of Canada began production at its Carol Lake project in Labrador. Jet piercing is being used for the drilling of bench blast holes at its Smallwood mine. The minimum diameter of holes is 6 1/2 inches near the collar; the bottom 30 feet of the 50-foot holes being pierced to a minimum of 13 inches in diameter to accommodate most of the explosive charge (AN-FO). Fuel oil and oxygen burning in a triple-orifice burner at the end of the rotating blowpipe produce gases of 4,000°F at a rate of 600 feet per second which causes continuous spalling of the rock. The rock chips are ejected from the hole by the gas stream together with steam formed from the cooling water which is discharged near the bottom of the hole. Oxygen for piercing is supplied by a 20-ton-a-day oxygen plant and is transported to the drills by 113,000-cubic-foot trailers that are later connected directly to the drill.

Research was conducted and the testing of underground drilling techniques was continued to further the suppression of noise. Drill manufacturers have introduced several devices that reduce the noise level of drills. The experimental work that began in 1961 on the use of rubber-lined collars cemented to drill shanks by epoxy resin, continued in 1962. On the basis of 20 months testing by one mining company this application promises longer steel life, reduced drill and maintenance costs, as well as a great reduction in noise.

Tests under operating conditions at several Canadian mines indicated that small additions of uranium to steel - up to 0.7 per cent - improved drill footage performance.

Important developments in INCO mines included more efficient airleg drills, the use of stainless steel stoper legs, and the introduction of auger drill steel. The improved airleg drills combined larger diameter pistons and a shorter stroke; the introduction of stainless steel legs in stopers greatly reduced down-time and maintenance costs and improved resistance to wear. The auger type of drill steel has been particularly successful in drilling holes in badly broken ground such as encountered in the INCO undercut-and-fill mining methods. Falconbridge conducted successful investigations into the effect of increasing air pressures to as high as 140 pounds-per-square-inch in drilling with conventional jackleg machines.

Probably the most significant and widespread development during 1962 was the continuing change-over from conventional explosives to AN-FO mixtures for blasting, wherever possible. Initially, this blasting agent was used in large-diameter, open-pit bench holes; subsequently it was introduced for small-diameter blast holes in long-hole stoping, then into secondary blasting and finally for routine short-hole blasting in underground operations. Improvements continued to be made in priming AN-FO blasts, in loading techniques, and in delivery of the agent to the blast site. Most of the research and developments in 1962 involved loader design, loading techniques, methods of initiating the blast and elimination of static electricity. Greater use of metallic AN-FO slurries for open-pit blasting was another important development. Metallized slurries initiate a blast at higher temperatures more quickly than do straight AN-FO mixtures and as a consequence improved fragmentation and break-out is obtained.

Loading, Hauling and Handling

Loading techniques have not changed basically in open-pits except that larger equipment is gaining more widespread acceptance with a view to reducing haulage and handling costs. At Iron Ore Company's Carol Lake project, 12-cubic-yard, electric shovels were fitted with 10-cubic-yard dippers. The dippers are hydraulically actuated by the pressing of a button by the operator in the cab, tilting the dipper 24 degrees upwards to an essentially vertical position. This allows for complete filling of the dipper from the muck pile and reduces spillage as the dipper travels to the haulage unit. Truck loading is speeded up and tire wear resulting from spillage is greatly reduced. The company, at its Carol project, is the first to use 100-ton-capacity side-dumping trailers. End-dump trucks of 30- 40-ton load capacity are gradually replacing smaller units. Kam Kotia Porcupine Mines, Limited, in its open pit copper mine near Timmins, Ontario, is using 17-cubic-yard end-dump trailers.

Testing of lightweight truck boxes was begun during 1962 in Canadian open pits. One company in the United States installed an aluminum box and a lightweight steel box on trucks to compare their performance with the standard steel box. Wear characteristics were not fully evaluated at the year-end but the aluminum box has about 20 per cent more carrying capacity than a standard box. At several Canadian asbestos mines, tests continued using aluminum boxes to increase carrying capacity. In one case their use allowed 38 tons to be loaded where only 30 tons were formerly carried in steel boxes. Steel body rebuilding performances were improved at other pits by the use of wear strips and hard surfacing of parts subject to severe abrasion.

The outstanding event of the year in open-pit operations was the start of production by Iron Ore Company of Canada at Carol Lake where 17 million tons of specularite-magnetite ore will be mined each year to produce seven million tons of concentrate. This highly efficient operation is equipped with many automatic devices to make each step of the operation as efficient and trouble-free as possible. A six-mile completely automated railway was built from the Smallwood mine to the crusher-dump site. Four 18-car trains shuttle between the mine and the dumping site under the control of only two operators, one at the loading site and one at the dumping site. The control system, designed by the General Railway Signal Company, operates on fail-safe principles with manual override provided. The railway can transport 55,000 long tons of iron ore a day over the six miles from the loading site to the dumper at the concentrator.

Underground haulage in Canadian mines continued to rely heavily on train haulage but belt haulage coupled with automatic loading and hoisting devices became more common. Cochenour Willans Gold Mines, Limited, used a scraper train for driving eight-foot by eight-foot development headings. Each train is made up of six 165-cubic-foot bottom-dump cars; a ten-foot advance cycle was established per eight-hour shift. In other underground operations there has been a marked trend to automatic control of trains, cars, belt conveyors, hoists, loading pockets, etc. Specially designed equipment was successfully applied to raising, shaft sinking, tunnelling and stoping with resultant increases in speed of advance and a reduction of operating costs. The Alimak Raise Climber, which has gained widespread acceptance by the mining industry, is being used to an ever greater extent in underground raises of all types.

Research

The Ontario Department of Mines and the Ontario Mining Association worked with McPhar Manufacturing Ltd. to develop a device for the nondestructive testing of steel hoisting ropes. With this device, the internal condition of the wire rope, concerning corrosion, wear, nicking and breaking, can be determined quickly and accurately without removing the rope from service. The dual low-frequency, electromagnetic rope tester has been tested in a three-year program that involved over 500 working tests at operating mines at rope speeds of 200 to 300 feet per minute. A low-frequency, electromagnetic field is introduced into the hoisting rope as it passes through the coils of the rope tester at the shaft collar. Variations in the induced field are amplified and recorded to provide previously unavailable data on the internal condition of the wire rope. During the test program the instrument readings were correlated with subsequent breaking tests of the rope being studied.

A significant development of the past few years is the introduction of the new techniques of operations research and the acceptance of the importance of electronic computers. These aid in reaching decisions on many problems, particularly in determining size and grade of ore reserves, cut-off grade, and in the design of mining plants for the most economic mining of an orebody.

The growing acceptance of the importance of rock mechanics in mine design and operation was illustrated by the large attendance at the first Canadian symposium on rock mechanics, held at McGill University in the summer of 1962. It will probably become an annual event with all major Canadian universities being host in turn. Practical and theoretical papers were presented that outlined programs of ground control at operating mines.

MINERAL INDUSTRY TRENDS

Progress in the mineral industry can be appraised with reference to the tables which follow this summary. They are classified as follows: production, trade, consumption, prices, costs, employment, exploration, mine output, transportation, taxes, and capital investment. The following observations, related to the tables, are directed towards the more significant trends and to present conditions in the industry.

Production

The value of mineral production not only reached an all-time high in 1962 but the year's increase was the fourth greatest in the post-war period. This was in contrast to the small gains of the period 1957-61 (Tables 1 and 2). Thus there appeared to be a resumption of the rapid-growth trend which characterized the industry throughout the earlier years of the past decade. As in 1961, there was a marked gain in fuels output with the result that there has been a considerable change in the percentage composition of total mineral value, as noted in a comparison of 1962 and 1960 percentages: metallic minerals - 52.6 (56.4) per cent, nonmetallic minerals - 20.0 (20.9) per cent, fuels - 27.4 (22.7) per cent.

The extent to which the mineral industry has outpaced the industrial economy as a whole since 1948 is illustrated by a comparison of the indices of industrial production and of mining. However, in 1962 both indices increased at the same rate (Table 3). Although the relative importance of individual minerals changes somewhat from year to year, petroleum, nickel and copper continued to hold the three leading positions in terms of output value. Iron ore replaced uranium in fourth position dropping uranium to fifth ahead of gold in sixth position. Asbestos retained its seventh position. These seven minerals accounted for 68 per cent of total output (Table 4).

A regional analysis of mineral production provides some interesting locational comparisons. The Appalachian, St. Lawrence Lowlands and Cordilleran regions have approximately equal mineral productivity and, in the aggregate, accounted for a little over one quarter of the country's mineral value in 1962. The Interior Plains also accounted for slightly more than one quarter. The Canadian Shield, which has always been the leading regional mineral producer, was the source of almost one half the country's output (Table 5). On a provincial basis, Alberta widened its lead over Quebec and gained on Ontario (Table 7). These three provinces accounted for 70 per cent of total output value but production is well distributed throughout Canada. British Columbia and Manitoba made significant gains as a result of increased mining activity (Table 8). Although output of the leading minerals tends to be concentrated in certain provinces - crude petroleum in Alberta, nickel in Ontario, asbestos in Quebec - there is good provincial distribution of mineral production (Table 9) and further diversification can be expected as the resource base is enlarged. In particular, expected growth in the mineral economies of the Atlantic Provinces and of British Columbia will make for greater geographic diversification.

The importance of the mineral industry in the Canadian economy can be effectively measured by net values of production. The most-recently available statistics show that mineral production accounts for over one third of the net value of all commodity-producing industry compared with one quarter in the middle of the past decade (Table 10).

The importance of the Canadian mineral industry on a world scale is apparent from an analysis of mineral output for leading countries (Table 11). Canada ranks among the first six producing countries for 19 minerals. Although this country has always been a leading world producer, it has increased its prominence since the early 1950's when it was among the first six countries for 14 minerals.

Mineral Trade

Mineral exports and imports may be classified as: raw material, semiprocessed, and fully manufactured. For the raw and semiprocessed classes, Canada has a very favorable trade balance (Tables 12 and 13). During 1962, raw material exports exceeded imports by 80 per cent compared with 59 per cent in 1961. Semiprocessed exports were nine times greater than imports - 11 times greater than in the previous year. The greater emphasis on raw material exports lead to a lowering in the degree of processing of exported mineral materials. However, this trend was more apparent than real because the increase in total exports of raw materials was due mostly to increases in crude petroleum and iron ore which normally move in international trade in unprocessed form. In the raw-material category, exports of iron and its materials and of nonmetallic minerals (including fuels) showed favorable increases while imports were held near the previous year's levels. This trend toward a greater increase in exports than in imports was reversed for nonferrous metals, although not seriously. In the semiprocessed category, there were no significant over-all changes in exports or imports although the increase in nonferrous metal exports was cancelled out by a comparable decrease in exports of iron and its products. In total there was a favorable trade balance of about $1,280 million for raw and semiprocessed minerals and their products, compared with $1,150 million in 1961.

There has always been an unfavorable balance in the fully manufactured category; in 1962 this amounted to $2,332 million compared with $2,136 million the previous year. Mineral imports in the manufactured category accounted for over four fifths of total mineral imports - five times greater than mineral exports in this category. The extensive deficit in fully manufactured trade is due mostly to the large imports of iron and its products. As iron and steel manufacturing in Canada increases in the future, the dependence on imports will be reduced and the trade balance position in the manufactured category improved. Good progress is being made in steel production; Canada now produces close to nine tenths of her own steel requirements in the primary form.

The mineral industry has a prominent position in Canada's export trade. Since 1957, mineral exports in the raw and semiprocessed categories have been accounting for almost one third of all industrial product exports. On the other hand, mineral imports have been only about one tenth of industrial product imports (Tables 20 and 21). Mineral exports, including fully manufactured products, were two fifths of Canada's total exports in 1962 (Table 14). The extent of the imports of fully manufactured mineral products is readily apparent when measured in terms of total import trade. In the aggregate, raw materials, semiprocessed and fully manufactured mineral imports, account for 57 per cent of all imports. Again, it can be emphasized that the high percentage of minerals and mineral-based materials in the commodity import account is further evidence of Canada's heavy reliance on imports of fully manufactured iron and steel products.

United States was the destination of 60.5 per cent of Canada's export trade in minerals and mineral products, and the source of 70 per cent of the imports (Tables 16 and 17). Considering raw and semiprocessed mineral materials only, export trade analyses show that the net increase of $177 million in 1962 resulted from an increase in exports to United States despite declines to most other countries (Tables 18 and 19). The trend of the 1950's, which saw less reliance on the United States market, has been reversed. That market is now accounting for almost as high a percentage of Canada's mineral exports as it did in the early 1950's. There were significant declines in exports of iron ore, copper and nickel to the United Kingdom and the European Economic Community during 1962. Gains were made in iron ore and copper in the Japanese market, but large declines in primary ferrous metals and asbestos resulted in an overall trade cutback.

Domestic Consumption

The degree of mineral self-sufficiency is well illustrated in a comparison of consumption and production (Tables 22 and 23). With relatively few exceptions, Canada's large and diversified mineral production is well in excess of domestic demand and, therefore, the export market is of much importance to industry growth. The few notable exceptions to self-sufficiency in mineral supply continue to be molybdenum, tin and mica. The deficiency in sulphur has been overcome and the reliance on imported crude petroleum has been steadily declining. Domestic consumption and exports have continued to grow at similar rates with the result that exports remain equivalent to about three fifths of total output of raw and semiprocessed products. Three quarters of the metals are marketed outside Canada, as well as about one third of the industrial minerals and of the fuels. Of the four major nonferrous metals, aluminum has the most reliance on the export market and lead has least reliance. The domestic market share has been surprisingly consistent for all four metals in recent years (Table 24).

Prices

There were mixed trends in world metal prices in 1962. About one third of the metals had price increases; the same proportion showed declines and no change (Table 25). Silver had the largest price increase. In general, Canadian metal prices follow closely prices in the United States market. On balance, price changes in 1962 tended to increase overall production value, due chiefly to the price increases resulting from a decline in the value of the Canadian dollar. For some commodities such as gold, the unit price increase did not result in an increase in value because of the decline in production. The unit value increases for crude petroleum, nickel and copper had the most buoyant price effects on output value.

The price indices for nonferrous metals and products and for non-metallic minerals and products increased by about the same percentage as the wholesale index; the iron and products mineral index declined slightly. During the past decade, the iron products index has outpaced the general wholesale index, but the other two mineral indices have followed the general index closely. (Tables 26 and 27).

Principal Industry Statistics*

Census of industry statistics, as reported in Tables 28 and 29, afford a means of relating employment, the cost of energy, and the cost of supplies to gross and net value of production. In 1961, the net value of production for the metallic minerals group was 70 per cent of the gross value, as compared with 79 and 90 per cent, respectively, for the industrial minerals and the fuels groups. The relationship for nonferrous smelting and refining was 36 per cent. There are marked differences in the percentage costs of the factors of production. This is illustrated by the fact that energy costs in the industrial minerals industry are 9.6 per cent of gross value but only 3.7 per cent in the metallics industry. Wage percentages in the two industries are 25 and 31 per cent. The per capita value of net production is highest in the fuels industry and lowest in the metallics industry. Tables 30, 31 and 32 provide information for detailed analyses of energy consumption in the mineral industry and indicate an increasing reliance on electricity.

Employment

Since 1960 there has been a decline in employment in uranium mining, and for several years employment in coal mining and gold mining has been declining. Employment increases have been experienced in nonferrous metal mining and in some sectors of the industrial minerals industry. The average of annual salaries and wages in the industry as a whole increased almost 60 per cent during the past decade. Employment comparisons for recent years are difficult to make because of the changes in the D. B. S. employment statistics (Table 33). However, the decline in employment which became apparent at the end of the past decade tended to lessen in the latter part of 1961 and in 1962. With the more stable conditions in the uranium and coal mining industry, and increasing activity in metal mining in general, the down trend in employment should be arrested (Table 34).

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* It should be noted in studying the principal industry statistics and employment data of Tables 28 to 34 and Table 36 that a change was made by the Dominion Bureau of Statistics, commencing in 1960, in certain accounting procedures relative to the adoption of the Standard Industrial Classification. As a result, some firms in the industrial minerals classification, particularly those engaged in sand and gravel operations, were reclassified to the construction industry and other categories. Employment, salaries and wages, and other industry statistics for the industrial minerals sector are therefore not directly comparable with similar statistics for previous years.

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Over the past decade, employment in the metal mining sector has fluctuated between 45,000 and 51,000 employees. The average annual wage increased by 52 per cent but productivity increases resulted in a decline in the wage cost per ton mined (Table 35). The extent of the productivity increase is indicated in Table 36 and the extent of wage increases in recent years is shown in Table 38. There has also been a marked productivity increase in industrial mineral operations. The wage data of Table 38 shows the more favorable position of the mineral industry in relation to some other sectors of the economy. Wages in most sectors of the industry are higher and have risen faster than in manufacturing and construction. Wages in the depressed gold and coal mining industries are the exceptions (Table 39).

Prospecting and Exploration

Statistics on exploration expenditures for 1960 and 1961 show that mining companies classified as copper-gold-silver producers have been the most active; these are followed by nickel-copper companies. Quebec, Ontario and Manitoba have been the leading provinces in prospecting and exploration (Table 41). Exploration expenditures of the past decade reached a peak in 1957. The sharp decline in 1958 was followed by a steady, relatively high rate of activity through to 1961 (Table 42) and a further uptrend is expected.

Contract diamond drilling, as carried out for mining companies, reached a peak during the past decade in 1956, and the performance record of the past two or three years is very similar to that of the early 1950's (Table 43). Contract rotary drilling for the oil industry also reached a peak in 1956 but recent drilling activity exceeds that of the early 1950's by one third (Table 44).

Ore Mined and Rock Quarried

Iron ore mining in recent years has become the leading operation, by weight, in Canadian metal mining, accounting for one third of the metallic ore. Structural materials still account for the largest commodity tonnage handled in the mineral industry as a whole (Table 45). During the past decade there has been approximately equal amounts of metallic ores and industrial minerals mined. This production pattern continues (Table 46).

Transportation of Minerals

In Canada there is a close relation between the level of activity in the mineral industry and in railway transportation. Crude minerals account for two fifths of all revenue-producing freight moved by Canadian railways. This is essentially the same type of indicator as 'freight car loadings' (Table 47). During the past decade, crude-mineral shipments have been an important part of total freight loadings, the proportion having increased from about one third to the present two fifths (Table 48). Coal and iron ore account for about one half of mineral industry freight. The primary products of smelters and refineries constitute only a small percentage of the revenue freight received by Canadian railways (Table 49). Of the 1,792 miles of new railway construction completed in Canada since the end of World War II, a total of 1,349 miles was built for mineral development in northern areas.

The mineral industry provides about two fifths of the inland-waterways traffic through the principal canals (Table 50). Iron ore and coal account for over 80 per cent of mineral industry freight.

The largest expansion in Canadian transportation in the past 15 years has been in pipeline transportation. Major systems of oil and of natural gas pipelines have been extended across the country. There has been almost a fourfold increase in the shipment of petroleum and petroleum products by pipeline since 1952, and almost a sixfold increase in natural gas shipments (Table 51). The petroleum moved in pipelines in 1962 amounted to 57.2 million tons, almost as much as the total mineral tonnage received by railways and as much as the total freight traffic through Canadian canals.

Taxation

Almost 60 per cent of the taxes paid by five major divisions of the mineral industry are in the form of federal income taxes; provincial and municipal taxes account for the remainder. Taxes paid by the nickel-copper mining and smelting industry reflect this sector's leading position in the mineral economy (Tables 52 and 53). Complete information on the taxes paid by the entire industry is not available but the mineral industry accounts for almost one fifth of all federal income taxes (Table 54).

Capital Investment, Ownership and Control

In 1962, there was only a seven per cent increase in capital investment and repair expenditures in the mineral industry in contrast with an 11 per cent increase in 1961. Although expenditures rose in the metals and nonmetals sectors the large increase of the previous year in the petroleum and natural gas industry was not repeated. In fact, there was a decline in expenditures as a result of some curtailment in natural gas plant construction. The most important increases in expenditures in 1962 were related to plant expansion in the iron ore and asbestos industries. Table 55 sets out the capital and repair expenditures for the several sectors of the mining industry but the amounts shown do not include expenditures in the nonferrous smelting and refining industries, the petroleum refining industry, or the pipeline transportation industry. Total expenditures attributable to mineral industry activity are also understated to the extent of mining company expenditures on railways and electric power facilities, as well as expenditures by other businesses dependent on the industry.

Capital expenditures in all parts of the petroleum and natural gas industries, including transportation, processing, and marketing, amounted in 1962 to over six per cent of all capital invested in Canada that year. Expenditures on pipeline systems and on natural gas processing plants were lower while new petroleum-refinery construction raised expenditures on refining compared with the previous year (Table 56).

The latest available statistics (1961) show that 64 per cent of the mining sector of Canada's mineral industry is foreign owned. Sixty per cent of the petroleum industry and 56 per cent of the nonferrous smelting industry is foreign owned (Table 57). There has been a steady decline in Canadian ownership in recent years. Foreign-owned capital forms a larger proportion of total capital employed in the mineral industry than in other sectors of the economy such as manufacturing, the utilities, and construction (Table 58). Finally, statistics for the past 30 years illustrate the dominant position the

United States has maintained among foreign countries investing in the Canadian mineral industry. United States capital has constituted over 85 per cent of total foreign investment each year in the mining and smelting industries and in the petroleum and natural gas industry (Table 59).

Statistical Tables

Statistical Tables

Table 1

Mineral Production of Canada, 1961 and 1962

	Unit of Measure	1961 Quantity	1961 $ '000	1962 Quantity	1962 $ '000
Metals					
Antimony	000 lb	1,331	470	1,931	748
Bismuth	"	478	958	425	840
Cadmium	"	1,358	2,173	2,605	4,731
Calcium	"	99	101	124	124
Cobalt	"	3,183	4,751	3,482	6,345
Columbium (Cb_2O_5)	"	62	66	1,017	1,006
Copper	000 s.t.	439	255,158	457	282,733
Gold	000 troy oz	4,474	158,637	4,178	156,314
Indium	000 oz	na	na	na	na
Iron ore	000 l.t.	18,178	187,950	24,428	263,004
Iron, remelt	000 s.t.	...	14,720	...	9,846
Lead	"	230	47,055	215	42,721
Magnesium	000 lb	15,271	4,307	17,631	4,822
Molybdenum (Mo content)	"	771	1,092	818	1,261
Nickel	000 s.t.	233	351,262	232	383,784
Platinum group	000 troy oz	418	24,534	471	28,849
Selenium	000 lb	431	2,799	487	2,801
Silver	000 troy oz	31,382	29,581	30,423	35,443
Tantalum (Ta_2O_5)	000 lb	-	-	-	-
Tellurium	"	78	376	59	352
Thorium	"	na	na	na	na
Tin	"	1,119	727	651	443
Titanium ore	000 s.t.	-	-	-	-
Tungsten (WO_3)	000 lb	-	-	4	2
Uranium (U_3O_8)	"	19,281	195,692	16,859	158,184
Zinc	000 s.t.	416	104,750	463	112,081
Total metals			1,387,159		1,496,434
Nonmetals					
Arsenious oxide	000 lb	419	17	161	7
Asbestos	000 s.t.	1,174	128,956	1,216	130,282
Barite	"	191	1,799	227	2,124
Diatomite	s.t.	214	9	211	10
Feldspar	000 s.t.	11	230	10	223
Fluorspar	"	na	1,990	na	1,870
Garnet	s.t.	80	3	-	-
Graphite	"	1	*	-	-
Grindstone	"	10	2	10	2
Gypsum	000 s.t.	4,940	7,751	5,333	9,350
Iron oxide	"	0.8	68	0.8	58

Table 1 (cont'd)

	Unit of Measure	1961 Quantity	1961 $ '000	1962 Quantity	1962 $ '000
Nonmetals (cont'd)					
Lithia	000 lb	536	393	500	559
Magnesitic dolomite and brucite	"	na	3,064	na	3,432
Mica	"	1,816	125	1,204	85
Mineral water	000 gal	365	209	377	207
Nepheline syenite	000 s.t.	240	2,572	254	2,605
Peat moss	"	224	7,295	238	7,480
Potash (K_2O)	"	–	–	na	na
Pozzolana	s.t.	...	2	...	5
Pyrite, pyrrhotite	000 s.t.	517	1,831	517	1,880
Quartz	"	2,194	3,153	2,086	3,817
Salt	"	3,247	19,552	3,639	21,927
Soapstone, talc, pyrophyllite	"	48	691	46	625
Sodium sulphate	"	251	4,037	247	3,954
Sulphur, in smelter gas	"	277	2,708	293	3,090
Sulphur, elemental	"	395	7,288	695	9,287
Titanium dioxide, etc.	"	...	16,723	...	11,574
Total nonmetallics			210,468		214,453
Fuels					
Coal	000 s.t.	10,398	70,053	10,285	69,160
Natural gas	000 mcf	655,738	68,422	946,703	108,641
Natural gas byproducts	000 bbl	...	27,293	...	50,778
Petroleum, crude	"	220,848	487,560	244,115	552,353
Total fuels			653,328		780,932
Structural Materials					
Clay products	$	...	36,983	...	37,817
Cement	000 s.t.	6,206	103,923	6,879	113,234
Lime	"	1,415	19,217	1,424	17,647
Sand and gravel	"	170,751	104,654	181,246	118,603
Stone	"	48,939	66,568	47,553	65,866
Total structural material			331,345		353,167
Total all minerals			2,582,300		2,844,986

*less than $1,000 Symbols: na Not available; ... Not applicable; - Nil.

Table 2

Value of Mineral Production of Canada and Its Per Capita Value, Selected Years 1924-62

	Production ($ millions)				
	Metallics	Industrial Minerals	Fuels	Total	Per Capita Value $
1924	102	48	60	210	22.92
1929	154	80	77	311	31.00
1934	194	30	54	278	25.91
1939	343	61	71	475	42.12
1944	308	80	97	485	40.67
1949	538	179	184	901	67.01
1954	802	333	353	1,488	97.36
1959	1,371	503	535	2,409	137.79
1960	1,407	520	566	2,493	139.48
1961	1,387	542	653	2,582	141.59
1962	1,496	568	781	2,845	153.20

Table 3

Indexes of Physical Volume of Industrial and Mineral Production in Canada, 1948-62, Unadjusted (1949 = 100)

	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962
Total Industrial Production	96.4	100.0	106.9	116.6	120.9	129.1	128.5	142.3	154.9	155.4	154.4	166.1	167.4	172.9	186.0
Total Mining	90.0	100.0	109.5	123.4	131.0	142.1	158.7	185.2	212.3	227.8	227.0	251.1	253.3	266.9	287.4
Metals															
All metals	88.4	100.0	103.5	107.9	110.3	115.7	129.0	142.7	151.0	170.0	180.3	201.3	197.9	191.7	197.7
Gold	86.3	100.0	107.9	103.9	106.9	97.9	104.5	107.7	107.9	106.7	109.7	108.4	111.2	107.1	100.1
Nickel	102.4	100.0	96.2	107.1	109.2	111.7	125.3	135.9	139.0	146.8	110.2	144.8	166.9	183.8	184.2
Lead	104.7	100.0	103.7	99.0	105.5	121.4	136.8	126.9	118.2	113.9	116.0	113.7	128.3	139.3	132.2
Zinc	81.2	100.0	108.6	118.4	128.9	139.5	130.5	150.3	145.5	142.0	147.2	137.4	142.1	145.0	160.3
Copper	91.4	100.0	100.4	102.5	98.0	96.1	114.8	123.7	135.2	137.1	131.8	151.6	168.7	169.5	176.7
Iron Ore	40.0	100.0	96.0	115.9	126.5	170.6	185.4	316.5	410.6	462.6	321.5	448.9	406.3	504.7	632.5
Fuels															
All fuels	83.2	100.0	112.1	143.5	163.9	192.7	215.6	273.2	344.7	358.2	329.5	363.1	380.2	430.7	480.8
Coal	97.2	100.0	98.5	95.6	90.5	81.5	75.2	74.1	74.6	65.4	56.7	51.9	53.3	49.9	48.8
Natural gas	100.9	100.0	107.3	120.5	128.9	147.8	169.6	204.5	235.0	295.1	401.6	503.9	589.2	712.0	1,005.7
Petroleum	57.6	100.0	135.5	226.9	291.8	385.5	457.8	616.8	812.7	859.5	782.6	873.7	909.9	1,043.7	1,154.0
Nonmetals															
All nonmetals	118.8	100.0	139.1	156.3	155.5	152.9	161.4	180.2	187.6	179.0	170.9	191.4	192.6	211.7	222.5
Asbestos	124.5	100.0	151.8	170.7	171.5	162.3	167.8	191.9	188.4	184.3	178.3	193.5	201.4	223.4	234.1
Other non-metals	105.3	100.0	109.0	122.0	117.2	130.5	146.3	152.4	184.3	158.2	142.1	183.3	157.7	166.1	177.4
Quarrying and sand pits	101.9	100.0	119.3	142.9	153.5	154.3	189.6	204.3	237.7	264.2	308.2	317.7	301.2	337.1	380.5

Table 4

Percentage Contribution of Leading Minerals to Total Value of Mineral Production in Canada, 1953-62

	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962
Petroleum	15.0	16.4	17.0	19.5	20.7	19.0	17.5	17.0	18.9	19.4
Nickel	12.0	12.1	12.0	10.7	11.8	9.2	10.7	11.9	13.6	13.5
Copper	11.3	11.8	13.4	14.1	9.4	8.3	9.7	10.6	9.9	9.9
Iron ore	3.3	3.3	6.2	7.7	7.6	6.0	8.0	7.0	7.3	9.2
Uranium	na	1.8	1.4	2.2	6.2	13.3	13.7	10.8	7.6	5.6
Gold	10.4	10.0	8.7	7.2	6.8	7.4	6.2	6.3	6.1	5.5
Asbestos	6.4	5.8	5.4	4.8	4.8	4.4	4.5	4.9	5.0	4.6
Sand and gravel	4.0	4.0	3.8	3.9	4.1	4.6	4.3	4.6	4.1	4.2
Cement	4.4	4.0	3.7	3.6	4.3	4.6	3.9	3.7	4.0	4.0
Zinc	7.2	6.1	6.6	6.0	4.6	4.4	4.0	4.4	4.1	3.9
Natural gas	0.8	0.8	0.8	0.8	1.0	1.5	1.6	2.1	2.6	3.8
Coal	7.7	6.5	5.2	4.6	4.1	3.8	3.1	3.0	2.7	2.4
Stone	2.3	2.7	2.4	2.3	2.7	2.6	2.5	2.4	2.6	2.3
Lead	3.7	3.9	3.2	2.8	2.3	2.0	1.6	1.8	1.8	1.5
Clay products	2.2	2.2	2.0	1.8	1.6	2.0	1.8	1.5	1.4	1.3
Silver	1.8	1.7	1.4	1.2	1.1	1.3	1.2	1.2	1.1	1.3
Platinum metals	1.5	1.4	1.3	1.1	1.2	0.7	0.7	1.2	0.9	1.0
Salt	0.5	0.6	0.6	0.6	0.6	0.7	0.7	0.8	0.8	0.8
Lime	1.1	1.0	0.9	0.8	0.8	0.9	0.9	0.8	0.7	0.6
Titanium dioxide	0.3	0.3	0.3	0.4	0.4	0.3	0.4	0.5	0.6	0.4
Gypsum	0.6	0.5	0.4	0.3	0.4	0.2	0.3	0.4	0.3	0.3
Other minerals	3.5	3.1	3.3	3.6	3.5	2.8	2.7	3.1	3.9	4.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Symbol: na Not available.

Table 5
Value of Mineral Production in Canada
by Main Geological Regions, 1962

	Metals		Industrial Minerals		Fuels		Total, all Minerals	
	$ millions	% of Total	$ millions	% of Total	$ millions	% of Total	$ millions	% of Total
Canadian Shield	1,264.2	84.5	28.6	5.0	-	-	1,292.8	45.4
Appalachian Region	59.7	4.0	155.4	27.4	48.6	6.2	263.7	9.3
St. Lawrence Lowlands	1.0	-	264.6	46.6	9.5	1.2	275.1	9.7
Interior Plains	-	-	75.5	13.3	690.9	88.5	766.4	26.9
Cordilleran Region	171.5	11.5	43.6	7.7	31.9	4.1	247.0	8.7
Total, Canada	1,496.4	100.0	567.7	100.0	780.9	100.0	2,845.0	100.0

Table 6

Value of Mineral Production in Canada,
by Provinces and Mineral Classes, 1962

	Metals		Industrial Minerals		Fuels		Total	
	$ 000	% of Total	$ 000	% of Total	$ 000	% of Total	$ 000	% of Total
Ontario	729,770	48.8	174,109	30.7	9,463	1.2	913,342	32.1
Alberta	7	-	41,844	7.4	524,652	67.2	566,503	19.9
Quebec	281,433	18.8	235,020	41.4	-	-	516,453	18.1
Saskatchewan	71,161	4.7	15,981	2.8	150,511	19.3	237,653	8.3
British Columbia	156,994	10.5	41,072	7.2	37,362	4.8	235,428	8.3
Manitoba	128,835	8.6	20,661	3.7	9,436	1.2	158,932	5.6
Newfoundland	93,284	6.2	8,575	1.5	-	-	101,859	3.6
Nova Scotia	1,685	0.1	18,253	3.2	41,713	5.3	61,651	2.2
New Brunswick	3,484	0.3	11,427	2.0	6,901	0.9	21,812	0.8
Northwest Territories	16,758	1.1	-	-	779	0.1	17,537	0.6
Yukon Territory	13,023	0.9	-	-	115	0.01	13,138	0.5
Prince Edward Island	-	-	678	0.1	-	-	678	0.02
Total, Canada	1,496,434	100.0	567,620	100.0	780,932	100.0	2,844,986	100.0

Symbol: - Nil.

Table 7

Value of Mineral Production in Canada
by Provinces, 1953-62

($ millions)

	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962
Ontario	466	497	584	651	749	790	971	983	944	913
Alberta	249	279	326	411	410	346	376	396	473	566
Quebec	252	279	357	423	406	366	441	446	455	516
Saskatchewan	48	68	85	123	173	210	210	212	216	238
British Columbia	158	159	189	203	179	151	159	186	188	235
Manitoba	25	35	62	68	64	57	55	59	101	159
Newfoundland	34	43	68	84	83	65	72	87	92	102
Nova Scotia	67	73	67	66	68	63	63	66	62	62
New Brunswick	12	12	16	18	23	16	18	17	19	22
Northwest Territories	10	26	26	22	21	25	26	27	18	18
Yukon Territory	15	17	15	16	14	12	13	13	13	13
Prince Edward Island	-	-	-	-	-	-	5	1	1	0.7
Total, Canada	1,336	1,488	1,795	2,085	2,190	2,101	2,409	2,493	2,582	2,845

Symbol: - Nil.

Table 8
Percentage Contribution of Provinces to Total Value of Mineral Production in Canada, 1953-62

	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962
Ontario	34.9	33.4	32.5	31.2	34.2	37.5	40.3	39.4	36.6	32.1
Alberta	18.6	18.8	18.2	19.7	18.7	16.5	15.6	15.9	18.3	19.9
Quebec	18.9	18.8	19.9	20.2	18.5	17.4	18.3	17.9	17.6	18.1
Saskatchewan	3.6	4.6	4.7	5.9	7.9	10.0	8.7	8.5	8.4	8.3
British Columbia	11.8	10.7	10.5	9.7	8.2	7.2	6.6	7.5	7.3	8.3
Manitoba	1.9	2.4	3.5	3.3	2.9	2.7	2.3	2.4	3.9	5.6
Newfoundland	2.5	2.9	3.8	4.0	3.8	3.1	3.0	3.5	3.6	3.6
Nova Scotia	5.0	4.8	3.7	3.2	3.1	3.0	2.6	2.6	2.4	2.2
New Brunswick	0.9	0.8	0.9	0.9	1.1	0.8	0.8	0.7	0.7	0.8
Northwest Territories	0.8	1.7	1.5	1.1	1.0	1.2	1.1	1.1	0.7	0.6
Yukon Territory	1.1	1.1	0.8	0.8	0.6	0.6	0.5	0.5	0.5	0.5
Prince Edward Island	-	-	-	-	-	-	0.2	-	-	0.02
Total, Canada	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Symbol: - Nil.

Table 9

Production of Leading Minerals in Canada, by Provinces and Territories, 1962

	Unit of Measure	Nfld.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	N.W.T.	Y.T.	Total, Canada
Petroleum, crude	bbl	-	-	-	10,333	-	1,134,534	3,926,683	64,432,411	165,124,967	8,914,220	572,004	-	244,115,152
	$	-	-	-	14,466	-	3,661,174	9,435,819	141,783,520	379,830,363	16,872,122	755,045	-	552,352,509
Nickel	s.t.	-	-	-	-	1,540	166,582	61,482	-	-	1,738	900	-	232,242
	$	-	-	-	-	2,571,898	274,219,955	102,586,082	-	-	2,902,850	1,503,837	-	383,784,622
Copper	s.t.	17,308	-	204	3,674	147,431	188,995	12,738	32,017	-	54,490	314	214	457,385
	$	10,731,154	-	126,300	2,277,864	91,407,164	116,347,723	7,897,714	19,850,465	-	33,766,394	194,928	132,990	282,732,696
Iron ore	s.t.	7,986,910	-	-	-	11,163,982	6,414,936	-	-	-	1,793,848	-	-	27,359,676
	$	67,753,153	-	-	-	112,444,643	64,479,510	-	-	-	18,326,911	-	-	263,004,217
Uranium (U_3O_8)	lb	-	-	-	-	-	12,805,203	-	4,053,966	-	-	-	-	16,859,169
	$	-	-	-	-	-	118,283,081	-	39,900,588	-	-	-	-	158,183,669
Gold	oz	13,966	-	-	553	993,560	2,421,249	68,259	66,034	186	159,492	400,292	54,805	4,178,396
	$	522,468	-	-	20,688	37,169,080	90,578,924	2,553,569	2,470,332	6,958	5,966,596	14,974,924	2,050,255	156,313,794
Asbestos	s.t.	-	-	-	-	1,125,131	35,551	-	-	-	55,132	-	-	1,215,814
	$	-	-	-	-	114,297,886	5,686,720	-	-	-	10,297,360	-	-	130,281,966
Sand and gravel	s.t.	4,250,942	531,196	4,375,842	5,128,365	44,000,000	76,600,813	9,692,025	5,317,336	13,469,848	17,879,395	-	-	181,245,762
	$	3,504,594	452,906	2,738,424	2,790,933	23,000,000	52,365,204	6,770,210	3,344,568	12,644,098	10,992,346	-	-	118,603,283
Cement	s.t.	96,916	-	-	169,823	2,242,591	2,510,783	432,079	230,072	799,030	397,435	-	-	6,878,729
	$	1,985,524	-	-	2,774,908	33,330,630	38,704,090	8,715,034	5,830,227	14,780,423	7,112,890	-	-	113,233,726
Zinc	s.t.	32,541	-	757	2,498	70,737	63,132	49,920	30,900	-	206,716	-	5,944	463,145
	$	7,874,869	-	183,090	604,575	17,118,299	15,278,027	12,080,667	7,477,708	-	50,025,192	-	1,438,554	112,080,981
Natural gas	Mcf	-	-	-	95,750	-	15,648,294	-	38,845,732	770,963,122	121,093,122	56,707	-	946,702,727
	$	-	-	-	134,476	-	5,802,387	-	2,295,783	88,660,759	11,724,236	23,518	-	108,641,159
Coal	s.t.	-	-	4,204,779	815,529	-	-	-	2,256,306	2,087,310	913,196	-	7,649	10,284,769
	$	-	-	41,713,202	6,752,042	-	-	-	4,553,900	9,969,608	6,056,263	-	115,198	69,160,213
Stone	s.t.	227,707	225,000	548,834	2,950,906	21,173,016	18,797,648	943,765	-	105,695	2,580,914	-	-	47,553,485
	$	445,091	225,000	1,330,708	3,077,423	30,242,778	25,043,550	1,588,674	-	368,608	3,544,526	-	-	65,866,358
Lead	s.t.	25,330	-	2,682	1,879	4,716	1,144	3,792	-	-	167,641	-	8,145	215,329
	$	5,025,529	-	532,047	372,865	935,656	226,879	752,357	-	-	33,260,028	-	1,615,980	42,721,341
Clay products	$	142,000	-	1,712,503	822,400	7,450,131	20,146,786	621,275	1,354,635	3,445,687	2,121,461	-	-	37,816,878
Silver	oz	1,181,648	-	724,245	178,521	4,603,019	9,383,445	847,879	762,215	17	6,186,937	72,802	6,482,244	30,422,972
	$	1,376,620	-	843,745	207,977	5,362,517	10,931,713	987,779	887,980	20	7,207,782	84,814	7,551,814	35,442,761
Platinum metals	oz	-	-	-	-	-	470,782	-	-	-	5	-	-	470,787
	$	-	-	-	-	-	28,848,262	-	-	-	375	-	-	28,848,637
Salt	s.t.	-	-	312,519	-	-	3,155,589	25,010	54,931	90,729	-	-	-	3,638,778
	$	-	-	3,112,753	-	-	15,387,911	634,538	1,337,471	1,454,462	-	-	-	21,927,135
Lime	s.t.	-	-	-	17,341	365,473	910,930	46,348	-	48,138	36,229	-	-	1,424,459
	$	-	-	-	389,876	4,431,612	10,527,910	800,418	-	842,615	654,157	-	-	17,646,588
Gypsum	s.t.	83,992	-	4,451,072	91,835	-	435,140	122,870	-	-	147,900	-	-	5,332,809
	$	284,564	-	7,113,517	161,649	-	1,007,818	338,527	-	-	443,700	-	-	9,349,775
Total, leading minerals	$	99,645,566	677,906	59,406,289	20,402,142	479,762,294	897,527,624	155,762,663	231,087,177	512,003,601	221,275,189	17,537,066	12,904,791	2,707,992,308
Total, all minerals	$	101,858,960	677,906	61,651,093	21,811,575	516,453,166	913,342,174	158,932,169	237,653,502	566,502,703	235,428,135	17,537,066	13,137,730	2,844,986,179
Leading minerals as % of all minerals		97.8	100.0	96.4	93.5	92.9	98.3	98.0	97.2	90.4	94.0	100.0	98.2	95.2

Symbol: - Nil.

Table 10

World Role of Canada as Producer of Certain Important Minerals, 1962

Mineral		World Production	Rank of the Six Leading Countries 1	2	3	4	5	6
Nickel (mine production)	s.t.	390,000	CANADA 232,242	U.S.S.R. 90,000	New Caledonia 32,609	Cuba 13,900	U.S.A. 11,217	Republic of S. Africa 2,700
	% of world total		60	23	8	4	3	0.7
Asbestos	s.t.	3,047,300	CANADA 1,215,814	U.S.S.R. 1,100,000	Republic of South Africa 221,302	S. Rhodesia 142,196	China 90,000	Italy 61,233
	% of world total		40	36	7	5	3	2
Platinum group metals (mine production)	troy oz	1,207,000	CANADA 470,787	U.S.S.R. 375,000	Republic of South Africa 306,000	U.S.A. 28,742	Colombia 22,052	Japan 3,244
	% of world total		39	31	25	2	2	0.3
Uranium (U_3O_8 concentrates) (Free World)	s.t.	33,550	U.S.A. 17,010	CANADA 8,430	Republic of South Africa 5,024	France 1,656	Australia 1,300	Spain 55
	% of world total		51	25	15	5	4	-
Zinc (mine production)	s.t.	3,699,955	U.S.A. 505,648	CANADA 501,937	U.S.S.R. 451,900	Australia 287,320	Mexico 276,328	Japan 212,034
	% of world total		14	14	12	8	7	6
Cobalt (mine production) (Free World)	s.t.	15,700	Republic of the Congo 10,615	CANADA 1,741	Morocco 1,583	N. Rhodesia 948	Australia 13	- -
	% of world total		68	11	10	6	0.08	
Cadmium (smelter production)	'000 lb	26,076	U.S.A. 10,640	U.S.S.R. 4,409	CANADA 2,605	Japan 1,940	Belgium 1,521	Republic of the Congo 992
	% of world total		41	17	10	7	6	4
Titanium concentrates (ilmenite)	s.t.	2,295,100	U.S.A. 807,725	Norway 330,000	CANADA 301,448	Australia 204,000	India 152,100	Republic of S. Africa 87,096
	% of world total		35	14	13	9	7	4

			U.S.A.	U.S.S.R.	CANADA	France	Norway	W. Germany
Aluminum (primary metal)	s.t.	5,517,589	2,117,928	950,000	690,297	324,591	226,955	196,016
	% of world total		38	17	13	6	4	4
			U.S.A.	U.S.S.R.	CANADA	France	Britain	Spain
Gypsum	'000 s.t.	49,965	9,969	8,275	5,333	4,740	4,454	2,756
	% of world total		20	17	11	9	9	6
			Republic of S. Africa	U.S.S.R.	CANADA	U.S.A.	Australia	Ghana
Gold (mine production)	troy oz	50,000,000	25,491,993	12,200,000	4,178,396	1,556,000	1,068,724	888,038
	% of world total		51	24	8	3	2	2
			Peru	Mexico	Bolivia	CANADA	Japan	S. Korea
Bismuth (mine production)	s.t.	3,500	819	368	326	213	210	175
	% of world total		23	11	9	6	6	5
			Mexico	U.S.A.	Peru	CANADA	U.S.S.R.	Australia
Silver (mine production)	troy oz	242,154,000	41,249,402	36,345,000	36,016,676	30,422,972	27,000,000	17,250,000
	% of world total		17	15	15	13	11	7
			U.S.A.	U.S.S.R.	Norway	CANADA	Italy	Britain
Magnesium	s.t.	146,000	68,955	35,000	16,500	8,816	6,200	4,200
	% of world total		47	24	11	6	4	3
			U.S.A.	W. Germany	Mexico	CANADA	U.S.S.R.	Yugoslavia
Barite	s.t.	3,310,000	886,964	470,000	350,684	226,600	200,000	143,300
	% of world total		27	14	11	7	6	4
			U.S.S.R.	Australia	U.S.A.	Mexico	CANADA	Peru
Lead (mine production)	s.t.	2,676,428	438,000	392,463	237,386	213,072	211,321	137,865
	% of world total		16	15	9	8	8	5
			U.S.A.	Chile	N. Rhodesia	U.S.S.R.	CANADA	State of Katanga
Copper (mine production)	s.t.	4,792,297	1,223,978	646,064	619,856	550,000	457,385	322,974
	% of world total		26	13	13	11	10	7
			U.S.A.	U.S.S.R.	Chile	China	CANADA	Japan
Molybdenum (Mo content)	s.t.	37,500	25,622	6,250	2,636	1,650	409	405
	% of world total		68	17	7	4	1	1
			U.S.S.R.	U.S.A.	France	China	CANADA	Sweden
Iron ore	'000 l.t.	523,082	126,569	72,305	65,852	62,005	24,428	21,751
	% of world total		24	14	13	12	5	4

Sources: Dominion Bureau of Statistics for Canada. Other countries: nickel, zinc, aluminum, lead and copper from American Bureau of Metal Statistics; asbestos, platinum and platinum metals, uranium, cobalt, cadmium, titanium concentrates, gypsum, gold, bismuth, silver, magnesium, barite and molybdenum from U.S. Bureau of Mines; iron ore from American Iron and Steel Institute.

Table 11

Net Values of Production in Canada
of Commodity-Producing Industries
1956-60

($ millions)

	1956	1957	1958	1959	1960
Primary Industries					
Agriculture	2,143	1,676	1,925	1,850	2,001
Forestry	761	663	515	597	688
Fishing	106	94	117	106	101
Trapping	12	11	11	10	12
Mining	1,224	1,308	1,311	1,497	1,470
Electric power	587	632	683	748	796
Total	4,833	4,384	4,562	4,808	5,068
Secondary Industries					
Manufacturing	9,605	9,822	9,792	10,321	10,517
Construction	3,344	3,714	3,720	3,710	3,635
Total	12,949	13,536	13,512	14,031	14,152
Grand total	17,782	17,920	18,074	18,839	19,220

Table 12

Value of Exports of Minerals and Their Products from Canada, by Main Groups and Degree of Manufacture, 1961 and 1962

($ millions)

Minerals and Products	1961	1962	Increase or Decrease $ millions	%
Iron and its products				
Raw material	142.6	220.5	+ 77.9	+54.6
Semiprocessed	84.1	63.9	- 20.2	-24.0
Fully manufactured	368.5	457.7	+ 89.2	+24.2
Total	595.2	742.1	+146.9	+24.7
Nonferrous metals and their products				
Raw material	405.0	388.3	- 16.7	- 4.1
Semiprocessed	724.7	750.3	+ 25.6	+ 3.5
Fully manufactured	79.8	95.6	+ 15.8	+19.8
Total	1,209.5	1,234.2	+ 24.7	+ 2.0
Nonmetallic minerals and their products (including fuels)				
Raw material	272.1	379.3	+107.2	+39.4
Semiprocessed	126.7	129.2	+ 2.5	+ 2.0
Fully manufactured	31.7	37.0	+ 5.3	+16.7
Total	430.5	545.5	+115.0	+26.7
Total minerals and their products				
Raw material	819.7	988.1	+168.4	+20.5
Semiprocessed	935.5	943.4	+ 7.9	+ 0.8
Fully manufactured	480.0	590.3	+110.3	+23.0
Total	2,235.2	2,521.8	+286.6	+12.8

Table 13

Value of Imports of Minerals and Their Products into Canada, by Main Groups and Degree of Manufacture, 1961 and 1962
($ millions)

Minerals and Products	1961	1962	Increase or Decrease	
			$ millions	%
Iron and its products				
Raw material	47.4	56.3	+ 8.9	+18.8
Semiprocessed	21.5	24.1	+ 2.6	+12.1
Fully manufactured	1,956.5	2,182.3	+225.8	+11.5
Total	2,025.4	2,262.7	+237.3	+11.7
Nonferrous metals and their products				
Raw material	69.3	73.5	+ 4.2	+ 6.1
Semiprocessed	47.3	58.7	+ 11.4	+24.1
Fully manufactured	392.8	466.8	+ 74.0	+18.8
Total	509.4	599.0	+ 89.6	+17.6
Nonmetallic minerals and their products (including fuels)				
Raw material	399.6	418.3	+ 18.7	+ 4.7
Semiprocessed	17.7	19.0	+ 1.3	+ 7.3
Fully manufactured	267.2	273.7	+ 6.5	+ 2.4
Total	684.5	711.0	+ 26.5	+ 3.9
Total minerals and their products				
Raw material	516.3	548.1	+ 31.8	+ 6.2
Semiprocessed	86.5	101.8	+ 15.3	+17.7
Fully manufactured	2,616.5	2,922.8	+306.3	+11.7
Total	3,219.3	3,572.7	+353.4	+11.0

Table 14

Value of Exports of Minerals and Their Products from Canada, by Degree of Manufacture and in Relation to Total Export Trade, 1961 and 1962

	1961		1962	
	$ millions	% of Total	$ millions	% of Total
Raw material	819.7	14.2	988.1	16.0
Semiprocessed	935.5	16.3	943.4	15.3
Fully manufactured	480.0	8.3	590.3	9.5
Total, minerals and products	2,235.2	38.8	2,521.8	40.8
Total, all products	5,755.5	100.0	6,178.6	100.0

Table 15

Value of Imports of Minerals and Their Products into Canada, by Degree of Manufacture and in Relation to Total Import Trade, 1961 and 1962

	1961		1962	
	$ millions	% of Total	$ millions	% of Total
Raw material	516.3	9.0	548.1	8.8
Semiprocessed	86.5	1.5	101.8	1.6
Fully manufactured	2,616.5	45.3	2,922.8	46.7
Total, minerals and products	3,219.3	55.8	3,572.7	57.1
Total, all products	5,768.6r	100.0	6,257.8	100.0

r Revised from previously published figure.

Table 16

Value of Exports of Minerals and Their Products from Canada, by Main Groups and Destination, 1962
($ millions)

	Britain	United States	Other Countries	Total
Iron and its products	49.3	456.7	236.1	742.1
Nonferrous metals and their products	301.4	623.3	309.5	1,234.2
Nonmetallic minerals and their products	12.3	445.8	87.4	545.5
Total, minerals and their products	363.0	1,525.8	633.0	2,521.8
Percentage	14.4	60.5	25.1	100.0

Table 17

Value of Imports of Minerals and Their Products into Canada, by Main Groups and Sources, 1962
($ millions)

	Britain	United States	Other Countries	Total
Iron and its products	225.8	1,841.3	195.6	2,262.7
Nonferrous metals and their products	70.6	395.3	133.1	599.0
Nonmetallic minerals and their products	32.5	273.3	405.2	711.0
Total, minerals and their products	328.9	2,509.9	733.9	3,572.7
Percentage	9.2	70.3	20.5	100.0

Table 18

Value of Exports of Raw and Semiprocessed Minerals from Canada, by Commodity and Destination, 1962
($ 000)

Minerals	U.S.A.	Britain	Other E.F.T.A.(a) Countries	E.E.C.(b) Countries	Japan	Other Countries	Total
Iron ore	178,688	14,891	-	12,334	14,610	-	220,523
Primary ferrous metals	43,324	8,069	2	8,434	2,196	1,842	63,867
Aluminum	103,729	81,540	7,327	29,975	5,192	60,380	288,143
Copper	63,262	59,766	20,942	21,274	25,341	11,890	202,475c
Lead	13,708	6,493	-	3,646	773	1,177	25,797
Nickel	173,855	85,669	48,821	6,078	3,421	6,021	323,865
Zinc	33,866	16,816	52	4,134	28	5,662	60,558
Uranium	149,165	16,598	-	206	40	-	166,009
Asbestos	57,449	7,994	5,146	30,771	8,216	26,062	135,638
Fuels	308,227	1	-	-	5,946	57	314,231
All other minerals(d)	85,709	33,337	1,402	8,900	1,708	3,220	134,276
Total	1,210,982	331,174	83,692	125,752	67,471	116,311	1,935,382

(a) Other European Free Trade Area countries: Norway, Sweden, Denmark, Switzerland, Austria, Portugal.
(b) European Economic Community (Common Market) countries: France, West Germany, Italy, Belgium, Luxembourg and The Netherlands. (c) Brass scrap included. (d) Includes salt, which is under 'fully manufactured' in Tables 12, 13, 14 and 15.
Symbol: - Nil.

Table 19

Value of Exports of Raw and Semiprocessed Minerals from Canada, by Commodity and Destination, 1961
($ 000)

Minerals	U.S.A.	Britain	Other E.F.T.A.(a) Countries	E.E.C.(b) Countries	Japan	Other Countries	Total
Iron Ore	96,710	20,227	-	15,468	10,152	9	142,566
Primary ferrous metals	39,267	7,820	265	13,468	18,837	4,479	84,136
Aluminum	64,029	72,586	4,668	30,712	14,838	59,217	246,050
Copper	48,177	69,494	20,726	28,339	12,200	14,763	193,699(c)
Lead	14,598	5,838	50	5,072	1,033	1,003	27,594
Nickel	155,443	103,768	49,932	16,339	2,267	15,278	343,027
Zinc	26,463	17,550	614	6,491	2,508	5,117	58,743
Uranium	173,914	18,256	-	512	40	-	192,722
Asbestos	50,562	9,450	4,736	31,424	11,321	23,848	131,341
Fuels	198,632	1	-	-	6,212	90	204,935
All other minerals(d)	79,089	36,698	1,288	10,925	2,761	2,473	133,234
Total	946,884	361,688	82,279	158,750	82,169	126,277	1,758,047

(a) Other European Free Trade Area countries: Norway, Sweden, Denmark, Switzerland, Austria and Portugal. (b) European Economic Community (Common Market) countries: France, West Germany, Italy, Belgium, Luxembourg, and The Netherlands. (c) Brass scrap included. (d) Includes salt, which is under 'fully manufactured' in Tables 12, 13, 14 and 15.

Symbol: - Nil.

Table 20

Value of Exports of Raw and Semiprocessed Minerals from Canada in Relation to Total Export Trade, 1953-62
($ millions)

	Raw	Semi-processed	Total Minerals*	Exports All Products	Mineral Export as % of Export Trade
1953	235	613	848	4,117	21
1954	241	630	871	3,881	22
1955	352	772	1,124	4,282	26
1956	530	857	1,387	4,790	29
1957	655	854	1,509	4,839	31
1958	676	682r	1,358r	4,791r	28
1959	778	753	1,531	5,022r	30
1960	774	906	1,680	5,264r	32
1961	820	935	1,755	5,755r	30
1962	988	943	1,931	6,179	31

*Salt excluded. r Revised from previously published figure.

Table 21

Value of Imports of Raw and Semiprocessed Minerals into Canada in Relation to Total Import Trade, 1953-62

($ millions)

	Raw	Semi-processed	Total Minerals	Imports All Products	Mineral Imports as % of Import Trade
1953	435	63	498	4,383	11
1954	390	53	443	4,093	11
1955	432	73	505	4,712	11
1956	521	115	636	5,705	11
1957	561	90	651	5,623	12
1958	468	62	530	5,192	10
1959	470	82	552	5,509r	10
1960	500	83	583	5,483r	11
1961	516	86	602	5,769r	10
1962	548	102	650	6,258	10

r Revised from previously published figure.

Table 22

Reported Consumption of Minerals in Canada and Relation To Production, 1962

Mineral	Unit of Measure	Consumption	Production(a)	Consumption as % of Production
Metals				
Aluminum	s.t.	144,616	690,297	20.9
Antimony	lb	1,210,656	1,931,397	62.7
Bismuth	"	37,250	425,102	8.8
Cadmium	"	231,876	2,604,973	8.9
Chromium (chromite)	s.t.	70,342	-	-
Cobalt	lb	383,442	3,481,922	11.0
Copper	s.t.	151,525b	457,385	33.1
Lead	"	45,976c	215,329	21.4
Magnesium	"	3,614	8,816	41.0
Manganese ore	"	85,410	-	-
Mercury	lb	135,291	-	-
Molybdenum (Mo content)	"	1,261,380	817,705	154.3
Nickel	s.t.	5,259	232,242	2.3
Selenium	lb	12,587	487,066	2.6
Silver	oz	15,673,513	30,422,972	51.5
Tellurium	lb	4,306	58,725	7.3
Tin	l.t.	4,507	291	1,548.8
Tungsten (W content)	lb	1,348,111	3,580	-
Zinc	s.t.	65,320c	463,145	14.1

Nonmetals				
Feldspar	s.t.	6,818	9,994	68.2
Fluorspar	"	123,694	na	na
Mica	lb	2,850,000	1,204,034	236.7
Barite	s.t.	11,249	226,600	5.0
Talc etc.	"	37,877	46,161	82.3
Nepheline syenite	"	43,729	254,418	17.2
Phosphate rock	"	1,116,607	-	-
Sodium sulphate	"	210,691	246,672	85.4
Sulphur, elemental	"	523,000	695,098	75.2
Potash (muriate of potash)	"	159,555	na	na
Fuels				
Coal	s.t.	21,888,258	10,284,769	212.8
Natural gas	Mcf	420,029,073	946,702,727	44.4
Petroleum, crude	bbl	308,971,417	244,115,152	126.6

(a)Production for metals, in most cases, means production in all forms. This includes the recoverable metal content of ores, concentrates, matte, etc. exported and the metal content of primary products recoverable at domestic smelters and refineries. Production of nonmetals is producers' shipments. (b)Producers' domestic shipments of refined copper. (c)Consumption of primary refined metal only. (d)Ground talc. (g)Includes soapstone and pyrophyllite. (h)Domestic and imported crude oil. na Not available. - Nil.

Table 23

Apparent Consumption of Minerals in Canada
and its Relation to Production, 1961
(short tons)

Minerals	Unit of Measure	Apparent Consumption*	Production**	Consumption as % of Production
Asbestos	s.t.	51,144	1,215,814	4.2
Quartz (silica)	"	2,703,811	2,085,620	129.6
Gypsum	"	1,239,759	5,332,809	23.2
Salt	"	2,700,000e	3,638,778	74.2
Cement	"	6,686,090	6,878,729	97.2
Lime	"	1,388,991	1,424,459	97.5
Iron ore	l.t.	7,387,343	24,428,282	30.2

*Production plus imports less exports. Consumption of these commodities as reported by consumers is not readily available.
**Producers' shipments.
e Estimate.

Table 24

Domestic Consumption of Principal Refined Base Metals (a) in Relation to Production (b) in Canada, 1953-1962

	Unit of Measure	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962
Copper											
Domestic consumption (c)	s.t.	105,482	102,432	138,559	145,286	118,225	122,893	129,973	117,636	141,807	151,525
Production	"	236,966	253,365	288,997	328,458	323,540	329,239	365,366	417,029	406,359	382,502
% consumption of production		44.5	40.4	47.9	44.2	36.5	37.3	35.6	28.2	34.9	39.6
Zinc											
Domestic consumption (d)	s.t.	50,717	46,735	58,062	61,173	52,713	56,097	64,788	55,803	60,878	65,320
Production	"	250,961	213,775	256,542	255,564	247,316	252,093	255,306	260,968	268,007	280,158
% consumption of production		20.2	21.9	22.6	23.9	21.3	22.3	25.4	21.4	22.7	23.3
Lead											
Domestic consumption	s.t.	67,718	67,947	76,351	75,882	71,583	69,769	65,935	72,087	73,418	77,286
Production	"	165,752	166,005	148,811	147,865	142,935	132,987	135,296	158,510	171,833	152,217
% consumption of production		40.9	40.9	51.3	51.3	50.1	52.5	48.7	45.5	42.7	50.8
Aluminum											
Domestic consumption (g)	s.t.	88,548	80,355	91,522	91,869	77,984	101,886	114,344	120,831	135,575r	144,616
Production	"	548,445	557,897	612,543	620,321	556,715	634,102	593,630	762,012	663,173	690,297
% consumption of production		16.1	14.4	14.9	14.8	14.0	16.1	19.3	15.9	20.4	20.9

(a)Refined metal of primary and secondary origin. (b)Refined metal from all sources, including metal derived from secondary materials at primary refineries. (c)Producer's domestic shipments. (d)Primary refined zinc only. (g)Producers' domestic shipments: primary aluminum to 1958; primary and secondary aluminum for 1959 and thereafter. r Revised from previously published figure.

Table 25

Annual Averages of Prices of Main Minerals*, 1961 and 1962

	Unit of Measure	1961	1962	Cents or Dollars	%
Aluminum ingot, 99.5%	cents/lb	25.458	23.875	-1.583	-6.2
Antimony, New York, boxed	cents/lb	35.335	36.250	+0.915	+2.6
Bismuth	$/lb	2.25	2.25	-	-
Cadmium	cents/lb	167.500	178.056	+10.556	+6.3
Calcium	$/lb	2.05	2.05	-	-
Chromium metal, 98.5%, .05% C	$/lb	1.15-1.17	1.15-1.17	-	-
Cobalt metal, 500 lb lots	$/lb	1.50	1.50	-	-
Cobalt ore, 10% Co, free market, contained Co	cents/lb	60	60	-	-
Copper, U.S. domestic, f.o.b. refinery	cents/lb	29.921	30.600	+0.679	+2.3
Gold, Canadian dollars	$/troy oz	35.46	37.41	+1.95	+5.5
Iron ore, 51.5% Fe, lower lake ports					
Bessemer					
Mesabi	$/l.t.	11.60	10.97	-0.63	-5.4
Old Range	$/l.t.	11.85	11.22	-0.63	-5.3
Non-Bessemer					
Mesabi	$/l.t.	11.45	10.82	-0.63	-5.5
Old Range	$/l.t.	11.70	11.07	-0.63	-5.4
Lead, common, New York	cents/lb	10.871	9.631	-1.240	-11.4
Magnesium, ingot	cents/lb	35.250	35.250	-	-
Mercury	$/flask (76 lb)	197.605	191.208	-6.397	-3.2
Molybdenum metal	$/lb	3.35	3.35	-	-
Molybdenite, 95% MoS_2, contained Mo	$/lb	1.34	1.40	+0.06	+4.5
Nickel, f.o.b. Port Colborne (duty incl.)	cents/lb	77.653	79.895	+2.242	+2.9
Platinum	$/troy oz	82.000	82.000	-	-
Selenium	$/lb	6.40	5.75	-0.65	-10.2
Silver, New York	cents/troy oz	92.449	108.375	+15.926	+17.2
Sulphur, Mexican export price	$/net ton	23.00	23.00	-	-
Tin, straits, New York	cents/lb	113.311	114.652	+1.341	+1.2
Titanium metal, A-1 99.3%, max. 0.15% Fe	$/lb	1.50	1.45	-0.05	-3.3
Titanium ore (ilmenite) 59.5% TiO_2	$/l.t.	23 to 26	23 to 26	-	-
Tungsten metal	$/lb	2.81	2.75	-0.06	-2.1
Zinc, prime western, East St. Louis	cents/lb	11.542	11.625	+0.083	+0.7

*From E & M J Metal and Mineral Markets, in United States currency except for gold which is the Canadian price.

Table 26

Wholesale Price Indexes of Minerals and Mineral Products, Canada, 1952 and 1960-62

(1935-39 = 100)

	1952	1960	1961	1962
Iron and products	219.0	256.2	258.1	256.2
Pig iron	256.7	295.3	295.3	294.6
Rolling-mill products	203.9	251.8	251.7	251.6
Pipe and tubing	244.7	268.3	269.9	271.5
Wire	237.0	294.2	294.2	292.5
Scrap iron and steel	316.8	288.5	313.4	279.0
Tinplate and galvanized sheet	223.4	238.4	238.3	238.3
Nonferrous metals and products				
Total (including gold)	172.9	177.8	181.6	192.1
Total (excluding gold)	na	242.9	246.5	260.8
Antimony	257.3	167.5	191.6	198.8
Copper and products	270.2	291.4	282.9	298.8
Lead and products	336.4	224.0	213.5	208.8
Silver	215.5	228.9	241.6	299.2
Tin	227.1	196.8	229.4	242.8
Zinc and products	375.0	291.1	272.9	262.9
Solder	239.2	200.6	218.6	221.8
Nonmetallic minerals and products	173.9	185.6	185.2	189.1
Clays and clay products	207.0	255.8	245.6	244.6
Pottery	146.8	185.8	196.0	222.1
Coal	176.1	191.9	192.3	197.9
Coal tar	213.7	214.5	235.7	235.7
Coke	226.8	241.6	241.9	257.8
Window glass	200.0	272.7	272.7	276.5
Plate glass	170.7	218.8	218.8	218.8
Petroleum products	162.1	162.2	160.8	162.3
Crude oil	na	187.1	184.4	192.2
Gasoline	138.1	135.8	134.6	132.0
Coal oil	129.2	134.4	134.4	134.4
Asphalt	181.1	199.5	194.5	192.3
Asphalt shingles	na	116.3	116.6	109.8
Sulphur	174.0	201.8	211.6	223.5
Plaster	126.4	138.1	141.2	142.6
Lime	190.4	212.0	212.1	213.1
Cement	154.6	162.6	163.8	165.0
Sand and gravel	142.6	145.2	144.5	149.4
Crushed stone	155.8	171.4	171.2	171.1
Building stone	192.0	208.8	185.4	174.3
Asbestos and products	267.1	302.2	302.2	303.0
General wholesale price index (all products)	226.0	230.9	233.3	240.0

na Not available.

Table 27

General Wholesale Price Index and Main Component Groups, Canada, Selected Years 1941 to 1962

(1935-39 = 100)

	1941	1948	1952	1954	1956	1958	1960	1962
General wholesale price index	116.4	193.4	226.0	217.0	225.6	227.8	230.9	240.0
Mineral products								
Iron and products	112.8	161.4	219.0	213.4	239.8	252.6	256.2	256.2
Nonferrous metals and products (including gold)	107.2	146.9	172.9	167.5	199.2	167.3	177.8	192.1
Nonmetallic minerals and products	111.1	150.8	173.9	177.0	180.8	188.5	185.6	189.1
Other products								
Vegetable	106.1	185.7	210.3	196.8	197.3	198.1	203.0	211.6
Animal	123.8	236.7	248.2	236.0	227.7	250.7	247.6	262.5
Textile	128.4	216.3	251.5	231.1	230.2	229.0	229.8	241.2
Wood products	127.0	238.3	291.0	286.8	303.7	298.5	303.8	315.8
Chemical	118.6	152.2	180.1	176.4	180.1	183.0	188.2	190.5

Table 28

Principal Statistics of the Mineral Industry by Sectors, in Canada, 1961 *

	Establish-ment	Employees	Salaries and Wages	Cost of Fuel and Electricity	Cost of Process Supplies	Value of Gross	Production Net(a)
			$ 000	$ 000	$ 000	$ 000	$ 000
Metallics							
Placer Gold	47	243	1,326	108	48	2,466	2,255
Gold quartz	140	15,876	65,465	7,360	19,396	135,034	106,879
Copper-gold-silver	276	10,901	51,459	5,932	39,709	175,463	84,048
Silver-cobalt	20	560	2,217	296	375	4,516	3,424
Silver-lead-zinc	73	4,352	22,099	2,447	6,629	111,172	61,422
Nickel-copper	50	13,697	74,755	4,636	17,877	134,732	109,350
Iron	55	8,049	47,108	8,332	21,644	186,333	124,589
Other	43	5,919	34,332	5,857	22,984	201,214	170,664
Total	704	59,597	298,761	34,968	128,662	950,930	662,631
Industrial Minerals							
Asbestos	23	6,875	35,093	6,666	10,241	133,407	112,095
Feldspar, quartz and nepheline syenite	23	339	1,313	224	265	4,795	3,820
Gypsum	9	613	2,272	313	1,451	6,597	4,834
Salt	9	912	3,950	1,154	974	19,568	15,390
Sand and gravel	493	2,513	9,899	3,110	535	39,438	35,721
Stone	228	3,395	12,623	3,029	4,115	44,709	37,129
Clay products	99	3,526	13,401	5,611	4,734	34,527	24,182
Cement	20	3,038	16,113	16,262	14,359	107,044	76,423
Lime	21	825	3,570	2,239	1,785	12,979	8,955
Other	111	2,543	8,534	2,123	1,489	21,874	15,588
Total	1,036	24,579	106,768	40,731	39,948	424,938	334,137
Fuels							
Coal	113	10,461	35,608	4,063	11,476	72,210	58,068
Petroleum and natural gas(b)	630	4,901	28,125	8,030	35,350	639,587	583,713
Total	743	15,362	63,733	12,093	46,826	711,797	641,781
Total, mining industry	2,483	99,538	469,262	87,792	215,436	2,087,665	1,638,549
Nonferrous smelting and refining	25	29,290	155,948	48,085	88,698c	1,462,457	521,002

(a) Net value equals the gross value of production less the cost of process supplies, fuel and electricity, freight and smelter charges.

(b) Includes natural gas processing.

(c) Due to changes in statistical classification, some process supplies formerly reported as purchased are not now included. This has reduced "Cost of Process Supplies" in 1961.

*Subject to revision.

Table 29

Principal Statistics(a) of Mining Industry(b)
in Canada, 1952-61

	Establish-ments	Employees	Salaries and Wages	Cost of Fuel and Electricity	Cost of Process Supplies	Value of Gross	Production Net(c)
			$ 000	$ 000	$ 000	$ 000	$ 000
1952	19,939	109,508	365,012	54,418	110,027	1,085,831	845,733
1953	20,490	104,923	358,520	58,504	110,257	1,111,401	871,340
1954	21,882	103,397	362,710	60,686	115,483	1,239,726	987,861
1955	24,091	105,030	384,406	66,228	124,844	1,456,825	1,156,309
1956	26,914	111,772	435,908	79,195	139,893	1,672,830	1,326,719
1957	29,430	116,256	476,397	88,886	167,145	1,807,562	1,386,948
1958	29,546	112,581	479,418	91,132	177,944	1,823,432	1,438,748
1959	31,587	112,901	497,283	92,599	188,357	2,051,018	1,631,522
1960	3,871	105,605	488,478	91,565	219,420	2,020,455	1,579,982
1961*	2,483	99,538	469,262	87,792	215,436	2,087,665	1,638,549

(a)Commencing in 1960 certain changes in the industrial classification were made by the Dominion Bureau of Statistics. The definition of establishments was changed to include only those establishments considered separate accounting units, capable of reporting employment, salaries, and wages, etc. on a unit basis. This substantially reduced the number of establishments in comparison with previous years. Also some companies formerly included in the mining industry were transferred to other industries (manufacturing, construction, etc.) if their main revenue-producing activity was not mining.

(b)Does not include the nonferrous-smelting and refining industries.

(c)Net value equals the gross value of production less the cost of process supplies, fuel and electricity, freight and smelter charges.

* Subject to revision.

Table 30

Consumption of Fuels and Electricity in Canadian Mineral Industry, 1961 **

	Unit	Metal Mining	Nonferrous Smelting and Refining	Total	Production of Industrial Minerals	Production of Crude Mineral Fuels	Total, Mineral Industry
Coal and coke	s.t.	142,511	1,274,984	1,417,495	878,866	49,836	2,346,197
	$	2,093,638	18,411,372	20,505,010	9,626,408	355,598	30,487,016
Gasoline and kerosene	gal	3,079,138	866,887	3,946,025	9,054,829	6,870,995	19,871,849
	$	1,106,639	244,317	1,350,956	3,082,139	2,662,592	7,095,687
Fuel oil	gal	52,593,364	61,277,202	113,870,566	74,832,198	3,019,299	191,722,063
	$	8,512,547	5,264,939	13,777,486	8,471,310	593,358	22,842,154
Liquefied petroleum gas	gal	279,284	185,030	464,314	231,794	1,571,914	2,268,022
	$	74,344	43,696	118,040	60,425	131,157	309,622
Manufactured gas	Mcf	3,248	-	3,248	9,000	-	12,248
	$	1,640	-	1,640	8,292	-	9,932
Natural gas	Mcf	1,493,884	10,455,801	11,949,685	23,209,420	11,844,402	47,003,507
	$	302,775	3,171,362	3,474,137	6,831,126	1,289,884	11,595,147
Other fuels	$	727,838	65,936	793,774	265,702	97,612	1,157,088
Total fuels	$	12,819,421	27,201,622	40,021,043	28,345,402	5,130,201	73,496,646
Electricity purchased	million kwh	3,270	5,182*	8,452	1,461	357	10,270
	$	22,148,435	20,883,846*	43,032,281	12,386,362	6,962,461	62,381,104
Total value, fuels and electricity purchased	$	34,967,856	48,085,468	83,053,324	40,731,764	12,092,662	135,877,750
Electricity generated by industry for own use	million kwh	515	14,572	15,087	32	37	15,156

*Due to changes in statistical classification, some electricity formerly reported as purchased is from 1961, reported as generated for own use.

**Subject to revision.

Symbol: - Nil.

Table 31

Cost of Fuel and Electricity Used in Canadian Mining Industry (a), 1952-61

	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961 (c)
Fuel (b)										
$ Millions	33.1	35.2	37.0	39.9	47.0	53.1	53.1	53.1	48.8	46.3
Electricity Purchased										
Millions kwh	3,026.4	3,091.7	3,243.3	3,540.2	4,213.5	4,585.9	6,292.9	5,163.7	5,193.9	5,088.0
$ Millions	21.3	23.3	23.7	26.5	32.2	35.8	38.1	39.5	42.8	41.5
Total Cost of Fuel and Electricity										
$ Millions	54.4	58.5	60.7	66.4	79.2	88.9	91.2	92.6	91.6	87.8
Electricity Generated for Own Use										
Millions kwh	248.8	240.3	426.2	486.9	557.7	590.0	526.7	550.9	575.4	584.0
Electricity Generated for Sale										
Millions kwh	21.0	8.5	18.8	47.1	12.0	14.2	15.8	17.0	32.9	29.0

(a) Excludes nonferrous smelting and refining.
(b) Coal, coke, fuel oil, gasoline, gas, wood, etc.
(c) Subject to revision.

Table 32

Cost of Fuel and Electricity Used in Nonferrous Smelting and Refining, 1952-61

	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961(c)
Fuel (a)										
$ Millions	23.9	23.0	24.8	24.3	29.9	27.3	23.4	26.3	26.9	27.2
Electricity Puchased										
Millions kwh	11,176.8	12,296.9	12,690.2	13,803.7	13,981.4	13,668.2	15,081.2	14,574.6	18,224.7	5,182.1
$ Millions	26.7	29.6	30.4	32.6	35.0	32.2	40.1	36.0	36.3	20.9
Total Cost of Fuel and Electricity										
$ Millions	50.6	52.6	55.2	56.9	64.9	59.5	63.5	62.3	63.2	48.1
Electricity Generated for Own Use										
Millions kwh	639.5	796.2	753.9	1,131.9	1,121.4	1,036.6	1,038.5	1,060.0	1,146.5	14,572.3 (b)
Electricity Generated for Sale										
Millions kwh	7.3	4.3	13.4	9.2	12.2	-	33.2	30.7	33.0	35.7

(a) Coal, coke, fuel oil, gasoline, gas, wood, etc.
(b) Revisions in statistical classification account for decrease in electricity purchased and corresponding increase in electricity generated for own use.
(c) Subject to revision.

Table 33

Employment, Salaries and Wages in Canadian Mineral Industry, by Sectors, at Five-Year Intervals, 1941-61

	1941		1946		1951		1956		1961	
	Employees	$ Millions	Employees	$ Millions	Employees	$ Millions	Employees	$ Millions	Employees	$ Millions
Metal mining	48,277	93.3	35,445	77.5	52,271	170.9	57,564	243.0	59,597	298.8
Nonferrous smelting and refining	16,014	27.5	14,546	30.6	22,814	75.5	30,788	130.1	29,290	155.9
Industrial minerals	18,601	21.4	20,500	31.5	25,296	69.7	30,021	107.1	24,579	106.8
Fuels*	30,335	44.2	28,705	57.1	28,490	81.1	24,187	85.8	15,362	63.7
Total	113,227	186.4	99,196	196.7	128,871	397.2	142,560	566.0	128,828	625.2
Annual average of salaries and wages	$1,646		$1,983		$3,082		$3,970		$4,853	

*Coal, crude petroleum, and natural gas (including natural gas processing in 1961).

Table 34

Numbers of Wage Earners - Surface, Underground, and Mill - in Canadian Mining Industry [(a)], by Sectors, 1952-61

	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961[(c)]
Metallics [(b)]										
Surface	15,689	13,959	14,098	15,540	16,706	18,532	16,602	16,697	16,039	15,815
Underground	28,941	27,580	26,821	26,522	27,679	29,382	29,712	31,384	30,774	28,975
Mill	4,643	4,320	4,761	4,664	5,624	6,168	6,541	6,573	6,162	6,047
Total	49,273	45,859	45,680	46,726	50,009	54,082	52,855	54,654	52,975	50,837
Industrial Minerals										
Surface	11,882	11,574	11,826	12,204	12,804	14,347	14,029	13,988	10,321	9,485
Underground	1,794	1,718	1,659	1,632	1,798	1,749	1,458	1,327	1,164	995
Mill	10,079	10,658	10,825	11,445	12,163	11,573	11,216	11,639	10,741	11,111
Total	23,755	23,950	24,310	25,281	26,765	27,669	26,703	26,954	22,226	21,591
Fuels										
Surface	9,990	9,838	9,082	8,886	9,622	8,683	7,887	7,537	6,715	5,229
Underground	14,897	13,587	12,422	11,439	11,065	10,043	9,247	8,022	8,257	7,996
Mill	-	-	-	-	-	-	-	-	-	-
Total	24,887	23,425	21,504	20,325	20,687	18,726	17,134	15,559	14,972	13,225
Total										
Surface	37,561	35,371	35,006	36,630	39,132	41,562	38,518	38,222	33,075	30,529
Underground	45,632	42,885	40,902	39,593	40,542	41,174	40,417	40,733	40,195	37,966
Mill	14,722	14,978	15,586	16,109	17,787	17,741	17,757	18,212	16,903	17,158
Total	97,915	93,234	91,494	92,332	97,461	100,477	96,692	97,167	90,173	85,653

(a) Does not include nonferrous smelting and refining.
(b) Includes placer operations.
(c) Subject to revision.
Symbol: - Nil.

Table 35

Labor Costs in Relation to Tons Mined from Metal Mines[a] in Canada 1941, 1951 and 1961

Types of Mines	Number of Wage Earners	Total of Wages	Average Annual Wage	Tons Mined	Average Annual Tons Mined per Worker	Wage Cost per Ton Mined
1961 [d]		$ Millions	$	'000 s.t.	s.t.	$
Auriferous quartz	14,033	54.9	3,912	14,262	1,016	3.85
Copper-gold-silver	9,210	42.3	4,592	15,009	1,630	2.82
Nickel-copper	12,223	64.0	5,236	21,640	1,770	2.96
Silver-cobalt[b]	481	1.8	3,742	234	486	7.69
Silver-lead-zinc	3,618	17.7	4,892	5,872	1,623	3.01
Iron ore	6,113	34.1	5,578	32,713	5,351	1.04
Miscellaneous metal mines	4,940	28.4	5,749	9,602	1,944	2.96
Total	50,618	243.2	4,805	99,332	1,962	2.45
1951						
Auriferous quartz	19,155	57.7	3,012	16,548	864	3.49
Copper-gold-silver	5,384	18.1	3,362	7,381	1,371	2.45
Nickel-copper	9,097	31.3	3,441	12,885	1,416	2.43
Silver-cobalt[b]	446	1.2	2,691	129	289	9.30
Silver-lead-zinc	8,104	25.6	3,159	6,318	780	4.05
Miscellaneous metal mines[c]	3,561	11.0	3,089	5,139	1,443	2.14
Total	45,747	144.9	3,167	48,400	1,058	3.00
1941						
Auriferous quartz	29,820	54.7	1,834	20,032	672	2.73
Copper-gold-silver	5,336	9.3	1,743	9,263	1,736	1.00
Nickel-copper	6,160	12.7	2,062	9,974	1,619	1.27
Silver-cobalt[b]	157	0.2	1,274	12	76	16.67
Silver-lead-zinc	1,427	2.9	2,032	2,817	1,974	1.03
Miscellaneous metal mines[c]	647	1.0	1,546	884	1,366	1.13
Total	43,547	80.8	1,855	42,982	987	1.88

(a) Excludes placer-mining operations.
(b) In silver-cobalt-mining operations considerable tonnages of old tailings were used. These tonnages are not included in this table.
(c) Includes iron-ore mines.
(d) Subject to revision.

Table 36

Man-hours Worked and Tons of Ore Mined and Rock Quarried - Metal Mines and Industrial Mineral Operations 1952-61

	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961(d)
Metal Mines[a]										
Ore Mined (millions s.t.)	52.3	54.4	59.0	69.2	77.4	84.3	78.8	99.0	101.6	99.3
Man-hours Worked[c] (millions)	124.7	112.6	111.8	116.6	126.4	135.7	133.6	133.3	130.5	124.9
Man-hours per Ton Mined (no.)	2.38	2.07	1.89	1.68	1.63	1.61	1.70	1.35	1.28	1.26
Industrial Mineral Operations[b]										
Ore Mined and Rock Quarried (millions s.t.)	37.4	39.6	53.6	55.0	62.9	70.0	66.5	78.4	86.0	94.6
Man-hours Worked[c] (millions)	30.4	29.6	30.0	31.7	32.7	32.2	29.3	29.3	27.4	26.9
Man-hours per Ton Mined (no.)	0.81	0.75	0.56	0.58	0.52	0.46	0.44	0.37	0.32	0.28

(a) Revised to exclude placer mining.
(b) Revised to exclude: salt, cement, clay products, stone produced for cement manufacture and stone produced for lime manufacture.
(c) Includes man-hours worked by all employees, surface, underground, mill and administration.
(d) Subject to revision.

Table 37

Basic Wage Rates per Hour in Canadian Metal-Mining Industry
on October 1, 1961

Occupation	Gold Mining	Iron Mining	Other Metal Mining
	$	$	$
Underground Workers			
Cage and skiptenders	1.52	na	2.21
Chute blaster	1.46	na	2.25
Deckman	1.44	na	1.99
Hoistman	1.63	2.52	2.33
Laborer	1.40	1.97	2.06
Miner	1.50	2.69	2.18
Miner's helper	1.40	na	1.77
Motorman	1.46	na	2.13
Mucking machine operator	1.42	2.50	2.15
Mucker and trammer	1.39	na	2.14
Timberman	1.51	na	2.26
Trackman	1.47	na	2.17
Open-pit Workers			
Blaster	na	2.31	na
Bulldozer operator	na	2.34	na
Driller machine	na	2.37	na
Oiler	na	2.19	na
Shovel operator	na	2.74	na
Surface and Mill Workers			
Carpenter, maintenance	1.62	2.59	2.20
Crusherman	1.46	2.25	2.14
Electrician	1.67	2.71	2.44
Laborer	1.32	1.84	1.78
Machinist, maintenance	1.67	2.75	2.40
Mechanic, maintenance	1.61	2.54	2.32
Millman	1.51*	2.62	na
Pipefitter, maintenance	1.56	2.57	2.24
Steel sharpener	1.52	na	2.22
Tradesman's helper	1.45	2.20	2.01
Truck driver, heavy truck	1.58	na	2.04
Truck driver, light truck	1.40	na	1.90
Welder, maintenance	na	2.60	2.38
Blacksmith	na	na	2.32
Solution man	na	na	2.22
Filter operator	na	na	2.19
Flotation operator	na	na	2.04
Grinding-mill operator	na	na	2.09

*Includes filter operator, grinding-mill operator, (ball-mill operator, rod-mill operator, tubeman) and solution man.

na Not available.

Table 38

Average of Weekly Wages and Hours of Hourly-Rated Employees in Canadian Mining, Manufacturing and Construction Industries, 1956-62

	1956	1957	1958	1959	1960	1961	1962
Mining							
Average hours per week	42.8	42.3	41.5	41.5	41.7	41.8	41.7
Average weekly wage	$73.92	$79.35	$81.30	$84.80	$87.26	$89.08	$91.22
Metals							
Average hours per week	43.0	42.9	41.8	41.7	41.9	42.2	41.9
Average weekly wage	$77.27	$83.70	$84.77	$88.73	$90.89	$92.83	$94.43
Fuels							
Average hours per week	42.0	40.8	40.0	39.9	40.6	40.3	40.7
Average weekly wage	$69.01	$72.91	$75.12	$77.11	$80.13	$80.98	$85.63
Nonmetals							
Average hours per week	43.1	42.5	42.3	42.2	42.2	42.3	42.4
Average weekly wage	$68.79	$71.57	$73.73	$76.87	$79.62	$82.60	$83.82
Manufacturing							
Average hours per week	41.0	40.4	40.2	40.7	40.4	40.6	40.7
Average weekly wage	$62.40	$64.96	$66.77	$70.16	$71.96	$74.27	$76.55
Construction							
Average hours per week	41.1	41.2	40.7	40.2	40.4	40.3	40.3
Average weekly wage	$67.77	$72.55	$72.36	$74.20	$78.36	$79.93	$83.16

Table 39

Average of Weekly Wages of Hourly-Rated Employees in Canadian Mining Industry in Current and 1949 Dollars, 1956-62

	1956	1957	1958	1959	1960	1961	1962
Current dollars							
All mining	73.92	79.35	81.30	84.80	87.26	89.08	91.22
Metals	77.27	83.70	84.77	88.73	90.89	92.83	94.43
Gold	65.77	67.48	68.09	68.95	70.81	73.34	75.76
Other	82.26	90.13	91.59	95.92	98.52	100.22	101.25
Fuels	69.01	72.91	75.12	77.11	80.13	80.98	85.63
Coal	61.04	63.51	67.43	67.00	69.36	70.36	73.82
Oil and natural gas	85.11	90.13	89.20	92.74	96.57	95.66	102.35
Nonmetallics	68.79	71.57	73.73	76.87	79.62	82.60	83.82
1949 dollars							
All mining	62.59	65.09	64.99	67.04	68.17	68.95	69.79
Metals	65.43	68.66	67.76	70.14	71.01	71.85	72.25
Gold	55.69	55.36	54.43	54.51	55.32	56.76	57.96
Other	69.65	73.94	73.21	75.83	76.97	77.57	77.47
Fuels	58.43	59.81	60.05	60.96	62.60	62.68	65.52
Coal	51.69	52.10	53.90	52.96	54.20	54.46	56.48
Oil and natural gas	72.07	73.94	71.30	73.31	75.45	74.04	78.31
Nonmetallics	58.25	58.71	58.94	60.77	62.20	63.93	64.13

Table 40

Industrial Fatalities in Canada per Thousand Paid Workers in Main Industry Groups, 1953-62

	1953	1954	1955	1956	1957	1958	1959	1960	1961**	1962
Agriculture	1.00	0.82	0.83	1.03	0.95	1.00	0.92	0.62	0.61	0.57
Logging (forestry)	2.70	2.50	2.00	1.90	1.50	1.70	1.70	1.50	1.32r	1.85
Fishing and trapping	3.30	3.10	3.20	1.80	2.30	3.80	7.20	2.70	5.71r	1.20
Mining*	2.00	2.00	1.60	2.10	1.50	2.20	2.00	1.92	1.75r	1.85
Manufacturing	0.18	0.16	0.16	0.14	0.14	0.11	0.13	0.19	0.12	0.13
Construction	0.77	0.86	0.79	0.89	0.91	0.77	0.79	0.56	0.71r	0.54
Public utilities	0.60	0.43	0.67	0.44	0.57	0.39	0.44	0.49	0.47r	0.55
Transportation, storage and communications	0.46	0.53	0.56	0.56	0.50	0.40	0.44	0.37	0.38	0.37
Trade	0.09	0.08	0.07	0.08	0.09	0.05	0.06	0.06	0.07r	0.07
Finance	0.02	0.01	0.03	0.05	0.01	0.02	0.01	0.09	0.05	0.04
Service	0.09	0.08	0.07	0.06	0.07	0.07	0.06	0.07	0.06	0.06
All industry	0.33	0.32	0.32	0.33	0.30	0.27	0.28	0.21	0.21	0.21

*Includes quarrying and oil-well drilling.
**Subject to revision.
r Revised from previously published figure.

Table 41

Cost of Prospecting by Metal-Mining Industry in Canada, by Provinces and Types of Operations, 1960 and 1961

$

	Placer Gold Operations	Gold Mines	Copper-Gold-Silver Mines	Silver-Cobalt Mines	Silver-Lead-Zinc Mines	Nickel-Copper Mines	Miscellaneous Metal Mines*	Total
1960								
Newfoundland	-	28,092	385,623	-	354,094	-	686,499	1,454,308
Nova Scotia	16,686	91,703	186,350	-	17,057	-	2,587	314,383
New Brunswick	-	286,612	809,925	-	669,595	-	9,327	1,775,459
Quebec	-	1,525,247	7,696,468	-	3,068,141	590,134	2,103,458	14,983,448
Ontario	42,440	914,549	3,763,158	26,805	99,036	2,832,077	1,705,987	9,384,052
Manitoba	-	248,231	2,649,070	-	11,691	5,171,145	27,655	8,107,792
Saskatchewan	-	2,364	575,099	-	20,323	462,622	18,061	1,078,469
Alberta	31,865	-	904	-	64,643	-	630	98,042
British Columbia	5,319	228,824	2,508,003	-	845,280	2,465	230,801	3,820,692
Northwest Territories	-	481,939	226,046	-	371,537	352,938	657,680	2,090,140
Yukon Territory	22,495	6,980	304,612	-	81,150	-	31,588	446,825
Total, Canada	118,805	3,814,541	19,105,258	26,805	5,602,547	9,411,381	5,474,273	43,553,610
1961**								
Newfoundland	-	7,794	588,297	-	476,305	-	484,443	1,556,839
Nova Scotia	-	12,997	184,268	-	48,404	-	28,119	273,788
New Brunswick	-	55,595	490,739	1,307	125,817	-	261,738	935,196
Quebec	52,134	1,300,112	7,450,734	12,016	5,101,504	1,771,332	3,135,387	18,823,219
Ontario	-	1,164,454	3,002,677	77,743	107,419	2,544,031	800,749	7,697,073
Manitoba	-	615,129	2,611,871	4,886	20,000	3,812,959	44,254	7,109,099
Saskatchewan	-	71,754	859,520	-	8,920	329,047	44,150	1,313,391
Alberta	3,209	-	892	-	10,655	-	10,000	24,756
British Columbia	11,771	263,003	2,666,130	6	696,468	4,650	352,319	3,994,347
Northwest Territories	-	162,483	248,158	-	294,337	365,527	213,601	1,284,106
Yukon Territory	32,370	10,099	263,862	-	161,926	-	5,000	473,257
Total, Canada	99,484	3,663,420	18,367,148	95,958	7,051,755	8,827,546	5,379,760	43,485,071

*Includes iron, uranium, and molybdenum mining, etc.

**Subject to revision.

Note: The amounts shown are the expenditures incurred by mining companies, as classified by their main type of metal-mining activity. These expenditures, however, apply to prospecting conducted by such companies in all sectors of the mineral industry. If, for example, a company whose chief activity is gold-quartz mining expends funds on prospecting for lead and zinc, such expenditures are included in the column headed "Gold Mines" in this table.

Symbol: - Nil.

Table 42
Cost of Prospecting by Metal-Mining Industry in Canada, by Types of Operations, 1952-61

$

	Placer Gold Operations	Gold Mines	Copper-Gold-Silver Mines	Silver-Cobalt Mines	Silver-Lead-Zinc Mines	Nickel-Copper Mines	Miscellaneous Metal Mines*	Total
1952	11,805	2,566,981	1,740,207	105,902	2,268,355	5,124,466	1,760,458	13,578,174
1953	33,007	2,573,466	2,514,501	63,985	3,593,678	6,742,918	2,311,203	17,832,758
1954	35,240	3,399,755	3,188,890	24,733	6,843,897	6,785,804	6,536,916	26,815,235
1955	24,804	1,470,643	7,147,498	86,524	3,192,248	8,344,186	6,662,638	26,928,541
1956	31,620	4,264,955	18,315,885	111,102	3,571,201	13,310,337	8,795,159	48,400,259
1957	75,468	3,370,252	17,545,591	9,065	2,781,917	12,220,660	18,421,466	54,424,419
1958	91,461	2,246,360	10,239,495	10,396	1,351,065	13,894,699	4,673,610	32,507,086
1959	65,139	3,649,286	22,226,933	87,883	1,559,613	8,512,264	6,916,517	43,017,635
1960	118,805	3,814,541	19,105,258	26,805	5,602,547	9,411,381	5,474,273	43,553,610
1961**	99,484	3,663,420	18,367,148	95,958	7,051,755	8,827,546	5,379,760	43,485,071

*Includes iron, uranium, and molybdenum mining, etc.
**Subject to revision.
Note: See the general footnote for Table 41.

Table 43

Contract Diamond-Drilling Operations* in Canada, 1952-61

	Footage Drilled	Income from Drilling	Average Number of Employees	Total of Salaries and Wages
		$ Millions		$ Millions
1952	5,180,783	14.7	2,345	7.1
1953	5,258,870	15.8	2,238	7.1
1954	5,639,574	15.9	2,352	7.8
1955	6,443,641	21.4	2,840	9.9
1956	7,840,670	27.6	3,415	12.6
1957	6,296,128	21.2	2,951	10.8
1958	4,426,594	14.4	1,717	6.9
1959	5,435,971	17.9	1,902	8.0
1960	5,521,211	17.1	1,912	8.0
1961 **	5,290,813	16.2	2,025	7.8

*Drilling operations conducted by contractors who employed diamond drills only, which were used chiefly in testing metalliferous deposits.

**Subject to revision.

Table 44

Contract Drilling* in Canada for Oil and Gas, 1952-61

	Footage Drilled				Gross Income from Drilling	Average Number of Employees	Total Salaries and Wages
	Rotary	Cable	Diamond	Total			
					$ Millions		$ Millions
1952	8,102,599	351,670	-	8,454,269	61.2	4,679	18.1
1953	10,139,151	625,891	-	10,765,042	59.7	4,903	19.8
1954	9,609,140	457,480	-	10,066,620	58.8	4,559	18.1
1955	12,711,953	344,053	-	13,056,006	68.3	4,901	22.3
1956	15,424,310	376,663	-	15,800,973	93.3	5,793	28.8
1957	12,126,069	369,277	-	12,495,346	75.6	5,468	25.7
1958	12,998,094	446,451	-	13,444,545	69.3	5,261	24.1
1959	13,020,214	317,719	7,567	13,345,500	63.8	4,734	21.4
1960	13,538,783	231,748	-	13,770,531	75.2	4,860	23.2
1961**	12,616,950	170,098	-	12,787,048	68.6	4,144	21.7

*Drilling done by contract-drilling companies only. Drilling by oil companies with their own equipment is not included.
**Subject to revision.

Table 45

Ore Mined and Rock Quarried
in Canadian Mining Industry, 1959-61

(millions of short tons)

	1959	1960	1961
Metallic ores			
Gold quartz	14.3	14.7	14.3
Copper-gold-silver	12.4	14.0	15.0
Silver-cobalt	0.2	0.2	0.2
Silver-lead-zinc	5.7	5.8	5.9
Nickel-copper	19.0	20.8	21.6
Iron	32.4	33.0	32.7
Miscellaneous	15.1	13.1	9.6
Total	99.1	101.6	99.3
Nonmetallics			
Asbestos	23.1	33.2	38.4
Feldspar and nepheline syenite	0.4	0.3	0.3
Quartz	1.0	1.3	0.9
Gypsum and anhydrite	6.0	5.1	5.1
Other*	2.7	2.1	2.3
Total	33.2	42.0	47.0
Structural materials			
Stone, all kinds**	46.4	45.3	48.9
Stone for manufacture of cement	8.0	7.8	8.2
Stone for manufacture of lime	3.1	2.7	2.6
Total	57.5	55.8	59.7
Total, ore mined and rock quarried	189.8	199.4	206.0

*Includes talc, salt, barite, fluorspar, mica mining, etc.
**Exclusive of stone for the manufacture of cement and lime.

Table 46

Ore Mined and Rock Quarried in Canadian Mining Industry,
at Five-Year Intervals, 1930-61

(millions of short tons)

	Metal Mines	Industrial-mineral Operations	Total
1930	14.8	20.1	34.9
1935	20.4	9.6	30.0
1940	39.3	20.2	59.5
1945	31.3	20.7	52.0
1950	45.9	41.8	87.7
1955	69.2	63.5	132.7
1960	101.6	97.8	199.4
1961	99.3	106.7	206.0

Table 47

Crude Minerals* Transported by Canadian Railways, 1961 and 1962
(millions of short tons)

	1961	1962
Coal		
Anthracite	1.1	1.0
Bituminous	10.5	10.2
Petroleum, crude	0.5	0.6
Copper ore and concentrates	0.7	0.8
Iron ore and concentrates	16.9	24.2
Copper-nickel ore and concentrates	3.9	2.9
Aluminum ore and concentrates	2.2	1.8
All other ores and concentrates	3.2	3.3
Sand and gravel	5.8	6.3
Stone and rock	5.5	5.3
Asbestos	1.1	1.1
Gypsum, crude	4.0	4.5
Salt	1.3	1.6
All other crude minerals (chiefly industrial)	2.9	2.9
Total	59.6	66.5
All revenue freight moved by Canadian railways	153.1	160.9
Crude minerals as percentage of revenue-freight total	38.9	41.3

*Both domestic and imported. Crude mineral shipments applies to revenue-producing freight loaded on Canadian railways and also received at U.S.A. connections in a given year; it constitutes a type of information similar to 'freight-car loadings'.

Table 48

Crude Minerals* Transported by Canadian Railways, 1953-62
(millions of short tons)

	Total of Revenue Freight	Total of Crude Minerals	Crude Minerals as % of Revenue Freight
1953	156.2	49.3	31.5
1954	143.1	49.6	34.6
1955	167.8	67.5	40.2
1956	189.6	75.7	39.9
1957	174.0	70.8	40.6
1958	153.4	57.8	37.6
1959	166.0	69.2	41.7
1960	157.4	62.9	39.9
1961	153.1	59.6	38.9
1962	160.9	66.5	41.3

*Both domestic and imported. Crude mineral shipments applies to revenue-producing freight loaded on Canadian railways and also received at U.S.A. connections in a given year; it constitutes a type of information similar to 'freight-car loadings'.

Table 49

Primary Mineral Products* Transported by
Canadian Railways, 1961 and 1962
(millions of short tons)

	1961	1962
Aluminum bar, ingot, pig and slab	0.37	0.46
Copper, ingot and pig	0.53	0.51
Lead and zinc, bar, ingot, and pig	0.44	0.47
Iron, pig	0.16	0.19
Iron and steel, billet, bloom, and ingot	0.26	0.32
Coke	1.57	1.36
Asphalt	0.33	0.33
Total, primary mineral products	3.66	3.64
Total, all revenue freight	153.1	160.9
Primary mineral products as a percentage of all freight transported	2.4	2.3

*Both domestic and imported.

Table 50

Crude Minerals* Transported through Canadian Canals* 1961 and 1962
(millions of cargo tons of 2000 pounds)

	1961	1962
Coal, bituminous	5.5	6.1
Petroleum, crude	0.2	0.2
Iron ore	10.8	16.3
Other metallic ores and concentrates	0.2	0.2
Clay and bentonite	0.1	0.2
Sand, gravel and crushed stone	1.3	1.3
Salt	0.4	0.5
Sulphur	0.2	0.1
Other crude materials, inedible	0.7	0.8
Total	19.4	25.7
Total freight traffic through Canadian canals	57.2	63.6
Crude minerals as percentage of total freight traffic	33.9	40.4

*Canals and inland waterways include: St. Lawrence, Welland, Sault Ste. Marie, St. Peter's, Canso, Richelieu River, Ottawa River, Rideau, Murray, Trent, and St. Andrews.

Table 51

Quantities* of Petroleum, Petroleum Products, and Gas (Manufactured and Natural) Transported by Pipeline in Canada, 1953-62

	Petroleum and Petroleum Products		Gas
	Millions of bbl	Millions of s.t.	'000 Mcf
1953	147.3	21.8	84,500e
1954	172.5	25.5	102,500e
1955	224.3	33.2	136,738
1956	274.9	40.7	163,764
1957	290.8	43.1	184,738
1958	274.8	40.7	211,751
1959	308.5	45.7	283,808
1960	316.0	46.8	326,212
1961	353.4	52.4	379,044
1962	385.6	57.2	421,631

*Both domestic and imported.
e Estimate.

Table 52

Taxes* Paid by Five Important Divisions of Canadian Mineral Industry, 1956-61 ($ millions)

	1956	1957	1958	1959	1960	1961
Auriferous-quartz mining	6.2	5.9	6.1	7.0	6.5	7.0
Copper-gold-silver mining	26.1	19.2	8.5	13.0	19.7	20.1
Silver-lead-zinc mining and smelting	20.8	12.7	10.8	12.2	15.3	15.7
Nickel-copper mining, smelting and refining	48.9	46.6	22.4	12.1	41.0	38.2
Absestos mining	11.7	12.1	11.4	12.1	14.2	16.8
Total	113.7	96.5	59.2	56.4	96.7	97.8

*As the amounts reported pertain only to the payments actually made within the calendar year specified, these tax payments do not necessarily reflect the tax assessments of a calendar year. Included are taxes on nonoperating revenue.

Table 53

Taxes* Paid to Federal, Provincial and Municipal Governments in Canada
by Five Important Divisions of Mineral Industry, 1961
$

	Federal Income Tax	Provincial Tax	Municipal Tax	Total
Auriferous-quarts mining	3,644,092	2,507,930	852,038	7,004,060
Copper-gold-silver mining	11,313,497	6,896,685	1,876,876	20,087,058
Silver-lead-zinc mining and smelting	12,008,687	2,444,861	1,276,905	15,730,453
Nickel-copper mining, smelting and refining	22,691,226	13,508,237	1,972,620	38,172,083
Asbestos mining	10,251,265	5,169,083	1,425,782	16,846,130
Total	59,908,767	30,526,796	7,404,221	97,839,784

*As the amounts reported pertain only to the payments actually made within the calendar year specified, these tax payments do not necessarily reflect the tax assessments of a calendar year. Included are taxes on nonoperating revenue.

Table 54

Federal Income Tax Declared by Companies
in Mining and Related Industry in Canada,
Fiscal Year Ended March 31, 1961
($ millions)

Mining, Quarrying and Oil Wells	
Gold Mining	3.6
Other metal mining	54.5
Coal mines	0.3
Oil and natural gas	8.2
Other nonmetal mines	11.5
Quarries	1.9
Prospecting and Contract Drilling	3.7
Total	83.7
Metallurgical and Metal-Fabricating Industries	
Iron and steel mills	36.5
Iron foundries	4.9
Metal smelting and refining	10.1
Boilers and fabricated structural material	3.0
Metal stamping, pressing and coating	6.5
Wire and wire products	4.0
Miscellaneous metal fabricating	5.9
Total	70.9
Nonmetallic mineral products	
Cement, clay and stone products	15.6
Glass and nonmetallic minerals	7.7
Fertilizers and industrial chemicals	7.3
Total	30.6
Petroleum and products	
Petroleum refineries	46.1
Coal and petroleum products	9.8
Total	55.9
Total mining and related industries	241.1
Total, all industries	1,301.6

Table 55

Capital and Repair Expenditures of Canadian Mining Industry
($ 000)

	1961			1962p			1963f		
	Capital	Repair	Total	Capital	Repair	Total	Capital	Repair	Total
Metals									
Gold mines	8,241	9,228	17,469	5,142	9,273	14,415	4,928	9,404	14,332
Silver-lead-zinc	15,972	4,928	20,900	12,374	5,357	17,731	20,047	4,997	25,044
Uranium	3,841	6,440	10,281	1,572	3,486	5,058	1,651	3,113	4,764
Iron mines	89,697	23,418	113,115	141,442	32,172	173,614	99,788	31,042	130,830
Other metal mines*	32,239	24,515	56,754	31,579	26,732	58,311	26,956	25,405	52,361
Total	149,990	68,529	218,519	192,109	77,020	269,129	153,370	73,961	227,331
Nonmetals									
Asbestos, gypsum, salt and other nonmetals	25,562	18,566	44,128	48,820	21,081	69,901	26,991	19,570	46,561
Quarries and sand pits	11,297	13,069	24,366	13,026	12,715	25,741	8,202	12,462	20,664
Total	36,859	31,635	68,494	61,846	33,796	95,642	35,193	32,032	67,225
Fuels									
Coal	2,990	4,174	7,164	5,696	3,540	9,236	3,702	4,618	8,320
Petroleum and natural gas	182,378	15,105	197,483	187,583	16,262	203,845	200,929	16,344	217,273
Natural gas processing	76,584	2,360	78,944	29,963	3,093	33,056	43,584	3,871	47,455
Total	261,952	21,639	283,591	223,242	22,895	246,137	248,215	24,833	273,048
Total mining industry	448,801	121,803	570,604	477,197	133,711	610,908	436,778	130,826	567,604

*Includes copper-gold-silver, nickel-copper, and silver-cobalt mines.

Symbols: p Preliminary; f Forecast.

Table 56

Capital Investment in the Canadian Petroleum and Natural Gas Industries(a), 1947-63
($ millions)

									Capital Investment in Canada	
Year	Exploration	Development and Production	Oil and Gas Pipelines	Rail and Water Transport	Gas Processing	Petroleum Refining	Marketing Oil(c)	Marketing Gas(d)	Petroleum and Natural Gas Industry	All Industries
1947	b	9.5	-	2.6	-	25.7	14.9	2.5	56.7	2,440
1948	b	37.3	-	4.3	-	32.6	9.7	3.8	89.5	3,087
1949	b	45.0	7.0	0.77	-	21.6	11.3	4.3	92.0	3,539
1950	b	53.9	53.8	1.2	-	24.1	16.7	6.6	160.7	3,936
1951	b	72.1	9.8	0.9	-	50.9	18.1	6.8	161.8	4,739
1952	59.8	101.6	78.7	15.9	1.3	60.5	25.0	6.3	352.2	5,491
1953	59.1	107.2	75.5	4.0	0.7	66.1	36.7	11.2	363.1	5,976
1954	55.1	126.8	62.6	2.5	8.5	83.9	46.3	9.7	401.5	5,721
1955	67.4	201.6	46.0	-	2.9	102.9	56.5	9.4	497.0	6,244
1956	73.7	252.4	176.1	1.0	10.5	79.1	68.5	46.6	707.9	8,034
1957	77.3	237.8	307.9	2.2	34.5	81.5	74.9	69.8	885.9	8,717
1958	62.4	181.5	236.6	1.8	40.1	94.9	63.6	79.4	760.3	8,364
1959	51.0	191.9	58.6	0.6	24.4	95.0	73.1	89.8	584.4	8,417
1960	50.4	209.1	98.9	-	19.4	59.2	68.1	62.9	568.0	8,262
1961	47.7	182.4	163.0	1.8	76.6	31.2	56.0	59.3	618.0	8,172
1962p	49.9	187.5	69.9	1.7	30.0	58.0	52.9	67.5	517.4	8,738
1963f	50.2	201.0	87.8	0.2	43.6	53.3	59.5	78.8	574.4	9,088

(a)The petroleum and natural gas industries in this table include all companies engaged in whole or in part in oil and gas industry activities. The investment data under "Petroleum and Natural Gas" in Tables 57 to 59 inclusive apply only to companies whose main revenues are derived from oil and gas activities. (b)Capital investment in exploration prior to 1952 is included in Development and Production column. (c)Capital investment in this item chiefly includes outlets reported by major companies. (d)Capital expenditures in gas marketing are on gas-distribution pipelines. Symbols: p Preliminary; f Forecast; - Nil.

Table 57

Ownership and Control of Canadian Mineral Industry, Year-End, 1960 and 1961

	1960		1961	
	$ Million	%	$ Million	%
Mining(a)				
Estimated total investment	2,355	100.0	2,428	100.0
Owned in:				
Canada	886	37.6	875	36.0
United States	1,315	55.8	1,397	57.6
Britain	87	3.7	85	3.5
Other countries	67	2.9	71	2.9
Petroleum and Natural Gas(b)				
Estimated total investment	6,054	100.0	6,717	100.0
Owned in:				
Canada	2,327	38.4	2,694	40.1
United States	3,184	52.6	3,434	51.1
Britain	270	4.5	299	4.5
Other countries	273	4.5	290	4.3
Nonferrous Smelting and Refining(c)				
Estimated total investment	936	100.0	968	100.0
Owned in:				
Canada	428	45.7	432	44.6
United States	386	41.3	421	43.5
Britain	65	6.9	62	6.4
Other countries	57	6.1	53	5.5

(a)Excludes petroleum and natural gas.
(b)Applies only to companies whose main revenues are derived from oil and gas activities.
(c)Native ores only.

Table 58

Estimated Book Value, Ownership and Control of Capital Employed in Selected Canadian Industries, Year-End, 1958-61

($ billions)

	1958	1959	1960	1961
Total Capital Employed				
Manufacturing	11.0	11.7	12.2	12.7
Petroleum and natural gas*	5.1	5.6	6.1	6.7
Other mining and smelting	2.9	3.1	3.3	3.4
Railways	4.9	5.2	5.3	5.4
Other utilities	8.0	8.5	9.2	10.3
Merchandising and construction	8.5	9.5	9.4	9.8
Total	40.5	43.6	45.6	48.2
Resident-owned capital				
Manufacturing	5.4	5.7	5.8	5.9
Petroleum and natural gas*	2.0	2.2	2.3	2.7
Other mining and smelting	1.3	1.3	1.3	1.3
Railways	3.5	3.8	3.9	4.0
Other utilities	6.9	7.3	7.9	9.0
Merchandising and construction	7.7	8.6	8.5	8.9
Total	26.7	28.8	29.9	31.7
Nonresident-owned capital				
Manufacturing	5.6	6.0	6.4	6.8
Petroleum and natural gas*	3.2	3.5	3.7	4.0
Other mining and smelting	1.7	1.8	2.0	2.1
Railways	1.4	1.4	1.4	1.4
Other utilities	1.1	1.2	1.3	1.3
Merchandising and construction	0.8	0.9	0.9	0.9
Total	13.8	14.8	15.7	16.5

*The investment data under "petroleum and natural gas" apply only to companies whose main revenues are derived from oil and gas activities.

Note: Owing to rounding, figures do not add to totals in all cases.

Table 59

Foreign Capital Invested in the Canadian Mineral Industry,
Selected Years (end of year) 1930-61

	1930	1945	1955	1956	1957	1958	1959	1960	1961
Owned by All Nonresidents									
Mining and Smelting	311	359	1,121	1,330	1,570	1,657	1,783	1,977	2,089
Petroleum and Natural Gas*	150	157	1,854	2,275	2,849	3,187	3,455	3,727	4,023
Owned by United States Residents									
Mining and Smelting	234	280	975	1,129	1,307	1,386	1,513	1,701	1,818
Petroleum and Natural Gas*	147	149	1,716	2,063	2,570	2,866	3,108	3,184	3,434

*Data apply only to companies whose main revenues are derived from oil and gas activities.

Abrasives

J.S. Ross*

With the exclusion of ores used in autogenous and pebble grinding, Canada's output of natural abrasives has become relatively insignificant. Canada's crude artificial abrasives industry, however, continues as the largest of its kind in the world.

The term 'abrasives' includes materials which are employed for their cutting, grinding, polishing, gripping or wear-resistant properties. These materials may contain or be composed entirely of rocks, ores, mineral concentrates, crude artificial products and manufactured commodities. While most minerals, mineral assemblages and man-made crude materials may be used as abrasives, only those with the most suitable physical properties are normally in demand. Abrasives may be classified not only by origin (natural or artificial) but by degree of abrasiveness. High-grade types include diamond, corundum and the chief artificial products - silicon carbide and fused alumina. Quartz and feldspar are examples of the low-grade types. Mild abrasives, commonly used for polishing and scouring, include lime and diatomite. Although all types are used by many industries, the high-grade varieties have the widest application.

In Canada, most natural abrasives are derived from materials that are produced primarily for nonabrasive purposes. Each year, some 5,500 tons valued at about $100,000 are normally consumed as abrasives. These include silica and beach sand, iron oxide, feldspar, granite and grindstone. These statistics do not include ores used for pebble and autogenous milling.

Exports were minor in quantity and value but re-exports, consisting of industrial diamonds, had a large value amounting to $4,795,455 in 1962. Owing mainly to industrial diamonds, imports are also substantial in value amounting to $6,383,946, an increase from $6,091,030 for 1961. The remainder of these imports included emery, corundum, garnet, pumice, pumicite and calcareous tufa. Unknown amounts of silica sand and diatomite are also imported for abrasive use.

Canada is a major supplier of crude silicon carbide and fused alumina, the most commonly consumed artificial abrasives. About one quarter and one tenth of the respective outputs are for nonabrasive uses. Canada's output of these materials fluctuates directly with export demand; in 1962 production of crude silicon carbide amounted to 65,854 tons valued at $10,233,094 - a decrease of 17 per cent in quantity over 1961. Shipments of crude fused alumina fluctuate greatly. They amounted to 161,849 tons valued at $17,081,260, a rise of 26 per cent above the 1961 output. Metallic abrasives, such as shot and grit, are also produced.

*Mineral Processing Division, Mines Branch.

Table 1

ABRASIVES - PRODUCTION, TRADE AND CONSUMPTION

	1961		1962	
	Short Tons	$	Short Tons	$
PRODUCTION				
Artificial abrasives				
Crude silicon carbide (a)..........	79,188	12,478,654	65,854	10,233,094
Crude fused alumina (a)...........	128,661	13,597,378	161,849	17,081,260
Abrasive wheels and segments.....		6,863,217		7,882,626
Other products (b)................		10,003,117		na
Total........................		42,942,366		
IMPORTS				
Natural and artificial abrasives				
Artificial-abrasive grains.........		2,366,931		2,880,156
Diamond dust, bort and carbonado .		5,733,917		5,941,353
Emery in bulk (c)		189,406		204,872
Grinding wheels, bonded, with natural or artificial grains.......		2,010,950		2,263,360
Grinding stones or blocks manufactured by bonding together either natural or artificial abrasives, not otherwise provided for.		361,707		426,647
Grindstones, not otherwise provided for		12,005		9,178
Pumice and pumice stone, lava and calcareous tufa, not further manufactured than ground........		167,707		237,721
Coated abrasive paper and cloth ...		1,306,592		1,526,229
Manufactures of abrasives, not otherwise provided for		559,694		568,072
Total........................		12,708,909		14,057,588
EXPORTS				
Natural and artificial abrasives				
Abrasives, natural, not elsewhere specified................	5	4,945	-	-
Fused alumina, crude and grains ..	133,321	14,723,100	164,870	17,972,548
Silicon carbide, crude and grains ..	84,327	12,795,554	62,766	9,343,177
Abrasive paper and cloth..........		788,548		714,695
Abrasive wheels and stones		132,926		280,086
Abrasive basic products not elsewhere specified................		963,394	281	1,780,064
Total........................		29,408,467		30,090,570

Table 1 (cont'd)

	1961		1962	
	Short Tons	$	Short Tons	$
RE-EXPORTS				
Diamonds, industrial, and dust.......		4,124,748		4,795,455

	1960	
CONSUMPTION (incomplete) (d)		
Abrasives, natural and artificial, in the production of artificial-abrasive products	Short Tons	$
Natural-abrasive grains		
Garnet	234	64,449
Emery	42	5,301
Quartz or flint	105	6,797
Other		545
Total		77,092
Artificial-abrasive grains for wheels, paper, etc.		
Fused alumina	2,472	714,619
Silicon carbide	2,036	582,891
Total	4,508	1,297,510

Source: Dominion Bureau of Statistics. (a)Includes material for use in refractories and for other nonabrasive purposes. (b)Includes abrasive cloth, abrasive paper, abrasive tile, artificial pulpstone, boron carbide and fused magnesia. (c)Includes also corundum and garnet. Separation is not possible. (d)Does not include the consumption of such natural abrasives as diamonds, pumice and calcareous tufa, nor does it include the consumption of natural and artificial grains for use as loose grains.
Symbols: na Not available; - Nil.

In addition to artificial abrasives, manufactured abrasives products are made in Canada. In 1962, the output of abrasive wheels and segments was valued at $7,882,626. The value of other products brought the 1961 total for the artificial-abrasives industry to $42,942,366.

Exports of all types consisted chiefly of crude fused alumina and silicon carbide. In 1962 these two commodities accounted for 91 per cent of the total value of about $30 million. They were exported, in direct proportion to their production, mainly to the United States with most of the remainder going to Britain. Virtually all of the other exports were of the finished manufactured variety. Imports of artificial and finished manufactured abrasive products amounted to about half the total abrasive imports of about $14 million in 1962. Of this, the largest item - $2,880,156 - represented refined artificial-abrasive grains. These are virtually all of the types which are produced in Canada and exported in the crude form.

PRODUCERS

Natural abrasives were the sole shipments of only one Canadian plant in 1962. Practically all natural abrasives were co-products of industrial minerals processed mainly for other purposes. They included quartzite, sandstone, beach sand, feldspar, granite and iron oxide.

Sand for sandblasting is produced from quartzite by Dominion Industrial Mineral Corporation at Lachine, Quebec, and by Nova Scotia Sand and Gravel Limited near Shubenacadie, Nova Scotia. International Minerals & Chemical Corporation (Canada) Limited ships feldspar from near Buckingham, Quebec, for use in soaps and cleansers. Finely ground silica is sold for the same purpose by Canadian Silica Corporation Limited, St. Canut, Quebec. At Red Mill, Quebec, The Sherwin-Williams Company of Canada, Limited, processes bog iron oxide partly for use as crocus and jeweller's rouge. H.C. Reid manufactures grindstones from sandstone recovered in the Bathurst district, New Brunswick. In 1962, the garnet operation of Industrial Garnet Company Limited near River Valley, Ontario, was inactive. A few other companies supply small quantities of natural abrasives.

Although not considered products of the abrasives industry, ores used in pebble and autogenous grinding are essentially natural abrasives. Like most others, they result from materials required for other purposes. However, they serve a two-fold purpose, initially as grinding media and eventually as a semi-processed ore. In Canada, many ores are subjected to this type of comminution.

Canada's production of artificial abrasives is mainly in the form of crude fused alumina and silicon carbide. These commodities are produced by six companies in four plants in Ontario and in four in Quebec. Except for minor quantities, this output is exported in the crude form mainly to the United States. Production varies directly with metal fabrication in the consuming countries and is normally three quarters of the North American artificial abrasives output. Boron carbide is also supplied in small quantities.

Table 2

CANADIAN PRODUCERS OF CRUDE ARTIFICIAL ABRASIVES

Producer	Location of Plant	Product
Canadian Carborundum Company, Limited	Niagara Falls, Ont.	Fused alumina
	Shawinigan, Que.	Silicon carbide
Electro Refractories & Abrasives Canada Ltd.	Cap de la Madeleine, Que.	Silicon carbide
The Exolon Company	Thorold, Ont.	Silicon carbide Fused alumina
Lionite Abrasives, Limited	Niagara Falls, Ont.	Silicon carbide Fused alumina
Norton Company	Chippawa, Ont.	Silicon carbide Fused alumina
	Cap de la Madeleine, Que.	Silicon carbide
Simonds Canada Abrasive Company Limited	Arvida, Que.	Fused alumina

Minor amounts of semiprocessed fused alumina and silicon carbide are supplied for domestic consumption.

In addition, bonded and coated abrasives are manufactured at 12 plants in southern Ontario and at one each in Quebec and British Columbia.

DEVELOPMENTS

The chief developments in 1962 concerned diamonds. During that year Canadian Rock Company Limited, a subsidiary of Anglo-American Corporation of South Africa, obtained a licence for exclusive rights to explore for diamonds and other precious and semiprecious stones in an area 100 miles north of Cochrane, Ontario. The licence, granted by the Ontario Department of Mines, was for a maximum period of three years and involved 124 square miles around Coral Rapids comprising the townships of Neath, Hobson, Ophir, Pitt, Valentine and Wacousta. Although extensive exploration was carried out, reports indicate that no diamonds were found. Mainly because of this, the company surrendered its licence early in 1963.

Industrial Distributors, Ltd., of Johannesburg and London, introduced a new type of high-quality diamond for drilling consisting of natural diamonds that have been subjected to impact and then rounded so that those diamonds with flaws may be eliminated. Cleavage is also reduced.

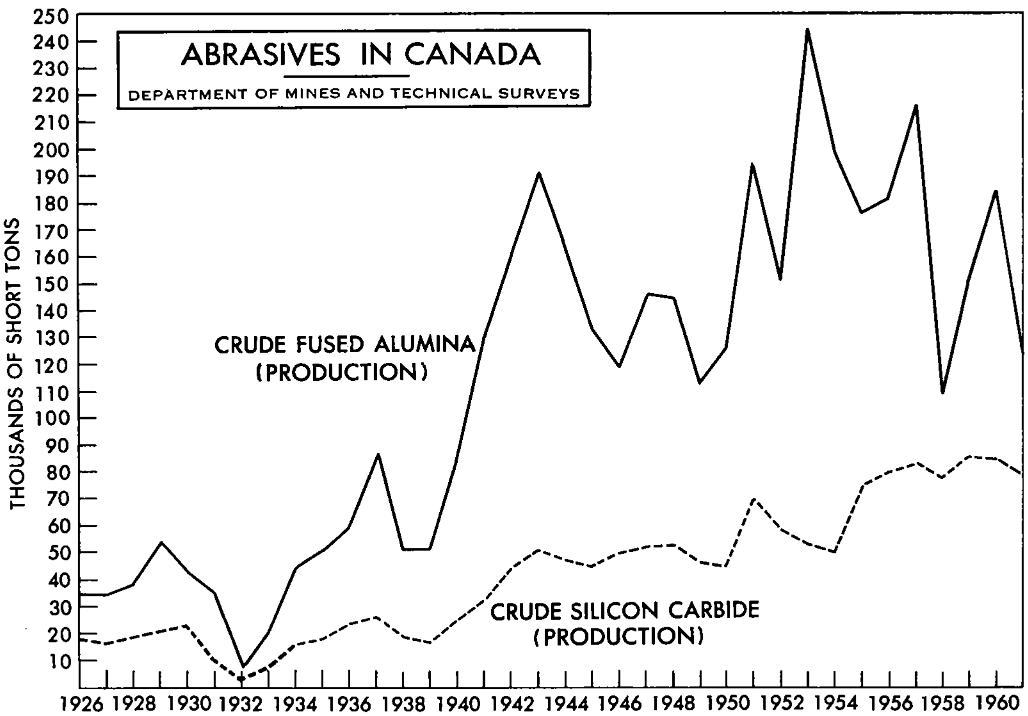
In 1962, additional interest was given to oriented diamonds for use in drill bits.

USES

Abrasives are employed universally and in numerous applications. Although each abrasive has many possible applications, its versatility is normally limited by cost and performance. As a result, there are numerous grades of each type to provide a preferred abrasive for every use.

All minerals and rocks can serve as natural abrasives. However, only a few are in demand. The use of ores in pebble and autogenous grinding has already been discussed. Natural and synthetic diamonds are employed in grinding, cutting and boring metallic and nonmetallic materials and in polishing glass. Emery is used in bonded and coated abrasives and in abrasive surfaces for floors of concrete, masonry and asphalt. Corundum may be employed in bonded shapes or loose grains for grinding and polishing. Silica and beach sand are used in sandblasting, silica flour in soaps and cleansers, and silica sand in coated abrasives. Garnet serves mainly in coated abrasives and as loose grains for sandblasting and polishing. Feldspar is used in soaps and cleansers, and iron oxide and diatomite are ingredients in polishes. Other industrial minerals are consumed for less-common abrasive purposes.

Fused alumina and silicon carbide are by far the most popular artificial abrasives. As loose refined grains, fused alumina is used for grinding, polishing, sandblasting and for providing 'nonslip' surfaces for certain concrete and masonry structures. When bonded, it is employed mainly to grind, cut or polish metallic products. In coated abrasives, fused alumina is used in the metalworking, woodworking and leather industries. Because silicon carbide and fused alumina are both high-grade abrasive types, they compete in many applications. In the form of loose grains, they have similar applications. Silicon carbide is also bonded into wheels, sticks, rubs, etc., and used to abrade metal, industrial-mineral products, rubber, leather and wood. In coated abrasives it is applied



to similar materials. Both silicon carbide and fused alumina have many other applications.

PRICES

The prices per short ton of refined abrasive grains used in 1960 for the production of artificial abrasive products averaged: fused alumina $289, silicon carbide $286, garnet $275, emery $126, and quartz $65.

Aggregates, Lightweight

H.S. Wilson*

Construction in Canada reached a record value of $7,329 million in 1962. This exceeded the $6,974 million of 1961 by 5.1 per cent and the previous record of $7,092 million of 1958 by 3.3 per cent.

The production of lightweight aggregates continued to increase, reaching a value of about $6.4 million during 1962 - an increase of 10 per cent over the previous year.

Table 1

TYPES OF CONSTRUCTION IN CANADA, 1961 and 1962

Type of Construction	Percentage change 1961-62	Percentage of Total Value 1961	1962
Engineering	-1.0	42	38
Residential	+7.6	28	29
Institutional	+25.1	9	11
Commercial	-2.8	11	10
Industrial	+19.9	6	7
Other	+2.4	4	5
Total	+5.1	100	100

Source: Dominion Bureau of Statistics.

For the second year, the production of expanded slag had the greatest increase - 15 per cent in volume and 19 per cent in value.

Expanded-clay and -shale production in 1962 increased 12 per cent in volume and 11 per cent in value over 1961. There has been a continuous increase in production except for 1958. One new plant - at Laprairie, Quebec, was put into operation.

The 1962 production of exfoliated vermiculite increased 4 per cent in volume and 2 per cent in value over 1961 production. Two new plants went into operation during 1962 - at Richmond, British Columbia, and at St. Boniface, Manitoba. Production increased for the second consecutive year.

*Mineral Processing Division, Mines Branch.

Expanded perlite showed the first increase in production since 1958, increasing four per cent in volume but decreasing over one per cent in value. One new plant, at Richmond, B.C., was put into operation in 1962.

The value of pumice used as a lightweight aggregate increased 40 per cent, approximately recovering from the decrease that occurred in 1961.

The production and value of the individual types of lightweight aggregates produced in 1961 and 1962 are shown in Table 2. The accompanying graph shows the production of the principal lightweight aggregates for the period 1954-61.

Table 2

PRODUCTION OF LIGHTWEIGHT AGGREGATES, 1961 and 1962

	1961		1962	
	Cubic Yards	$	Cubic Yards	$
From domestic raw materials				
Expanded clay and shale	395,753	2,203,716	441,400	2,447,800
Expanded slag	266,890	628,758	305,943	745,839
From imported raw materials				
Exfoliated vermiculite	316,082	2,403,630	327,822	2,452,468
Expanded perlite	92,000	740,000	96,132	731,704
Pumice		34,650		48,600
Total		6,010,124		6,426,411

Source: Information supplied directly by the producers.

USES OF LIGHTWEIGHT AGGREGATES

Lightweight aggregates are used in structural concrete, masonry units and insulating concrete. Structural concrete is made with expanded-clay, -shale, and -slag aggregates. All the lightweight aggregates can be used in masonry units, but in Canada this application of vermiculite and perlite is not widely used. Vermiculite is used mainly as loose insulation, and perlite largely as plaster aggregate. These two, because of their insulating properties and low unit weights, are employed as aggregates in insulating concrete. Lightweight aggregates also serve as roofing gravel and in oil-well concrete, in stucco and for horticultural and acoustical purposes.

RAW MATERIALS

The shales and common clays are the most widespread raw materials used for lightweight-aggregate manufacture. Most plants obtain their raw materials from nearby deposits. One is supplied from 15 miles away. Twelve plants were in operation in 1962 as follows: Quebec - Laprairie; Ontario - Ottawa and Cooksville; Manitoba - St. Boniface (2); Saskatchewan - Regina (2); Alberta - Calgary (2) and Edmonton (2); and British Columbia - Saturna Island.

Expanded blast-furnace slag is a byproduct of the iron and steel industry. It is processed at Hamilton and Port Colborne, in Ontario, and at Sydney, Nova Scotia.

Vermiculite is a type of hydrous mica that exfoliates when heated, to form a cellular material possessing good insulating properties. All the raw vermiculite exfoliated in Canada is imported from the United States and the Transvaal, South Africa. Six companies produce exfoliated vermiculite at 12 locations: British Columbia - Vancouver (2) and Richmond; Alberta- Calgary; Saskatchewan - Regina; Manitoba - Winnipeg and St. Boniface; Ontario - Toronto, Rexdale and St. Thomas; and Quebec - Lachine and Montreal.

Perlite is a volcanic rock that "pops" when heated, to form a cellular product of low density. Deposits occur in central and southern British Columbia but they have not been developed commercially. Raw material is imported from the western United States for processing. Ten plants were in operation during the year: Quebec - Ville St. Pierre, Beauport and Charlesbourg West; Ontario - Caledonia and Hagersville; Manitoba - Winnipeg; Alberta - Calgary (2); British Columbia - Vancouver and Richmond.

Pumice, a highly vesicular material of volcanic origin, is used in its natural state as a lightweight aggregate. All the pumice used is imported from the United States. Because the known Canadian deposits are either too small or too far from transportation facilities, none is produced in Canada.

CONSUMPTION

Expanded Clay and Shale

Concrete block and precast concrete shapes accounted for 73 and 6 per cent respectively of the 1962 production, consumption changing from 75 and 5 per cent in 1961. Cast-in-place structural concrete used 18 per cent in 1962, compared with 17 per cent the previous year. Minor uses - refractory materials, loose insulation and lightweight brick - accounted for 3 per cent of production; this was unchanged from 1961. Considering that total production was 13 per cent higher in 1962 than in 1961, the volume used in each type of product was greater in 1962.

Expanded Slag

In 1962, ninety-eight per cent of expanded slag was used as aggregate in concrete block, two per cent more than in 1961. Precast concrete shapes, and cast-in-place structural concrete each consumed one per cent and both used one per cent less than in 1961. As in the previous year, all the increase in production (15 per cent) went into concrete block, less being used in precast and structural concretes.

Exfoliated Vermiculite

Loose insulation consumed 79 per cent of production in 1962, compared with 77 per cent in 1961. Plaster accounted for 13 per cent - one per cent less. Five per cent, 2 per cent more than in 1961, was used in insulating concrete. Three per cent was used for such purposes as soil and fertilizer conditioners, underground pipe insulation, and for agriculture and horticulture. These minor uses consumed 2 per cent less than in 1961. Insulation and concrete used more vermiculite in 1962; plaster and the minor uses consumed less than in 1961.

Table 3

LIGHTWEIGHT AGGREGATE PLANTS IN CANADA

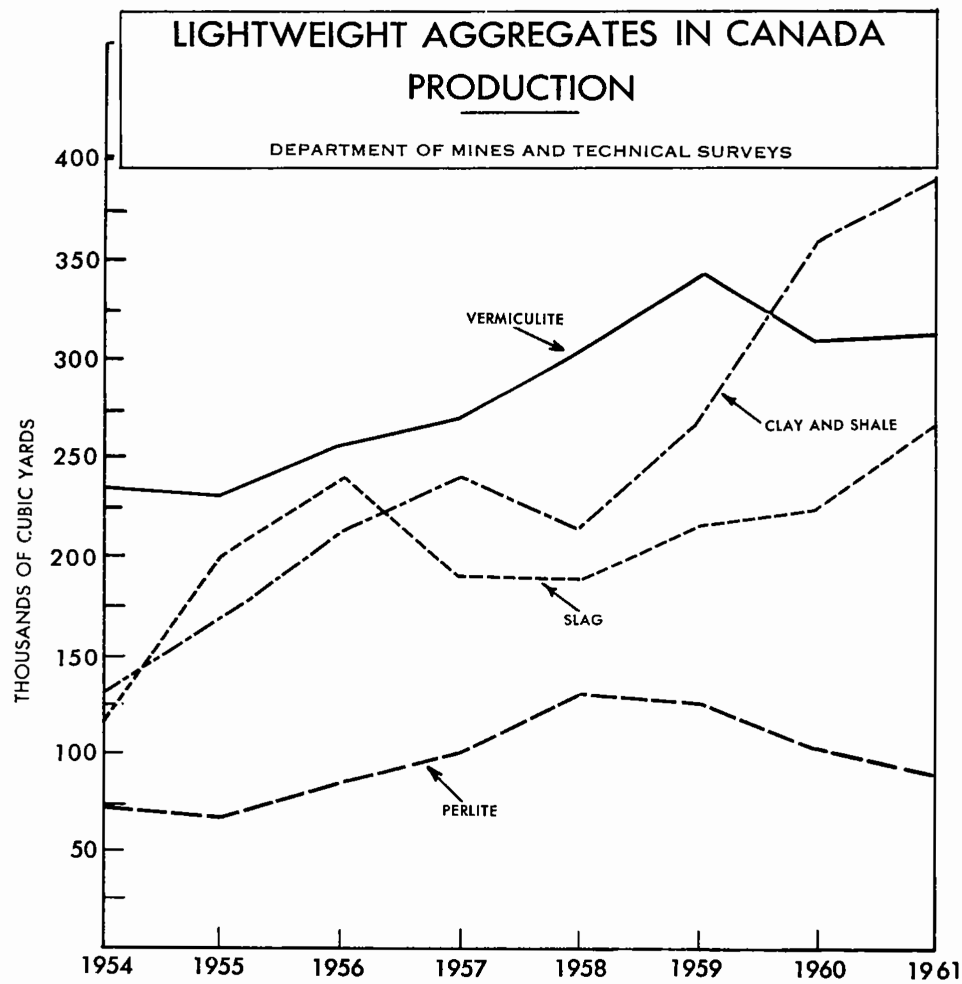
Company	Location	Aggregate
Producing Plants		
Atlas Light Aggregate Ltd.	St. Boniface, Man.	Expanded clay
Cindercrete Products Limited	Regina, Sask.	" "
Echo-Lite Aggregate Ltd.	St. Boniface, Man.	" "
Edmonton Concrete Block Co. Ltd.	Edmonton, Alta.	" "
Hobbs Concrete Blocks Ltd.	Edmonton, Alta.	" "
Light Aggregate (Sask.) Limited	Regina, Sask.	" "
Aggrite Inc.	Laprairie, Que.	Expanded shale
British Columbia Lightweight Aggregates Ltd.	Saturna Island, B.C.	" "
Burtex Industries Limited	Calgary, Alta.	" "
Consolidated Concrete Limited	Calgary, Alta.	" "
Domtar Construction Materials Ltd.	Cooksville, Ont.	" "
Hayley-Lite Limited	Ottawa, Ont.	" "
Dominion Iron & Steel Limited	Sydney, N.S.	Expanded slag
National Slag Limited	Hamilton, Ont.	" "
	Port Colborne, Ont.	" "
Grant Industries Ltd.	Vancouver, B.C.	Vermiculite
	Calgary, Alta.	"
	Regina, Sask.	"
	Winnipeg, Man.	"
F. Hyde & Company, Limited	Montreal, Que.	"
	Toronto, Ont.	"
	St. Thomas, Ont.	"
Mid-West Expanded Ores Co. Ltd.	St. Boniface, Man.	"
Western Expanded Ores Ltd.	Richmond, B.C.	"
Western Gypsum Products Limited	Vancouver, B.C.	"
Vermiculite Insulating Limited	Rexdale, Ont.	"
	Lachine, Que.	"
Canadian Gypsum Company Limited	Hagersville, Ont.	Perlite
Domtar Construction Materials Ltd.	Caledonia, Ont.	"
	Calgary, Alta.	"
Laurentide Perlite Inc.	Beauport, Que.	"
	Charlesbourg West, Que.	"
Perlite Industries Reg'd	Ville St. Pierre, Que.	"
Western Gypsum Products Limited	Vancouver, B.C.	"
Western Expanded Ores Ltd.	Richmond, B.C.	"
Perlite Products Ltd.	Winnipeg, Man.	"
Western Perlite Co. Ltd.	Calgary, Alta.	"
Evans, Coleman & Evans, Limited	Vancouver, B.C.	Pumice
Miron Company Ltd.	Montreal, Que.	"
Nonproducing Plants		
Featherock Inc.	St. Francois du Lac, Que.	Expanded clay
Miron Company Ltd.	Montreal, Que.	Perlite

Expanded Perlite

Plaster aggregate accounted for 86 per cent of the 1962 production - 5 per cent less than in 1961. Nine per cent was used in insulating concrete - 5 per cent more than in 1961. As in 1961, 5 per cent was used in horticulture, insulation, etc. The quantity used in plaster was less than in 1961; other uses consuming larger quantities.

Pumice

As in previous years, all pumice was used as aggregate in concrete blocks.



PRICES

Expanded-clay and -shale aggregates sold at \$4.50 to \$7.40 a cubic yard, the average being \$5.55 a cubic yard. Expanded slag sold at \$2.35 to \$3.85 a cubic yard. Exfoliated vermiculite sold at 25 to 30 cents a cubic foot and expanded perlite at 25 to 35 cents a cubic foot. Vermiculite and perlite are marketed in bags of 3 and 4 cubic feet. All prices are f.o.b. plant. Raw vermiculite was imported at costs ranging from about \$25 to \$50 a ton and raw perlite at costs ranging from about \$20 to \$30 a ton.

Aluminum

W. H. Jackson*

DEPARTMENT OF MINES AND TECHNICAL SURVEYS, OTTAWA

Primary aluminum output increased by 4.1 per cent in 1962 to 690,297 tons. The overall operating rate of the industry, 77.7 per cent of capacity, was lower than for the rest of the Free World due to competition for available export markets among the world's producers.

British Columbia and particularly Quebec are the two provinces most affected by world aluminum demand. The locations of the six Canadian smelters are shown on the accompanying map and estimated capacities are listed in Table 4. Canadian consumption amounted to 136,962 tons. Primary aluminum exports had a value of $266 million representing 4.3 per cent of all goods exported from Canada. The tonnage exported rose to 576,206 tons from 487,034 tons in 1961.

There was a 7.2 per cent rise in shipments to Britain and an 80 per cent rise to the United States. According to data compiled by the British Bureau of Non-Ferrous Metals, Canada supplied 61.4 per cent of Britain's imports. Consumption in Britain remained static in 1962, at 282,130 long tons compared with 279,626 in 1961. However, there was a substantial increase in secondary consumption.

Exports of primary metal from Canada to the European Economic Community were 54,014 tons having declined for three successive years.

According to the U.S. Department of Commerce, United States imports of crude metal and alloys were 304,117 tons of which Canada supplied 209,891 tons. U.S. exports amounted to 151,250 tons.

CANADIAN DEVELOPMENTS

Aluminum Company of Canada, Limited (ALCAN) operated at 76 per cent of its rated annual capacity of 788,000 tons (including Beauharnois) with production at 596,200 tons compared with 569,200 tons in 1961. The company is the world's largest seller of aluminum on competitive export markets; its relatively low operating rate in comparison to other major world producers results from their higher ratio of fabricating capacity integrated with smelter

*Mineral Resources Division.

Table 1

ALUMINUM - PRODUCTION AND TRADE

	1961		1962	
	Short Tons	$	Short Tons	$
PRODUCTION				
Ingot	663,173		690,297	
IMPORTS				
Bauxite and alumina for refining				
British Guiana	1,003,889	11,010,867	1,183,095	13,385,482
Jamaica	437,175	27,785,220	475,843	29,813,206
Surinam	276,871	1,642,097	186,062	1,273,659
United States	109,127	7,164,552	142,787	10,067,679
Ghana	-	-	13,047	89,605
Guinea	380,627	4,823,876	11,739	895,624
Australia	5,862	347,894	-	-
Total	2,213,551	52,774,506	2,012,573	55,525,255
Cryolite				
Denmark	3,307	528,000	3,353	636,111
Italy	573	121,071	1,531	360,376
United States	142	32,691	219	59,648
Britain	2	396	7	1,795
West Germany	10	2,444	-	-
Total	4,034	684,602	5,110	1,057,930
Aluminum products				
Semimanufactured		8,405,685		16,019,316
Fully manufactured		19,862,141		23,871,855
Total		28,267,826		39,891,171
EXPORTS				
Pigs, ingots, shot, slabs, billets, blooms and extruded wire bars				
United States	117,760	54,670,004	211,999	95,043,603
Britain	156,575	71,552,826	167,822	80,452,880
Australia	12,335	5,647,895	22,637	10,784,900
West Germany	40,981	17,876,532	21,790	10,161,517
Brazil	14,988	6,759,951	15,570	7,156,154
Republic of South Africa	12,827	5,865,050	15,162	7,111,142

Table 1 (cont'd.)

	1961		1962	
EXPORTS (cont'd.)	Short Tons	$	Short Tons	$
Italy	8,349	3,673,470	14,289	6,175,059
Sweden	3,457	1,622,829	11,726	5,522,038
Belgium and Luxembourg	7,654	3,416,569	11,509	5,239,171
Spain	4,116	1,844,298	9,169	4,437,313
Mexico	6,565	2,994,976	9,083	4,245,931
Japan	26,188	11,678,867	7,629	3,469,751
Other countries	75,239	33,923,461	57,821	26,428,966
Total	487,034	221,526,728	576,206	266,228,425
Bars, rods, plates, sheet, circles, castings and forgings				
United States	10,846	7,366,752	10,921	6,407,472
India	7,918	3,910,464	4,201	1,947,619
Britain	1,024	726,463	1,583	1,027,693
Spain	443	198,228	1,545	726,896
Venezuela	922	577,331	1,301	759,565
Sweden	8	4,423	688	324,211
Portugal	987	486,985	575	278,910
Italy	5	2,809	508	241,885
Other countries	816	614,815	1,321	871,211
Total	22,969	13,888,270	22,643	12,585,462
Foil				
Britain	40	43,054	312	340,756
United States	54	51,834	79	83,753
New Zealand	7	10,900	23	34,276
Peru	11	13,052	22	30,771
Venezuela	9	13,128	18	26,038
Other countries	26	29,130	9	15,890
Total	147	161,098	463	531,484
Fabricated materials, not elsewhere specified				
Pakistan	305	221,418	914	467,826
Brazil	2,371	1,022,503	863	447,313
Bulgaria	550	276,261	771	380,179
New Zealand	2,625	1,339,868	655	376,868
United States	199	179,856	598	478,831
Britain	87	92,923	547	621,848
Thailand	286	178,992	489	333,985
Venezuela	254	133,236	426	223,069
Other countries	4,960	2,803,911	2,624	1,878,400
Total	11,637	6,248,968	7,887	5,208,319

Table 1 (cont'd)

	1961		1962	
EXPORTS (cont'd.)	Short Tons	$	Short Tons	$
In ores and concentrates (alumina)				
United States	1,253	157,970	1,933	256,496
Norway	6,763	405,282	1,512	86,174
Britain	79	11,174	235	38,350
Cuba	-	-	189	13,041
Spain	10,779	624,816	-	-
Other countries	2	1,397	4	3,280
Total	18,876	1,200,639	3,873	397,341
Scrap				
Italy	9,381	3,249,765	13,425	4,701,049
United States	7,377	1,833,924	10,715	2,022,493
Japan	8,368	3,095,476	4,550	1,722,065
West Germany	2,746	778,665	784	205,564
Belgium and Luxembourg	104	40,273	376	152,407
Other countries	1,463	435,720	395	129,781
Total	29,439	9,433,823	30,245	8,933,359

Source: Dominion Bureau of Statistics.
Symbol: - Nil.

Table 2

PRIMARY ALUMINUM - PRODUCTION, TRADE AND CONSUMPTION, 1953-62
(short tons)

	Production	Imports	Exports	Consumption*
1953	548,445	35	459,692	88,548
1954	557,897	115	468,494	80,355
1955	612,543	99	510,631	91,522
1956	620,321	1,405	508,994	91,869
1957	556,715	2,122	478,670	77,984
1958	634,102	11,257	484,438	101,886
1959	593,630	852	507,290	89,000
1960	762,012	501	552,155	120,831
1961	663,173	636	487,034	135,575r
1962	690,297	3,855	576,206	144,616

*Producers' domestic shipments to 1959; consumer reports from 1960.
Symbol: r Revised from previously published figure.

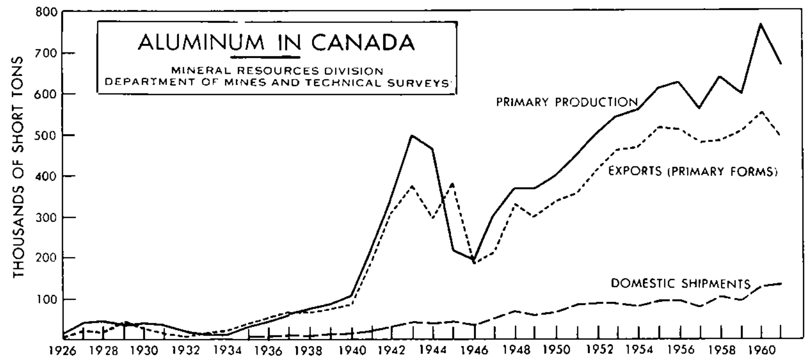
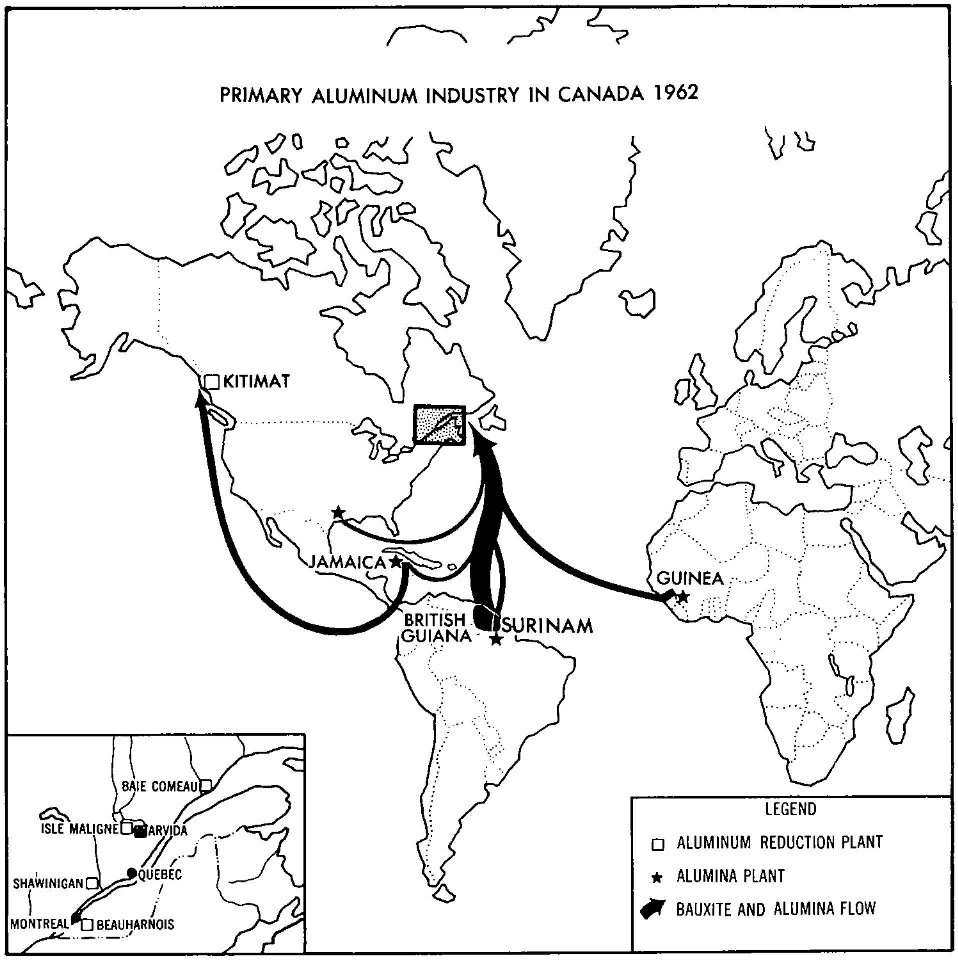


Table 3
CANADIAN CONSUMPTION OF ALUMINUM
(short tons)

	1961	1962
Castings		
Sand	1,183	1,472
Permanent-mould	2,348	2,583
Die	3,520	4,558
Other	593	747
Total	7,644	9,360
Wrought products		
Extrusions	30,524	34,015
Sheet, plate, coil and other (including rod, forgings and slugs)	94,944	97,792
Total	125,468	131,807
Destructive uses		
Nonaluminum-base alloys	967	1,554
Deoxidizers	1,496	1,895
Total	2,463r	3,449
Total consumed	135,575	144,616
Secondary aluminum produced	9,644	11,422

Receipts and inventories at plants:	Metal Entering Plant		On Hand Dec. 31	
	1961	1962	1961	1962
Primary aluminum ingot and alloys	126,352	148,583	43,241	54,862
Secondary aluminum	8,014	6,062	1,300	815
Scrap originating outside plant	13,115	14,964	1,225	1,385

Source: Dominion Bureau of Statistics as reported by consumers.
Symbol: r Revised from previously published figure.



output. This situation has been changing in the last five years during which ALCAN's emphasis has been on fabricating expansion rather than on smelter construction. In Canada, construction of buildings that will eventually house new potlines has been proceeding at Kitimat.

Aluminium Limited group companies, of which ALCAN is the largest, continued expansion of fabricating plants in 18 countries in 1962. The main developments in this field were: an increase at ALCAN Industries Limited in Britain to 95,000 tons annual capacity, the near completion of a cold-rolling sheet mill which will double the capacity of Kingston works in Ontario to 55,000 tons a year, and completion of a 100,000-ton-a-year hot-rolling mill at Oswego, New York. Up to 25,000 tons of coil will be imported from Oswego annually for the new Kingston mill which can be expanded in stages to 200,000 tons. The Oswego plant will use sheet ingot from Canada.

Table 4

ANNUAL CAPACITIES OF CANADIAN ALUMINUM PLANTS, DECEMBER 31, 1962

Companies and Plants	Short Tons
Aluminum Company of Canada, Limited (ALCAN)	
Arvida, Que.	373,000
Beauharnois, Que.*	38,000
Shawinigan, Que.	70,000
Isle Maligne, Que	115,000
Kitimat, B.C	192,000
Canadian British Aluminium Company Limited (CBA)	
Baie Comeau, Que.	100,000
Total	888,000

*Leased to Chryslum Limited

Power operations at Kemano, B.C., continued at about 60 per cent of present capacity of 1,050,000 hp. The plant, which supplies the Kitimat smelter, has a potential capacity of 2,4000,000 hp. By the end of 1962, hydro-electric power plants operated by the company on the Saguenay and Peribonka rivers in Quebec were brought on full load. These plants have a firm generating capacity of 2,600,000 hp.

Canadian British Aluminium Company Limited produced 95,467 tons compared with 91,182 tons in 1961, in both years exceeding nominal annual capacity of 90,000 tons. The high operating rate is possible because of a long-term agreement whereby The British Aluminium Company, Limited purchases 60 per cent of output. The remainder is sold mainly to Canadian fabricators including the rolling mill of Reynolds Aluminum Company of Canada Ltd. at Cap de la Madeleine. The smelter, rectifying plant, carbon plant and metal casting facilities are located at Baie Comeau, Quebec, on the north shore of the St. Lawrence. The port can be kept open all year with the aid of ice-breakers. The smelter turns out remelt ingot, wire bars, extrusion ingot and slab in a variety of alloys, and master alloys (hardeners). Much of the power is supplied by the Manicouagan Power Company; the remainder is supplied by the Quebec Hydro-Electric Commission. No firm date has yet been decided on for the commencement of construction of a 45,000-ton smelter addition.

The generating capacity of the Manicouagan Power Company, now 292,400 hp, will be doubled upon completion of the power development of the Manicouagan-Outardes basins by the Quebec Hydro-Electric Commission. Development in this area will add six million horsepower to the province's installed capacity of 13 million. Quebec's potential is 34 million. A further six million horsepower could be developed at Hamilton Falls in Labrador. The first 1.3 million horsepower from the Manicouagan project will come on line in 1965 followed by another 3 million in 1968. Transmission is via 735 kv lines.

Chryslum Limited, which has held the Beauharnois plant on lease since mid-1959, produces aluminum alloys for the Chrysler Corporation of Canada, Limited, and affiliated plants in the United States. The plant is operated by ALCAN and plant output is reported with its production.

There is only one alumina plant in Canada - at Arvida, Quebec. It treats beneficiated ore from the Demerara Bauxite Company (DEMBA) in British Guiana and from N.V. Billiton Company in Surinam. DEMBA is operating a new 245,000-ton alumina plant in British Guiana and ALCAN Jamaica Limited operates two alumina plants in Jamaica at Kirkvine (540,000 tons) and at Ewarton (305,000 tons). Much of the alumina is processed at ALCAN smelters in Canada; the rest is sold to overseas customers. Bauxite from the Republic of Guinea in Africa is no longer available to the Arvida plant as the mines at Kassa were seized when ALCAN, through a subsidiary company, did not proceed with an agreed schedule for completion of a large new bauxite mine development at Boke. Subsequently, an opportunity to acquire the mining rights to the area was granted by the Government of Guinea to Harvey Aluminum Company of the United States. Part of the alumina for the Baie Comeau plant comes from operations of the Fria consortium in Guinea but most is supplied by the Corpus Christi, Texas, plant of Reynolds Metals Company.

In 1962, Canadian imports of bauxite and alumina for refining totalled 2,012,573 tons. As bauxite mining and alumina refining are usually carried out by integrated companies or sold under long-term contracts, free market quotations are not available. Metal-grade bauxite is valued on the basis of material having a specific content of alumina, silica, iron and titania with bonus and penalty clauses. E & M J Metal and Mineral Markets quote $7.25 per long ton f.o.b. vessels British Guiana for 60 per cent Al_2O_3, 6 per cent SiO_2, and 1.25 per cent Fe_2O_3. Jamaican ores are not amenable to further beneficiation but contain less silica than do those of Surinam and British Guiana. Alumina from Jamaica, according to data contained in Table 1, had an f.o.b. value of $62.65 per short ton.

Other major raw materials needed for aluminum production are fluorspar for making the artificial cryolite which is the electrolyte in the reduction cells, and petroleum coke for anodes required in amounts up to 50 per cent by weight of metal produced. Fluorspar shipments from Newfoundland Fluorspar Limited, an ALCAN subsidiary, to Arvida, totalled 77,700 tons and imports of cryolite for all metallurgical purposes totalled 5,110 tons.

WORLD DEVELOPMENTS

Table 5 indicates production, consumption and productive capacity for primary aluminum in 1962, by geographical area.

Planning continued on the means of disposing of surplus aluminum in United States government stockpiles. At the end of June 1962, the Strategic Stockpile contained 1,127,000 tons and the Defense Production Act inventory reported 882,000 tons.

Operating rates at United States smelters improved in 1962 and production at 2,117,928 tons, and shipments of 2,750,000 tons, both established records. Capacity at year-end was 2,484,000 tons. Construction of a plant at New Johnsonville, Tenn., was begun by Consolidated Aluminum Company, a subsidiary of Swiss Aluminium Company. In Mexico, Aluminio S.A. de C.V. should commence production from its 20,000-ton-a-year smelter in mid-1963.

Negotiations connected with Britain's entry into the European Economic Community (EEC) were suspended as were related negotiations to either eliminate the common external aluminum tariff, or substantially reduce it in conjunction with quotas. Following negotiations under the General Agreement on Tariffs and Trade, the original 10-per-cent duty on ingot from countries outside the EEC was reduced to nine per cent, but Germany, Belgium and the Netherlands were permitted import quotas at a reduced rate for 1962. Expansion of smelting facilities within the EEC and its associate member countries is continuing. During and subsequent to World War II, expansion of smelting facilities occurred mainly in North America. At present, most competing companies are increasing fabricating capacity in the EEC.

Norwegian capacity was increased by 35,000 tons a year to 230,000 tons. Ninety per cent of Norwegian output is exported and further expansion is planned. In Japan, Mitsubishi Chemical Company hoped to complete a new 25,000-ton plant early in 1963. Japanese annual capacity is expected to reach 300,000 tons by 1965. India's capacity is now 50,000 tons and provision for a further 10,000 tons is under construction. Australian capacity is about 40,000 tons; an increase of 20,000 tons is planned for April 1963 and a like amount for 1964. The Australian government imposes quantitative restrictions on ingot imports to aid domestic production but import duties have not been increased. The vast bauxite deposits recently discovered in Australia are being developed to provide the basis of a domestic smelting industry and to supply bauxite and alumina to overseas smelters. The main deposits are at Gove, Northern Territory, at Weipa, Queensland, and Darling, Western Australia.

Table 5

PRELIMINARY WORLD DATA ON PRIMARY ALUMINUM, 1962
(short tons)

	Production	Consumption	Capacity
North America	2,808,225	2,435,300	3,372,000
South America	20,000	54,000	30,000
Europe	1,106,390	1,419,100	1,353,000
Africa	57,593	12,000	57,000
Australia	18,100	51,500	39,000
Asia	238,181	257,000	281,000
Total Free World	4,248,489	4,228,900	5,132,000
Soviet Bloc	1,269,100	1,250,000	1,334,000

Source: American Bureau of Metal Statistics.

Table 6

MAIN CONSUMERS OF PRIMARY ALUMINUM IN CANADA

Castings	Extrusions	Sheet	Rod	Forgings	Alloying	Deoxidizers	Company
						x	The Algoma Steel Corporation, Limited
	x						Alsco Products of Canada, Limited
x							Alumaloy Castings, Limited
x	x	x	x	x			Aluminum Company of Canada, Limited
	x						Aluminum Extruders, Limited
		x					Aluminum Goods, Limited
						x	Atlas Steels Company Limited
x							Barber Die Casting Co. Limited
x					x		Bay Bronze, Ltd.
x					x		The Canada Metal Company, Limited
x					x		Canadian General Electric Company Limited
	x						Canadian Mouldings, Limited
x							Canadian Steel Improvement, Limited
	x						Chromedge (Canada) Limited
x							Dominion Die Casting
						x	Dominion Foundries and Steel, Limited
	x				x	x	Dominion Magnesium Limited
x							Dunbar Aluminum Foundry Limited
x							Electrolux (Canada) Limited
x							Eureka Foundry and Manufacturing Co., Limited
x					x		Federated Metals Canada Limited
x							The Hoover Co., Limited
x							Lakeshore Die Casting Limited
x							McKinnon Industries, Limited
					x		Metals and Alloys, Limited
x							Monarch Fabricating Company Limited
x							Outboard Marine Corporation
x							Precision Dies & Castings, Limited
	x						Price-Acme of Canada Limited
		x					Reynolds Aluminum Company of Canada Ltd.
						x	The Steel Company of Canada, Limited
		x					Supreme Aluminum Industries, Limited
x							Thompson Products Limited
x	x						R.D. Werner (Canada) Limited

CONSUMPTION AND USES

Primary aluminum consumption in Canada, allowing for inventory adjustment, was 136,962 tons in 1962. Production of semifabricated products totalled 144,616 tons; the figure includes all primary and secondary metal used. The increase of 6.7 per cent over 1961 consumption was mainly in extruded shapes and in prepainted coil stock for fabrication into building siding. The data, derived from a consumer survey, are shown in more detail in Table 3.

Castings have varied end-uses. Aluminum rod goes into the making of electrical wire and cable. Building sheet, household utensils, foil, and slugs for making collapsible tubes, are well-known end-uses for sheet. Extrusions are used mainly in conjunction with sheet in curtain-wall systems of building construction, in the manufacture of doors and windows, in making pipe for oil distribution and irrigation and as tubing for lightweight furniture.

The main destructive uses of aluminum are as a deoxidizer in steel-making, as a component of galvanizing baths, as an alloy with magnesium, as a powder in paints and thermite, and in the manufacture of magnet alloys.

PRICES

In 1962, the Canadian base price of primary aluminum in 50-pound ingots, minimum purity 99.5 per cent, was 23.25 cents a pound until June 18; after this, following devaluation of the Canadian dollar, the price rose to 24.00 cents. On overseas markets, delivered in Britain and to main ports in Europe, the price dropped to 22.5 cents (U.S.) effective February 13 from 23.25 cents. In the United States, the nominal price for unalloyed ingot of 99.5 per cent purity was 24.00 cents until December 3 when it was lowered to 22.5 cents.

In the United States, Britain and parts of Europe, metal was consistently offered from certain marginal overseas suppliers at lower than quoted prices, although not for immediate delivery. In Britain, Russian aluminum was offered at about £160 a long ton compared with the regular trade price of £180.

TARIFFS

Canada	British Preferential	Most Favored Nation	General
Bauxite and alumina..............	free	free	free
Aluminum and aluminum alloys			
Pigs, ingots, blocks, notch bars, slabs, billets, blooms, and wire bars.....................	"	1 1/4¢ per lb	5¢ per lb
Bars, rods, plates, sheets, strips, circles, squares, disks and rectangles	"	3¢ per lb	7 1/2¢ per lb
Angles, channels, beams, tees, and other rolled, drawn or extruded sections and shapes ...	"	22 1/2%	30%
Wire and cable, twisted or stranded or not, and whether reinforced with steel or not	"	22 1/2%	30%
Pipes and tubes.................	"	22 1/2%	30%
Leaf not otherwise provided for or foil, less than 0.005 inch in thickness, plain or embossed, with or without backing	"	30%	30%
Aluminum powder	"	27 1/2%	30%
Aluminum leaf less than 0.005 millimetre in thickness	"	free	free
Aluminum scrap................	"	"	"
Manufactures of aluminum not otherwise provided for.........	15%	22 1/2%	30%
Kitchen or household hollow ware of aluminum, not otherwise provided for	20%	22 1/2%	30%

United States

Bauxite	free
Aluminum and aluminum alloys in which aluminum is the component material of chief value:	
In crude form (not including scrap)	1 1/4¢ per lb
In bars, blanks, circles, coils, disks, plates, rectangles, rods, sheets, squares and strips	2 1/2¢ per lb
Aluminum scrap......................................	free
Aluminum manufactures not otherwise provided for, wholly or in chief value of aluminum.........................	19%
Table, household, kitchen and hospital utensils, and hollow or flat ware, whether or not containing electrical heating elements as constituent parts, wholly or in chief value of aluminum	3 1/2¢ per lb and 17% ad valorem

Antimony

J.W. Patterson*

Antimony production in Canada from domestic ores and concentrates is in the form of antimonial lead from lead-refining. Antimonial-lead output in 1962 contained 1,931,397 pounds of antimony, considerably more than in any of the five preceding years.

Canada's only producer of antimonial lead is The Consolidated Mining and Smelting Company of Canada Limited (COMINCO) which operates a lead smelter and refinery, and an electrolytic zinc plant at Trail, British Columbia. The antimonial lead commonly contains about 25 per cent antimony. Small amounts of high-purity antimony are produced, from imported metal in COMINCO's electronic-materials plant at Trail.

The source of most of the antimonial lead produced at Trail is the lead concentrate obtained from ores of the company's Sullivan mine at Kimberley, British Columbia. Lead-silver ores and concentrates shipped to Trail from the company's two other mines in British Columbia and by other mining companies with mines in British Columbia and elsewhere account for the remainder. The lead bullion produced from the smelting of these ores and concentrates contains about one per cent antimony, which is recovered in anode residues and furnace drosses from the electrolytic refining of the bullion. These residues and drosses are treated to yield antimonial-lead alloy to which refined lead may be added to produce a marketable product.

Several Canadian occurrences or deposits of the principal antimony mineral, stibnite (Sb_2S_3), have been explored and partly developed, but results generally have not been encouraging. The better-known occurrences are: the Mortons Harbour mine, New World Island, Notre Dame Bay, Newfoundland; the West Gore deposits, Hants county, Nova Scotia; the Lake George property, Prince William parish, York county, New Brunswick; the South Ham deposit, Wolfe county, Quebec; and the Stuart Lake mine, near Fort St. James, British Columbia. Other deposits are situated as follows: British Columbia - near Bralorne in the Bridge River district, and, near Slocan City and Sandon in the southeastern part of the province; Yukon Territory - south of Whitehorse in the Wheaton River area, and, near Highet Creek in the Mayo district.

*Mineral Resources Division.

Table 1

ANTIMONY - PRODUCTION, TRADE AND CONSUMPTION

	1961		1962	
	Pounds	$	Pounds	$
PRODUCTION				
Antimony content of antimonial-lead alloys..	1,331,297	469,948	1,931,397	748,223
IMPORTS				
Regulus				
China (Communist)......	550,534	106,938	842,229	135,401
Britain	69,058	14,327	164,536	35,312
Czechoslovakia	-	-	110,230	23,670
West Germany..........	-	-	110,000	23,605
Belgium and Luxembourg	33,600	8,918	44,800	12,171
United States	5,000	1,129	4,122	1,428
Yugoslavia	88,506	23,235	-	-
U.S.S.R.	24,698	2,651	-	-
Netherlands	61,151	12,992	-	-
Total	832,547	170,190	1,275,917	231,587
Antimony oxide				
Britain	170,560	45,869	332,280	94,285
United States	100,150	23,189	128,055	33,868
China (Communist)......	-	-	99,900	17,191
Belgium and Luxembourg	44,007	11,077	67,354	18,301
France	44,000	10,160	-	-
Total	358,717	90,295	627,589	163,645
Antimony salts				
United States	45,028	23,341	30,688	19,976
Belgium and Luxembourg	-	-	2,600	2,105
Total	45,028	23,341	33,288	22,081
EXPORTS				
Antimony content of antimonial-lead alloys	1,192,820	na	1,582,480	na

Table 1 (cont'd)

	1961		1962	
	Pounds	$	Pounds	$
CONSUMPTION				
Antimony regulus in production of:				
Antimonial-lead alloys.....	500,877		749,850	
Babbitt	121,417		101,056	
Solder	22,674		14,698	
Type metal	132,667		180,751	
Other commodities*.......	251,284		164,301	
Total	1,028,919		1,210,656	

Source: Dominion Bureau of Statistics.
*Includes antimony oxide, foil, bronze, secondary metals, pipe and sheet, lead-base alloys, drop shot and other minor commodities.
Symbols: - Nil, na Not available.

Table 2

ANTIMONY - PRODUCTION, IMPORTS AND CONSUMPTION, 1952-62
(pounds)

	Production* (all forms)	Imports (regulus)	Consumption** (regulus)
1952	2,330,900	1,721,622	1,334,000
1953	1,488,105	1,729,253	1,606,000
1954	1,302,333	2,043,544	1,610,000
1955	2,021,726	1,359,163	1,692,000
1956	2,140,432	1,803,630	1,478,000
1957	1,360,731	1,794,846	1,401,000
1958	858,633	808,053	1,027,000
1959	1,657,797	1,170,796	1,135,000
1960	1,651,786	843,794	952,000
1961	1,331,297	832,547	1,029,000
1962	1,931,397	1,275,917	1,211,000

Source: Dominion Bureau of Statistics
*Antimony content of antimonial-lead alloys, flue dust and dore slag.
**Consumption of antimony regulus as reported by consumers. Does not include antimony in antimonial lead produced by COMINCO.

As in 1961, world production during 1962 was estimated at 60,000 tons. (See Table 3.)

Table 3

WORLD MINE PRODUCTION OF ANTIMONY, 1961 and 62
(short tons)

	1961	1962
China (Communist)	18,500e	18,500e
Republic of South Africa (exports)	11,804	11,697
Bolivia (exports)	7,429*	7,323*
U.S.S.R.	6,600e	6,600e
Mexico	3,977*	5,254*
Yugoslavia	2,715	2,966
Turkey	1,508	1,962
Czechoslovakia	1,800e	1,800e
Canada	666	966
Other countries	5,001	2,932
Total	60,000	60,000

Sources: U.S. Bureau of Mines.
*Includes the antimony content of smelter products derived from mixed ores.
eEstimate.

CONSUMPTION

Consumption of antimony metal in Canada in 1962 at 1,210,656 pounds differed little from previous years. More metal was used in the manufacture of antimonial-lead alloys and type metal but less in the manufacture of babbitt, solder and other products.

United States, the main importer of Canadian antimonial lead, consumed 15,452 tons of primary antimony in 1962 compared with 12,697 tons in 1961. As in Canada, a large part of the increase was due to more antimony being used in the production of antimonial lead. United States imports included: ores and concentrates, 8,602 tons of contained antimony; metal,4,740 tons; antimony oxide,2,415 tons; antimonial lead, 1,064 tons of contained antimony; and sulphide, 12 tons. The main sources of 1962 imports, besides Canada, were Belgium and Luxembourg, Britain, Mexico, the Republic of South Africa and Yugoslavia.

USES

Antimony is used both in its metallic form and in the form of antimony compounds, oxides and salts. Only a small amount of antimony is used as a pure metal. Its main use is as an ingredient in many lead alloys. This is because of its hardening and strengthening effects, but also to a lesser extent, because of the expansion-on-solidification effect which it imparts to the lead.

Antimonial lead containing from 3 to 12 per cent antimony is used in the manufacture of storage batteries. Various other alloys made up of antimony, lead and, in some cases, other metals are used mainly in the production of type metal, bearing metal, solder and cable sheathing.

In its non-metallic form, antimony has a wide range of industrial applications. Certain compounds of antimony, because of their fire-retardant properties, are used in flameproof plastics and in solutions that make fabrics fire-resistant by surface application. The pentasulphide of antimony is used as a vulcanizing agent by the rubber industry and as a red pigment. The trioxide is an important ingredient of water and acid-fume resistant paints. Other pigments are used in the manufacture of glass and ceramics.

High-purity antimony is used in increasing amounts by manufacturers of intermetallic compounds for semiconductor use. An aluminum-antimony alloy is widely used as a semiconductor in transistors and rectifiers. Also used by the electronics industry are alloys of antimony which exhibit thermoelectric properties.

PRICES AND TARIFFS

Throughout 1962 the price of antimony, boxed, New York, as quoted by E & M J Metal and Mineral Markets, was 36.25 cents a pound. The bulk price, f.o.b. shipping point, was 32.5 cents a pound.

Antimony metal and antimony salts enter Canada free of duty. Ad valorem duties of 12 1/2 per cent (most favored nation) and 15 per cent (general) are applied to imports of antimony oxide.

The United States imposes the following duties: antimony regulus, 2 cents a pound; the lead content of antimonial lead, 1-1/16 cents a pound; antimony oxide, 0.8 cent a pound; antimony, liquated or needle, 1/4 cent a pound; and antimony sulphides and other compounds, ad valorem rates plus fixed amounts. Antimony ores and concentrates enter the United States duty-free.

Asbestos

H. M. Woodrooffe*

Shipments of asbestos from Canadian mines reached record levels in 1962 for the third consecutive year amounting to 1,215,814 tons valued at $130,281,966. The three producing provinces reported increased shipments.

In 1962 the state of California joined the asbestos-producing regions of the world with initial production from the Coalinga Asbestos Company mine, Fresno county; the Jefferson Lake Asbestos Corporation mine in Calaveras county; and the Hidden Splendor Mining Company near Coalinga. This area has traditionally been served by the Canadian industry, however, these developments are well located to supply the western market. It is reported that these companies will provide approximately 100,000 short tons of asbestos fibre annually, a great deal of which will be of the shorter grades.

Almost all of the Canadian production is exported to world markets. In 1962 more than 50 per cent of the asbestos exported was shipped to the United States. All Canadian requirements of amosite are imported from the Republic of South Africa; requirements of crocidolite come from South Africa and from Australia.

Although chrysotile asbestos is not uncommon in northern Ontario, Quebec, Newfoundland, British Columbia and Yukon Territory, most occurrences are not of economic grade. Consequently, production is restricted to British Columbia, Ontario and Quebec, the latter contributing 95 per cent of Canada's output of asbestos fibre. Production has been continuous since 1878.

What are believed to be the world's largest deposits of asbestos occur in the Eastern Townships of Quebec in a narrow band extending from east of the Chaudiere River, southwest almost to Sherbrooke, approximately 80 miles east of Montreal. All the producing deposits in the province are in this region. The presence of the mineral at depth, as established by drilling, indicates that reserves are sufficient for many years.

TECHNOLOGY

Although a number of minerals resemble asbestos in habit, the term is applied in commerce to five minerals with an industrial application. The most widely used fibre is chrysotile, a hydrous magnesium silicate. The others are crocidolite, a sodium-iron silicate; amosite, a silicate of both iron and magnesium partly hydrated; and tremolite and anthophyllite, which are silicates of calcium, magnesium, and iron. To all these minerals, industry applies the broad term 'asbestos'.

*Mineral Processing Division, Mines Branch.

Table 1

ASBESTOS - PRODUCTION AND TRADE

	1961		1962	
	Short Tons	$	Short Tons	$
PRODUCTION (shipments)				
Crude	163	143,296	205	172,160
Milled fibres	548,230	95,583,906	547,447	95,676,720
Shorts	625,302	33,228,698	668,162	34,433,086
Total	1,173,695	128,955,900*	1,215,814	130,281,966*
By province				
Quebec	1,103,545	115,944,729	1,125,131	114,297,886
British Columbia	45,103	8,648,503	55,132	10,297,360
Ontario	25,047	4,362,668	35,551	5,686,720
Total	1,173,695	128,955,900	1,215,814*	130,281,966*
EXPORTS				
Crude				
West Germany	62	54,338	76	65,290
Japan	67	59,082	54	47,562
United States	28	31,834	18	15,935
East Germany	-	-	18	13,756
Other countries	19	18,268	16	12,621
Total	176	163,522	182	155,164
Milled - Group 3 grades				
United States	13,801	6,040,637	15,422	6,659,974
Britain	2,603	972,039	2,319	922,036
West Germany	3,184	1,292,214	2,247	907,551
France	1,689	669,867	1,553	620,852
Japan	1,834	693,589	1,524	631,143
Italy	670	248,990	933	365,071
Spain	630	240,511	429	167,279
Belgium and Luxembourg	289	109,431	332	127,995
Brazil	55	20,761	80	30,330
India	46	19,828	70	28,275
Austria	34	12,973	36	14,759
Australia	23	8,503	32	11,101
Other countries	2,746	1,073,371	2,847	1,127,778
Total	27,604	11,402,714	27,824	11,614,144
Milled - Group 4 and 5 grades				
United States	131,482	22,933,302	154,290	26,828,876
France	36,490	6,726,486	46,967	8,263,022
West Germany	48,430	8,644,742	41,410	7,586,766
Britain	34,963	6,426,134	30,080	5,248,243
Japan	51,094	6,752,460	29,881	3,984,575

Table 1 (cont'd.)

	1961		1962	
	Short Tons	$	Short Tons	$
EXPORTS (cont'd.)				
Milled - Group 4 and 5 grades (cont'd.)				
Belgium and Luxembourg.	23,535	4,209,109	27,635	4,869,750
Australia	22,315	3,460,172	21,148	3,644,894
Brazil	12,973	2,267,729	14,811	2,545,425
India	4,290	763,707	11,734	2,160,026
Italy	18,953	3,559,569	11,152	2,028,781
Austria	9,261	1,617,441	11,115	1,938,199
Colombia	9,730	1,846,720	11,110	2,151,945
Spain	10,175	1,945,169	10,223	1,838,599
Other countries	86,029	15,234,490	82,640	14,298,433
Total	499,720	86,387,230	504,196	87,387,534
Total, milled fibres, groups 3, 4 and 5				
United States	145,283	28,973,939	169,712	33,488,850
France	38,179	7,396,353	48,520	8,883,874
West Germany	51,614	9,936,956	43,657	8,494,317
Britain	37,566	7,398,173	32,399	6,170,279
Japan	52,928	7,446,049	31,405	4,615,718
Belgium and Luxembourg.	23,824	4,318,540	27,967	4,997,745
Australia	22,338	3,468,675	21,180	3,655,995
Brazil	13,028	2,288,490	14,891	2,575,755
Italy	19,623	3,808,559	12,085	2,393,852
India	4,336	783,535	11,804	2,188,301
Austria	9,295	1,630,414	11,151	1,952,958
Colombia	9,730	1,846,720	11,110	2,151,945
Spain	10,805	2,185,680	10,652	2,005,878
Other countries	88,775	16,307,861	85,487	15,426,211
Total	527,324	97,789,944	532,020	99,001,678
Milled - Short-fibre grades				
United States	412,722	21,556,498	449,147	23,944,176
Japan	44,618	3,815,841	41,663	3,551,600
Britain	36,950	2,052,007	34,163	1,823,776
West Germany	26,633	1,374,457	28,353	1,498,633
Belgium and Luxembourg.	13,212	1,024,761	13,657	1,121,048
France	11,662	662,208	12,362	836,885
Netherlands	7,547	474,473	11,331	715,376
Australia	4,008	263,974	5,639	385,348
Sweden	4,828	334,293	5,221	350,046
Other countries	27,200	1,828,831	30,932	2,253,916
Total	589,380	33,387,343	632,468	36,480,804
Grand total, exports of asbestos fibre	1,116,880	131,340,809	1,164,670	135,637,646

Table 1 (cont'd.)

	1961		1962	
	Short Tons	$	Short Tons	$
EXPORTS (cont'd.)				
Manufactured products				
Brake linings and clutch facings				
United States		43,467		43,502
Lebanon..............		37,088		39,841
Colombia.............		5,773		34,323
Ecuador..............		23,481		32,067
Syria		20,491		28,052
Venezuela............		52,623		22,975
Greece...............		19,695		16,690
El Salvador..........		20,634		16,053
Jamaica..............		9,611		15,391
Cuba		199,892		2,350
Other countries........		179,990		138,192
Total		612,745		389,436
Asbestos and asbestos cement building materials				
United States		98,331		320,859
Belgium and Luxembourg		-		24,020
Chile		-		12,361
Jamaica		231		852
Other countries........		7,389		6,034
Total		105,951		364,126
Other asbestos and asbestos cement products				
United States		119,708		327,254
Switzerland		51,704		18,608
Britain		19,888		15,667
Jamaica...............		4,767		13,281
Mexico		1,561		12,084
Cuba		22,018		10,963
Chile		-		2,355
Other countries		42,186		16,978
Total		261,832		417,190
Total, asbestos and asbestos cement products				
United States		218,039		648,113
Belgium and Luxembourg		-		24,020
Switzerland		51,704		18,608
Britain		19,888		15,667

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Table 1 (cont'd.)

	1961		1962	
	Short Tons	$	Short Tons	$
EXPORTS (cont'd.)				
Total, asbestos and asbestos cement products (cont'd)				
Chile		-		14,716
Jamaica		4,998		14,133
Mexico		1,561		12,084
Cuba		22,018		10,963
Other countries		49,575		23,012
Total................		367,783		781,316
Grand total exports of manufactured products ..		980,528		1,170,752
IMPORTS				
Packing	248	429,600	217	443,937
Auto brake linings		804,368		910,275
Auto clutch facings		296,713		249,528
Other brake linings and clutch facings		187,888		285,963
Other manufactured asbestos..............		3,553,166		3,050,140
Total................		5,271,735		4,939,843

Source: Dominion Bureau of Statistics.
*Does not include the value of the containers. This amounted to $4,404,380 in 1961, and $4,748,791 in 1962.
Symbol: - Nil.

Chrysotile, providing 90 per cent of the world's commercial asbestos, is the only variety mined in Canada. It occurs as 'cross fibre' and 'slip fibre'. In the former, individual fibres lie parallel across the vein so that the vein width is an approximate indication of fibre length. Many of the partings often found in the veins are caused by the inclusion of magnetite or other minerals. Some fibres are as long as five inches, but most of the fibre recovered commercially is half an inch or less in length.

Slip fibre, which frequently occurs along the Pennington Dike east of Thetford Mines, is normally found along fault planes in heavily sheared peridotite or serpentine bodies. Fibres of this type are arranged in an overlapping manner.

Many industrial uses of chrysotile are more the result of the mineral's physical characteristics than of its chemical nature. These properties vary to some degree with the occurrence. Quebec produces a fine, silky fibre which is ideally suited for spinning and can be worked into textile products; the Ontario product has a harsh texture. This harshness is much desired in the asbestos-cement industry because it gives a fast-filtering quality to an asbestos-cement slurry.

Table 2

ASBESTOS - PRODUCTION AND EXPORTS, 1953-62

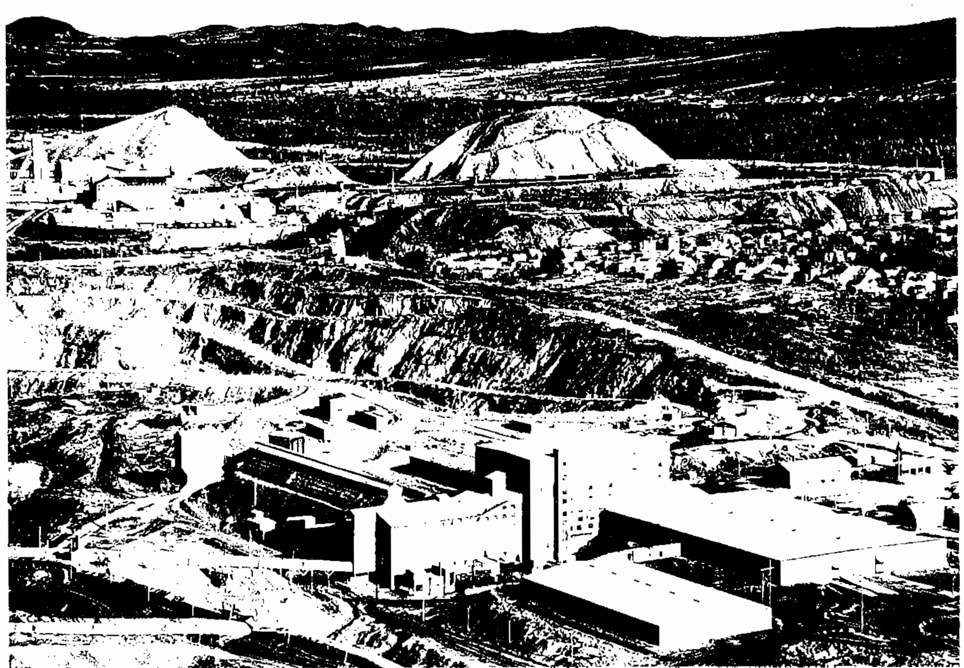
(short tons)

	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962
PRODUCTION*										
Crude	781	725	724	717	622	605	432	330	163	205
Milled	326,340	326,653	395,096	392,983	404,016	342,562	404,019	483,183	548,230	547,447
Shorts	584,105	596,738	667,982	620,549	641,448	582,164	645,978	634,943	625,302	668,162
Total	911,226	924,116	1,063,802	1,014,249	1,046,086	925,331	1,050,429	1,118,456	1,173,695	1,215,814
EXPORTS										
Crude	638	641	586	560	638	483	416	241	176	182
Milled	316,588	312,844	365,980	377,044	393,311	318,280	401,583	458,053	527,324	532,020
Shorts	561,304	574,243	635,261	586,317	636,611	547,867	611,923	610,199	589,380	632,468
Total	878,530	887,728	1,001,827	963,921	1,030,560	866,630	1,013,922	1,068,493	1,116,880	1,164,670

Source:Dominion Bureau of Statistics.
*Producers' shipments.

The open pit and mill of Lake Asbestos of Quebec Ltd. at Black Lake in the Eastern Townships of Quebec. In order to expose the orebody, which was under Black Lake, extensive dredging and draining had to be done. The remnants of the lake can be seen in the background. The Eastern Townships produce most of Canada's asbestos and 40 per cent of the world supply.

King-Beaver mill of Asbestos Corporation Limited at Thetford Mines, Quebec. Johnson's Company mill is in the left background.



The commercial fibre recovered in northern British Columbia is low in magnetite. This is an advantage to the electrical industry, in which the fibre is used to provide heat-resistant and nonconductive woven insulation.

Crocidolite, commonly called 'blue fibre', is an asbestos of the amphibole group and has properties of commercial value. It is used in the manufacture of asbestos-cement pressure pipe and of packing. It is not mined in Canada, although occurrences have been reported from the iron-ore region near the Labrador-Quebec boundary. Large commercial deposits occur in South Africa; it is also produced in Australia, and in the U.S.S.R.

Amosite, a heat-resistant type of anthophyllite, is used principally in the manufacture of thermal insulation. No Canadian occurrence is known. The world amosite market is supplied from deposits in South Africa.

Other asbestos minerals - fibrous tremolite, actinolite and anthophyllite - occur in Canada, but none are produced. The fibres of these minerals are usually weak and unsuitable for most asbestos uses. There are, however, certain uses for which their natural chemical and physical properties are suited. During the war, it was reported that a small amount of tremolite was being produced in eastern Ontario.

Chrysotile is mined in Canada by both open-pit and underground methods. It is prepared for the market by a dry-milling process in which the ore is crushed, impact-milled, fiberized and separated into different grades of commercial fibre and a waste product or tailing. Although the recovered fibre is graded for the market essentially by length, other factors, such as bulk volume, contained dust and degree of openness, are also considered.

PRODUCTION AND DEVELOPMENT

Newfoundland

Chrysotile occurs in several places in Newfoundland. A recent discovery of a semiharsh-fibre deposit near Baie Verte, on the northeast coast of the island, was being developed by Advocate Mines Limited. Substantial reserves have been established and construction of a milling plant was approaching completion. It is scheduled for production in mid-1963. The company is controlled by an international group of asbestos firms headed by Canadian Johns-Manville Company, Limited.

Quebec

Asbestos is produced in the southern part of the province, in the counties of Richmond, Arthabaska, Megantic and Beauce. There are 13 producing mines in the vicinities of Thetford Mines, Black Lake, East Broughton and Asbestos.

One of the world's largest asbestos mines, the Jeffrey, is operated by Canadian Johns-Manville Company, Limited, at Asbestos, Richmond county, 80 miles east of Montreal. For many years it was operated as an open-pit mine, but since the war extensive underground workings have been developed and much of the ore has been recovered by the block-caving mining method. Taking advantage of technical improvements, the company embarked upon an extensive conversion program, resulting in the Jeffrey reverting to an open-pit operation.

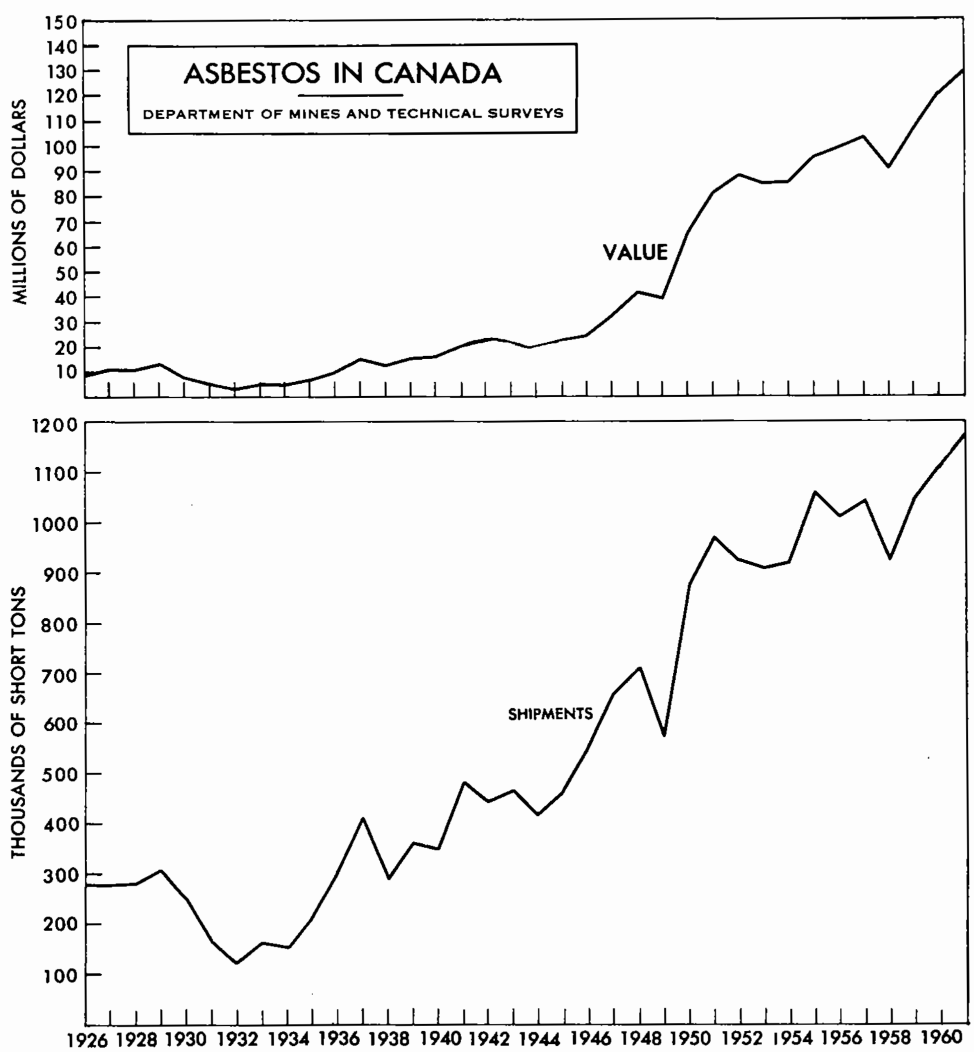
Asbestos Corporation Limited had three mills in operation in the Thetford Mines area. Two - the British Canadian, at Black Lake; and the Normandie, in Ireland township - processed ore recovered from adjacent open pits. At Thetford Mines, the operations of the Beaver pit and King underground mine have been integrated with a common mill.

Johnson's Company Ltd., the oldest in the industry, has an underground mine at Thetford Mines. Its associate, Johnson's Asbestos Company, produced the mineral from an open pit at Black Lake, where a 4,000-ton mill began operating in 1954.

The underground mine of Bell Asbestos Mines, Ltd., is also at Thetford Mines.

Flintkote Mines Limited and Nicolet Asbestos Mines Ltd. recovered asbestos from open-pit mines a few miles east of Thetford Mines and at St. Remi de Tingwick respectively.

Lake Asbestos of Quebec, Ltd., a subsidiary of American Smelting and Refining Company, operated a 5,000-ton-a-day mill at its deposit in the bed



of Black Lake. Preparation of the deposit for open-pit mining required extensive dredging and the draining of Black Lake.

Carey-Canadian Mines Ltd., a subsidiary of The Philip Carey Manufacturing Company, was in production with a 2,500-ton mill at its property near Tring Junction, Beauce county, east of Thetford Mines.

National Asbestos Mines Limited, a subsidiary of National Gypsum (Canada) Ltd., recovered asbestos from a deposit along the Pennington Dike a few miles east of Thetford Mines.

Murray Mining Corporation Limited was actively exploring an occurrence in Ungava, northern Quebec, about 30 miles south of Deception Bay. By the end of 1961 the company reported an asbestos zone bearing reserves of 20 million tons of ore. Asbestos Corporation Limited has in hand an engineering feasibility study of the deposit under terms of an option with Murray Mining.

Ontario

Canadian Johns-Manville Company, Limited, operated an underground mine at Munro, east of Matheson, in northern Ontario. This is the only producing asbestos mine in the province.

British Columbia

Cassiar Asbestos Corporation Limited recovered long- and medium-fibred asbestos from a deposit on Mount McDame, in northern British Columbia. The fibre is shipped by the Alaska Highway to Whitehorse, Yukon Territory, and then by the White Pass & Yukon Route railway to Skagway, Alaska.

WORLD REVIEW

According to preliminary information, world production of asbestos in 1962 rose to the record level of 2.95 million short tons. Canadian production is currently about 40 per cent of the world total.

During the past few years, the U.S.S.R. has markedly increased its production from deposits near Sverdlovsk in the Urals and is approaching Canada in volume of output. Although the U.S.S.R. does not publish statistics on the asbestos industry, its current level of production is estimated to be one million tons a year. It exports about 15 per cent of its production and competes with Canadian asbestos in overseas markets.

Africa supplies an important segment of world production. In 1962, the Federation of Rhodesia and Nyasaland reported an output of 161,000 short tons of high quality chrysotile. Rhodesian fibre, because of its freedom from magnetic iron, finds a ready market in asbestos products used in the electrical industry. The asbestos-mining industry of the Republic of South Africa is the dominant world producer of crocidolite and amosite. In 1962, its production of all varieties totalled 221,302 tons.

USES

Chrysotile, because of its physical characteristics, is an important raw material in many industrial processes. When of the proper texture, the longer fibres may be processed in much the same manner as the organic staple fibres. Consequently it may be carded, spun, and woven into cloths of different weights, thicknesses and qualities. These cloths are used in the manufacture of heat-resistant friction materials.

The most important single market for this commodity is the asbestos-cement industry. Asbestos is combined with portland cement for manufacture into a number of products, such as pressure and nonpressure pipe, flat and corrugated sheeting shingles, roofing tile and millboard. This use has grown considerably since the war, and the resulting products are well established throughout the world. Although asbestos-cement products are used largely in the construction of buildings, other industrial applications are growing, particularly in the electrical field. The use of asbestos-cement pipe in municipal water distribution systems and in the disposal of sewage waste is now well established. The durability of the pipe and its resistance to corrosion have been of advantage in these applications.

In thermal insulation, asbestos is used as a kind of paper. In combination with other materials, it is also widely used in the form of preformed sections or slabs for boiler and steam-pipe covering and in oil-refinery and chemical-plant construction.

The shorter-fibre grades of asbestos have the greatest number of uses. At present the volume of asbestos classified as short-fibre far exceeds that of all other grades combined. This type is used in the moulding of plastics, the manufacture of floor tiling and protective coatings, the paint industry and other applications requiring a fibrous filler with the physical characteristics of asbestos.

The automobile industry uses asbestos products in large quantities; they include woven and moulded brake linings, clutch facings and pressure gaskets. Undercoating compounds provide an important use for very short grades of fibre.

PRICES

Asbestos prices at the end of 1962 were virtually the same as in 1961. Prices, per short ton, f.o.b. mine, Quebec, in Canadian currency, by grades were as follows:

No. 1 crude	$1400	5 K fibre	$142
No. 2 "	750	5 R "	120
3 F fibre	565	6 D "	86
3 K "	480	7 D "	75
3 T "	370	7 F "	71
3 Z "	345	7 H "	61
4 A "	320	7 K "	50
4 D "	218	7 M "	44
4 H "	208	7 T "	41
4 K "	200	7 RF floats	44
4 M "	200	7 TF "	44
4 T "	181	7 R "	43
4 Z "	181	8 S "	29
5 D "	142	8 T "	22

Minimum carload quantity, grades 1 to 5 R inclusive, is 20 tons; grades 6 to 8 inclusive, is 30 tons.

Barite

J.S. Ross*

Barite output increased proportionately with exports of crude to the United States. Both production and exports are dependent mainly upon the requirements of one chief foreign importing company and do not necessarily fluctuate proportionately with the demands of the foreign well-drilling industry, the chief market.

In 1962, export demand increased over that for 1961 by 34 per cent and resulted in a 18 per cent rise in production. Producer's shipments again reached a relatively high level after two years of low output but were far below the record of 320,835 tons registered in 1956. They amounted to 226,600 tons valued at $2,123,964. Although 93 per cent of the output was shipped from mining operations in the crude form, about 26,000 tons - 11 per cent of the total - were eventually pulverized in Canada.

For 1962, estimates indicate that Canada remained as the fourth-ranking barite producer and that world production amounted to 3.3 million short tons. The leading producers in descending order were the United States, West Germany, and Mexico.

Exports, equivalent to 102 per cent of production, were mostly in the crude form. Although small shipments were made to Trinidad, 92 per cent of all exports went to the Gulf of Mexico ports of the United States. Occasionally small amounts go to Alaska. The most noteworthy trend in international barite trade was the 21 per cent increase in imports by the United States during 1962. Practically all this additional amount was supplied by Mexico and Canada in that descending order.

Imports continued to be minor. They were of the pulverized chemical variety and were almost entirely from the United States.

Canadian well-drilling footage was the lowest since 1959. Because of this reduced requirement by the well-drilling industry, total domestic barite consumption was only 11,249 tons in 1962, a drop of 40 per cent from 1961 and 56 per cent from 1960. This decrease has affected the production of the seven western barite-producing mines and plants.

*Mineral Processing Division, Mines Branch.

Table 1

BARITE - PRODUCTION, TRADE AND CONSUMPTION

	1961		1962	
	Short Tons	$	Short Tons	$
PRODUCTION (mine shipments)				
Crushed and lump	178,864	1,540,168	210,456	1,790,590
Ground	12,540	258,951	16,144	333,374
Total	191,404	1,799,119	226,600	2,123,964
IMPORTS (ground)				
United States	1,582	83,654	2,209	106,455
West Germany	282	9,632	218	8,436
Britain	25	962	-	-
Total	1,889	94,248	2,427	114,891
EXPORTS				
United States	157,920	1,782,876	212,535	1,805,915
Trinidad	9,856	182,336	18,368	332,260
Venezuela	3,920	33,323	-	-
Total	171,696	1,998,535	230,903	2,138,175
CONSUMPTION*				
Well-drilling	17,011		8,873	
Paints	910		1,343	
Rubber goods	301		322	
Glass	412		628	
Miscellaneous chemicals	80		73	
Miscellaneous non-metallic products	9		10	
Total	18,723		11,249	

Source: Dominion Bureau of Statistics. * These quantities are compiled from information provided by the Dominion Bureau of Statistics.
Symbol: - Nil.

Barium and strontium metal are produced in small quantities for export by Dominion Magnesium Limited at Haley, Ontario.

There was no major development in the domestic barite industry during the year. In the United States, the Federal Trade Commission held hearings on complaints against National Lead Company, Dresser Industries Incorporated, and the latter's subsidiary, Magnet Cove Barium Corporation, to determine whether they had violated certain laws by acquiring some of their competing companies. In the latter part of the year the Commission ruled that these companies had not violated antitrust laws.

Table 2

BARITE - PRODUCTION, TRADE AND CONSUMPTION, 1953-62
(short tons)

	Production(a)	Imports	Exports(b)	Apparent Consumption
1953	247,227	1,207	243,200	5,234
1954	221,472	1,236	207,800	14,908
1955	253,736	1,449	244,070	11,115
1956	320,835	1,475	312,275	10,035
1957	228,048	1,831	199,785	30,094
1958	195,719	1,382	172,942	24,159
1959	238,967	1,662	221,721	22,404c
1960	154,292	2,021	134,972	25,483c
1961	191,404	1,889	171,696	18,723c
1962	226,600	2,427	230,903	11,249c

Source: Dominion Bureau of Statistics. (a) Mine shipments.
(b) 1953 and 1954, based on producers' stated export shipments.
(c) Consumption reported by consumers.

PRODUCTION

Deposits of barite (natural barium sulphate) have been noted in all provinces except Alberta, Saskatchewan, and Prince Edward Island. Barite is recovered from one deposit in Nova Scotia and from four in British Columbia. In 1962 token shipments were made from a fifth occurrence in the latter province. All production from British Columbia was shipped out of the province for further processing. All from Nova Scotia was consumed elsewhere and most was processed in southeastern United States.

Nova Scotia

Depending on export demand, the Walton mine of Magnet Cove Barium Corporation normally supplies 90 per cent or more of the Canadian barite output. It is the only barite mine being operated in eastern Canada and is strategically situated near the ocean port of Walton from which it can supply world markets. Ore reserves are estimated at 1.7 million short tons. The ore was recovered by underground mining methods employing blast-hole stoping and block caving, and was concentrated at a beneficiation plant. Some barite was recovered from lead-silver ore which was also mined at this operation. Concentrates were trucked to the port of Walton from where crushed, lump, and occasionally pulverized barite was shipped, mainly by water. Most went to plants owned by the parent company in the United States as crushed and lump concentrates. It was then processed further, mainly for use in well-drilling in that country.

British Columbia

Mountain Minerals Limited mined barite from two vein deposits near Brisco and Parson. Ore was recovered by open-pit and underground methods and shipped to various other provinces. Much of it was processed at the company's grinding plant at Lethbridge, Alberta, for use in well-drilling muds.

Baroid of Canada, Ltd., recovered barite from the Giant mine near Spillimacheen and shipped it to the company's grinding plant at Onoway, Alberta, for further processing and eventual sale to the well-drilling industry.

Barite was recovered during the open-stope mining of lead-zinc ore at the Mineral King mine of Sheep Creek Mines Limited near Invermere. It is shipped as crude to grinding plants in Alberta and processed for use mainly as a heavy medium in well-drilling.

A small amount of crude barite was shipped from the Larrabee deposit near Invermere.

Alberta

No barite is mined in Alberta, however, most of this commodity mined in British Columbia is ground at either the Lethbridge plant of Mountain Minerals Limited, the Rosalind plant of Magcobar Mining Company, Limited, or at the Onoway operation of Baroid of Canada, Ltd.

Quebec

At Montreal, Industrial Fillers Limited grinds purchased barite as the market demands.

OTHER OCCURRENCES

In most provinces there are many other barite deposits some of which have been mined intermittently particularly during the early part of the century. The more noteworthy are at the Buchans mine, Buchans, Newfoundland; near Lake Ainslie, Cape Breton Island; in Penhorwood and Langmuir townships, northern Ontario; on McKellar Island, Lake Superior; and at Mile 397 on the Alaska Highway, British Columbia. Witherite (barium carbonate) occurs in a large deposit near Mile 497 on the British Columbia section of the Alaska Highway. Witherite, barylite, barytocalcite and other, rarer, barium minerals occurring in Canada, have not yet been used.

Barite deposits in Quebec and Nova Scotia were explored during the year.

Estimated reserves in deposits now being worked are sufficient to meet normal requirements for more than a decade. Additional barite is available from a number of noteworthy deposits that are not being exploited for that commodity.

USES AND SPECIFICATIONS

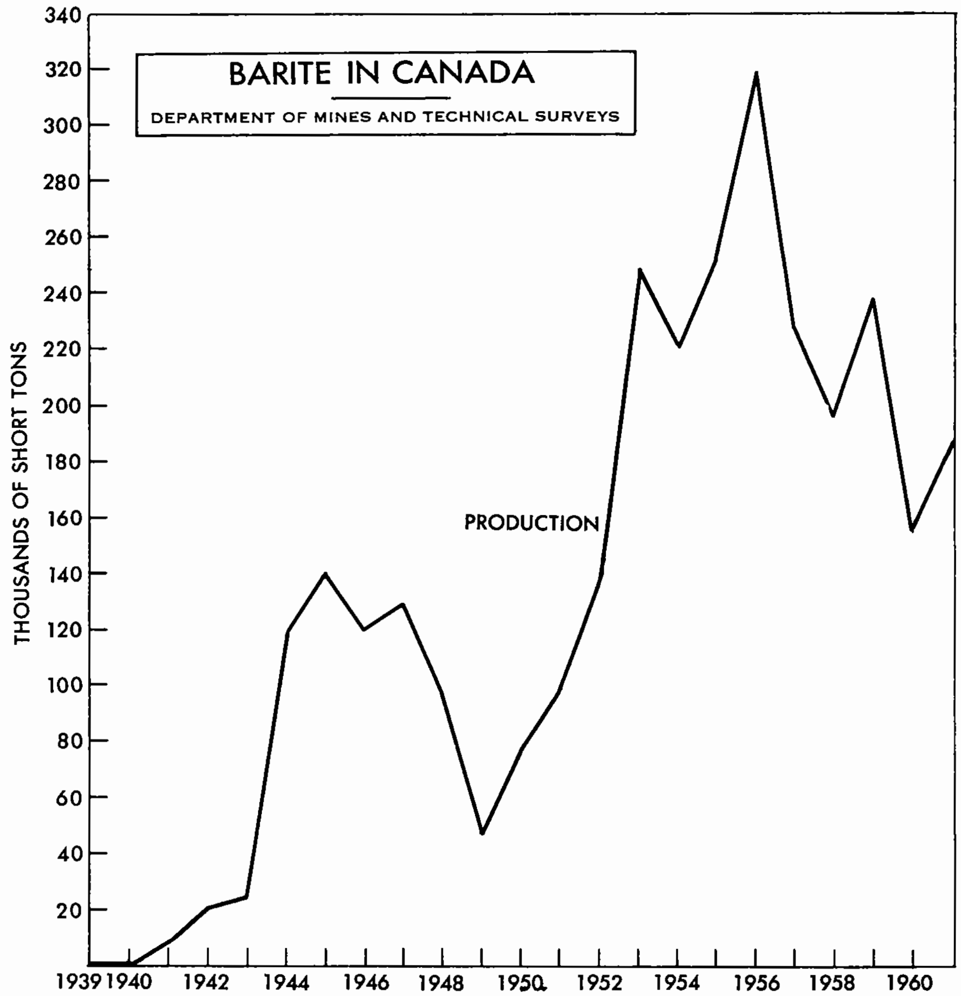
Barite is used by industry mainly because of its physical properties. These include a relatively high specific gravity, inertness under normal conditions, and on occasion, whiteness. Demand for its chemical properties is minor. It is used by the chemical industry because of its barium content.

Barite is marketed in lump, crushed or ground form. By far the largest part of world production is used as a heavy medium in well-drilling muds, in which it helps to control fluid pressures and to float drill cuttings. Barite, normally the most desirable commodity for this purpose, is not likely to be replaced to any extent in the near future by other heavy media. Although the use of fluids other than water-bentonite mud has increased notably in North America in recent years, it has not had any noticeable effect on barite consumption.

In 1962, 79 per cent of the barite consumed in Canada was used as a heavy medium in oil- and gas-well drilling. About 90 per cent of the North American consumption was used for this purpose. Practically all the barite exported by Canada was used in the well-drilling industry. Specifications vary according to the particular needs of the consumer and commonly designate a minimum specific gravity of 4.20 to 4.25 and a particle size at least as fine as 90 to 95 minus 325 mesh. A small amount of iron oxide is allowable but soluble salts are objectionable.

Fifteen per cent of Canada's requirements was consumed as a conventional type of filler in 1962. It was used in paints, rubber products, paper and miscellaneous products. Except for some rubber products, barite required for filler purposes should normally have a high reflectivity, a minimum of 94 per cent barium sulphate, and a particle size under 200 mesh.

Most of Canada's remaining requirements were used in glass manufacture where it acts as a flux, increases the melt-workability, and adds lustre to the product. Usual specifications are a minimum of 98 per cent barium



sulphate, less than 0.15 per cent ferric oxide and a particle size of 20 to 200 mesh.

Because the barium-chemicals industry is almost nonexistent in Canada, this industry's consumption of barite is minor and sporadic. The more common barium compounds manufactured throughout the world and some of their applications are as follows: precipitated barium sulphate, or blanc fixe, used as an extender and pigment in paints and as a filler in paper; lithopone, a mixture of barium chloride, for case-hardening and the prevention of scumming on brick; and barium carbonate, used for the reduction of scumming on brick and ceramics. Barium oxide, hydrate, titanate, chlorate, nitrate, sulphide and phosphate are also manufactured. Some of these chemicals are used as a source of barium metal. Because barium titanate has a high dielectric constant and piezoelectric and ferroelectric properties, its use in relatively minor amounts has become widespread. Barite for the manufacture of chemicals must be in lump form and contain a minimum of 94 per cent barium sulphate and a maximum of one per cent ferric oxide.

Import and consumption statistics on some of the barium chemicals consumed in Canada are given in Table 3.

Small amounts of crushed barite are used as heavy aggregate in concrete shielding against atomic radiation.

Table 3

BARIUM COMPOUNDS - IMPORTS AND CONSUMPTION

	1961		1962	
	Short Tons	$	Short Tons	$
IMPORTS				
Lithopone (70% $BaSO_4$)........	630	91,250	734	120,156
Blanc fixe and satin white.....	1,144	101,149	1,156	125,700
	1960			
CONSUMPTION of some barium compounds in the chemical and allied-products industries				
Barium chloride	297			
Barium nitrate	58			
Blanc fixe...................	284			
Lithopone	1,058			

Source: Dominion Bureau of Statistics.

PRICES

In 1962 Canadian shipments of crushed, lump, and semiprocessed barite averaged $8.51 a short ton at the mine or mill. For the finished ground product, prices varied from about $20 to $25 a ton.

The E & M J Metal and Mineral Markets for December 31, 1962 quoted the following prices for barite - unchanged from the previous December.

	Dollars
Canada	
Crude, in bulk, f.o.b. shipping point, per long ton	11.00
Ground, in bags , per short ton	16.50
Missouri	
Water-ground and floated, bleached, carload lots, f.o.b. mill, per short ton	45.00-49.00
Crude ore, min. 94% $BaSO_4$ less than 1% Fe, per short ton ...	16.00-18.00
Crude oil-well drilling, min. specific gravity 4.3, bulk, per short ton	18.00
Ground, oil-well grade, per short ton	26.75

	Dollars
U.S. Gulf ports	
Foreign, crude, oil-well grade, min. specific gravity 4.25, bulk, c.i.f. ports, per short ton	11.00-14.00

TARIFFS

Tariffs currently in effect in Canada and the United States have not changed in recent years and are as follows:

Canada	British Preferential	Most Favored Nation	General
Barite			
Crude or ground	free	25%	25%
For drilling-mud use	"	free	free

United States	
Ore, per long ton	
Crude or unmanufactured	$2.55
Ground or otherwise manufactured	6.50

Bentonite

J.S. Ross*

Consumption of bentonite in Canada, which was 57,237 tons in 1962, will increase greatly in the immediate future. Assuming that bentonite remains competitive as a pelletizing agent and based on estimated rated requirements by iron-ore pelletizing plants in operation, planned and under construction, total consumption could be as high as 155,000 tons per annum about the end of 1965. About 90,000 tons of this increase will be for pelletizing. Because all current requirements for this use are imported, a challenge exists for the establishment of a high-quality Canadian source for pelletizing iron-ore concentrates. To this end, the co-operation of the iron and steel and the iron-ore industries is essential.

Several definitions have been ascribed to the term 'bentonite'. For the purpose of this review it is regarded as a clay composed essentially of minerals of the montmorillonite group. These minerals have ions in their structures that can be exchanged for others. Although there are various classifications, bentonites may be roughly classified into two main types - swelling and nonswelling. In the swelling variety, the predominant exchangeable ion is sodium; in the nonswelling type it is calcium. In contact with water, swelling bentonite increases noticeably in volume and forms a colloidal suspension. Under similar conditions, the nonswelling variety expands only slightly in volume. It has the faculty of adsorbing certain impurities from liquids and, when activated, may have appreciable adsorptive characteristics. Many definitions have been applied to fuller's earth. In this review it is designated as a naturally active, nonswelling bentonite.

PRODUCTION AND TRADE

Swelling, nonswelling and activated bentonites, the most commonly used types, are produced by three companies, two in Alberta and one in Manitoba. Production statistics are not available but it is estimated that domestic operations supply about half Canada's current requirements.

*Mineral Processing Division, Mines Branch.

Table 1

BENTONITE - TRADE AND CONSUMPTION

	1961 Short Tons	1961 $	1962 Short Tons	1962 $
IMPORTS (incomplete)				
Activated clay(a)				
United States		1,006,916		934,465
Fuller's earth				
United States		150,576		165,282
West Germany		4,619		4,346
Britain................		1,807		3,187
Total		157,002		172,815
Clay for use in drilling mud				
United States	14,224	364,252	14,954	416,800
EXPORTS				
Earths or clays artificially activated(b)				
United States	4,503	191,841	4,029	149,132
CONSUMPTION(c)				
Well drilling	36,664		29,839	
Iron and steel foundries.	12,912		13,878	
Pelletizing iron-ore concentrates	10,213		10,091	
Petroleum refining	2,265		1,870	
Paper.................	227		366	
Miscellaneous chemicals............	251		378	
Miscellaneous nonmetallic products ..	736		815	
Total	63,268		57,237	

Sources: Dominion Bureau of Statistics with exceptions as indicated.
(a) Includes clay catalysts in addition to adsorptive clays. (b) From exports of activated clays to the United States as given by the U.S. Department of Commerce, in its United States Imports of Merchandise for Consumption (Report FT 110). (c) Includes fuller's earth; calculated from data provided by the Dominion Bureau of Statistics.

Several grades of swelling bentonite are recovered from the Edmonton formation near Rosalind, Alberta, by Magcobar Mining Company, Limited. The clay is dried, ground and sized at Rosalind and marketed for various uses but mainly for well drilling. Baroid of Canada, Ltd., recovers a similar type of bentonite from the Edmonton formation and processes it at Onoway, Alberta; it is primarily for use in drilling mud. The nonswelling and activated types are supplied by Pembina Mountain Clays Ltd. This company removes the clay from the Vermilion River formation near Morden, Manitoba, and processes it at Morden for miscellaneous uses. Most is shipped to the company's Winnipeg plant for activation and eventual sale as bleaching clay for use in the refining of animal, vegetable and mineral oils. Much of the activated product is exported.

In the latter part of 1962, Carol Pellet Company commenced construction of a plant for pulverizing bentonite at Labrador City, Labrador.

Bentonite exports continued to be small in 1962. Activated clay, amounting to 4,029 tons valued at $149,132, was exported to the United States. The amount exported in the non activated form is unknown but was either minor or non existent. Imports were significant. They included fuller's earth valued at $172,815, activated clay and clay catalysts amounting to $934,465 and clay for use in drilling mud valued at $416,800. Practically all the clay for drilling mud was bentonite; the clay catalysts included some bentonite. In addition, an estimated 18,000 tons of bentonite were imported for pelletizing and foundry use. From this it can be estimated that Canada imported 38,000 tons of bentonite in 1962.

CANADIAN OCCURRENCES

The more-extensive bentonite deposits are in formations of Cretaceous and Tertiary age in the four western provinces. In Manitoba, nonswelling bentonite occurs in the Vermilion River formation; the semiswelling variety occurs in the Riding Mountain formation. Both formations extend from the international border, near Morden, northwest to Swan River. In Saskatchewan, semiswelling bentonite is in the Ravenscrag formation in the southwestern part of the province; the nonswelling horizons are in the Vermilion River and Riding Mountain formations in the southeastern part and in the Ravenscrag formation near Rockglen.

The better types of swelling bentonite in Alberta are in the Edmonton and Bearpaw formations, which are near such communities as Rosalind. Onoway, Camrose, Drumheller-Rosedale, Irvine-Bulls Head, Bickerdike and Grande Prairie.

In British Columbia, bentonite is in Tertiary formations chiefly near Princeton, Merritt, Kamloops and Clinton.

Table 2

BENTONITE - IMPORTS AND CONSUMPTION, 1953-62a

	Imports(b) Bentonite ($)	Consumption Fuller's Earth (short tons)	Bentonite (short tons)
1953	443,510	15,982	35,167
1954	835,433	1,732	23,844
1955	1,247,355	1,565	28,821
1956	1,484,124	1,783	30,562
1957	1,536,512	1,654	26,105
1958	980,585	1,595	23,429
1959	1,082,593	1,369	60,258c
1960	1,590,441		64,871c
1961	1,528,170		63,268c
1962	1,524,080		57,237c

Sources: Dominion Bureau of Statistics except where otherwise indicated. (a) The value of producers' shipments is not available for publication after 1952. (b) Activated clays for oil-refining. They include clay catalysts in addition to adsorptive clays. (c) The larger total is due in part to an increase in the survey coverage, particularly in well-drilling. It includes fuller's earth. Calculated from data provided by the Dominion Bureau of Statistics.

CONSUMPTION AND USES

In 1962, domestic bentonite consumption was 57,237 tons valued at an estimated two and a half million dollars. Fifty-two per cent was used in well drilling, 24 per cent in iron and steel foundries and 18 per cent in pelletizing iron-ore concentrates. In 1963, consumption for pelletizing iron-ore concentrates should approximate that for well drilling.

Activated bentonite is used in decolorizing vegetable, animal and mineral oils, as well as beverages, syrups, and other liquids. It is also employed as a catalyst in the refining of fluid hydrocarbons. Small quantities of the natural nonswelling type are used as a binder.

Swelling bentonite is used in much greater quantities than the non-swelling type. Its applications are numerous; for most it is used in small quantities. It is used mainly in well drilling fluids, foundry mouldings and pelletizing. In drilling fluids, bentonite prevents settling of drill cuttings, retains drilling fluids by forming impervious coatings on drill-hole walls, and within limits, controls the viscosity of drilling fluids. Drilling with air and other gases has increased in recent years but this application has not appreciably affected bentonite consumption. In the foundry industry and in the pelletizing of iron-ore concentrates, it commonly serves as a binder.

Currently, two iron-ore producers, one in Quebec and one in Ontario, use bentonite for pelletizing. The large plant of Carol Pellet Company, which is currently starting production at Labrador City, Labrador, is now using it for this purpose. Construction in progress and proposed for similar types of pelletizing plants could be completed within about three years by Lowphos Ore, Limited, near Capreol, Ontario; Jones & Laughlin Steel Corporation, Boston township, Ontario; and Wabush Mines, Wabush Lake, Labrador. If bentonite remains competitive, the rated annual consumption for pelletizing could be approximately 100,000 tons in the latter part of 1965.

Swelling bentonite also serves: to plasticize abrasive, ceramic and refractory raw mixes; as a filler in paper, rubber, pesticides, cosmetic and medicinal products, soaps and cleansers; in the grouting of underground water-bearing zones; and in sealing such structures as dams and reservoirs. Bentonite slurry is effective in firefighting.

PRICES AND TARIFFS

Prices vary with the type, quality and quantity of bentonite. In 1962, much of the domestic drilling-quality bentonite was reduced in price from $56 to $40 a ton. Imported clay for drilling averaged $27.87 a ton, up from $25.61 in 1961. Exported activated clay averaged $37.01 a ton, down from $42.60 in 1961.

In the United States, carload lots of bagged swelling bentonite cost about $14 a ton, f.o.b. the mines, and about $7 to $8 a ton in bulk.

	British Preferential	Most Favored Nation	General
Canada			
Clays, not manufactured further than ground	free	free	free
Activated clays			
For refining oils	10%	10%	25%
Not for refining oils	15%	20%	25%

United States	
Bentonite, per long ton	
Unwrought and unmanufactured	37 1/2¢
Wrought and manufactured	81 1/4¢
Clays, artificially activated	1/10¢ per lb plus 12 1/2% ad valorem

Bismuth

J.W. Patterson*

In 1962 the entire output of bismuth, 425,102 pounds, came from British Columbia and Quebec. In 1961, those provinces and Ontario produced 478,118 pounds. The decline in output was largely the result of a reduction in British Columbia's production of lead with which bismuth is associated and recovered as a byproduct. Three companies produced all of Canada's output. The Consolidated Mining and Smelting Company of Canada Limited (COMINCO) at its Trail, British Columbia, refinery produced 49 per cent of the total; Gaspé Copper Mines, Limited, at its copper smelter at Murdochville, Quebec, produced 11 per cent; and Molybdenite Corporation of Canada Limited at Lacorne, Quebec, produced 40 per cent.

World output during 1962 was 3,500 tons, with Peru, Mexico, Bolivia and Canada in that order being the principal Free World producers. Communist China produced an estimated 300 tons. United States production is not reported.

DOMESTIC SOURCES

British Columbia

Lead concentrate, derived from the lead-zinc-silver ore of COMINCO's Sullivan mine, at Kimberley, is the main source of bismuth produced at Trail. Other important sources of bismuth are the lead concentrates from COMINCO's other mines in southeastern British Columbia - the Bluebell mine at Riondel and the H.B. mine at Salmo. The lead bullion obtained at the Trail smelter from these concentrates and from other concentrates originating mainly at mines in British Columbia contains about 0.05 per cent bismuth. Bismuth (99.99+per cent pure), antimony and precious metals are recovered from the residue from the electrolytic refining of the bullion. This bismuth may be further treated to produce a high-purity (up to 99.9999 per cent) bismuth which is used in research and in the electronics industry. In 1962 COMINCO completed the construction of a plant at Trail to produce thermoelectric materials of which bismuth telluride is one of the best known.

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*Mineral Resources Division

Table 1

BISMUTH - PRODUCTION, TRADE AND CONSUMPTION

	1961		1962	
	Pounds	$	Pounds	$
PRODUCTION				
All forms(a)				
Quebec	174,832	297,670	196,501	332,418
British Columbia	283,363	637,567	228,601	507,494
Ontario	19,923	22,388	-	-
Total	478,118	957,625	425,102	839,912
Refined metal(b)	305,000r		230,000	
IMPORTS				
Metal and residues				
Bolivia	10,149	8,193	55,947	35,695
United States	2,000	4,670	1,116	2,799
Yugoslavia	4,409	8,992	-	-
Netherlands	1,425	2,712	-	-
Total	17,983	24,567	57,063	38,494
Salts				
Britain	12,856	32,644	10,855	27,988
United States	1,551	7,217	320	1,378
Total	14,407	39,861	11,175	29,366
EXPORTS				
Refined and semirefined metal	389,500		382,182	
CONSUMPTION				
Refined metal				
Fusible alloys and solders	34,484		29,130	
Other uses(c)	8,144		8,120	
Total	42,628		37,250	
	1960		1961	
Bismuth salts				
Chemical and allied products industries	9,049		na	

Source: Dominion Bureau of Statistics. (a) Refined metal from Canadian ores plus the bismuth content of bullion and concentrates exported. (b) Refined bismuth metal from domestic and foreign ores. (c) Includes bismuth used in research and in the manufacture of pharmaceuticals, fine chemicals and malleable iron. Symbols: - Nil; na Not available ; r Revised from previously published figure.

Quebec

A large part of Quebec's bismuth is produced by Molybdenite Corporation of Canada Limited which operates the Lacorne molybdenite-bismuth mine, 23 miles northwest of Val d'Or. During the year ending September 30, 1962, the impure ingots produced there contained 139,525 pounds of bismuth. The treatment involves three principal steps. A bulk concentrate containing about eight per cent bismuth is obtained by flotation. By leaching the flotation concentrate with hydrochloric acid the bismuth is separated as bismuth oxychloride which is then smelted in electric-arc furnaces. The resulting bullion is cast into ingots containing 98 per cent bismuth, minor amounts of lead and silver and traces of copper, iron and antimony.

Quebec's only other important producer of bismuth, Gaspé Copper Mines, Limited, produced 42,800 pounds of bismuth from the treatment of flue dust recovered in copper-smelting operations at Murdochville.

Table 2

BISMUTH - PRODUCTION, EXPORTS AND CONSUMPTION, 1953-62
(pounds)

	Production		Exports(b)	Consumption(c)
	All Forms(a)	Refined Metal		
1953	117,366	72,000	-	68,000
1954	258,675	226,000	134,000	74,000
1955	265,896	160,000	56,000	92,000
1956	285,861	156,000	135,000	131,000
1957	319,941	146,000	143,000	55,000
1958	412,792	172,000	352,000	39,800
1959	334,736	182,000	300,000	39,700
1960	423,827	248,000	286,000	44,700
1961	478,118	305,000r	389,500	42,600
1962	375,345	230,000	382,182	37,200

Source: Dominion Bureau of Statistics. (a) Refined metal from Canadian ores plus the bismuth content of bullion and concentrates exported.
(b) From 1953 to 1957 inclusive - refined metal; 1958 and subsequent years - refined and semirefined metal. (c) Refined metal reported by consumers.
Symbols: - Nil; r Revised from previously published figure.

Table 3

WORLD PRODUCTION OF BISMUTH, 1961 and 1962
(pounds)

	1961	1962
Peru(a)	1,031,795	1,638,000
Mexico(a)	2,345,700b	736,400e
Bolivia(d)	465,300	652,500
Canada(c)	478,118	425,102
Japan (metal)	422,326	420,000e
South Korea (in ore)	333,000	350,000e
Yugoslavia (metal)	216,348	199,765
Other countries(f)	7,413	2,578,233
Total	5,300,000	7,000,000

Source: U.S. Bureau of Mines, Bismuth Preprint 1962.
(a) Refined metal plus the bismuth content of bullion exported.
(b) Includes approximately two million pounds of bismuth in impure bars which is excluded from the world total to avoid duplication.
(c) Refined metal plus the bismuth content of bullion and concentrates exported.
(d) Bismuth content of ore and bullion exported except that in tin concentrates.
(f) Includes United States production which is not available for publication.
Symbol: e Estimate

Ontario

Cobalt Refinery Limited at its silver refinery near Cobalt has facilities for the production of a base bullion made up principally of lead, silver and bismuth. This bullion, when produced, will be shipped periodically to a lead smelter for recovery of the contained metals. No shipments were reported in 1962.

USES AND CONSUMPTION

Manufacturers of low-melting-point alloys, that find application in fire-protection devices, electrical fuses and solders, use large amounts of bismuth. Many of these alloys contain 50 per cent or more bismuth with the chief additive metals being cadmium, lead and tin. Because bismuth expands on solidification and imparts expansion to its alloys, it is used in making type metal. Another important use is in the production of compounds for medical and cosmetic preparations. It is also used to improve the machinability of aluminum alloy, malleable iron and steel forgings.

Increasing use is being made of the thermoelectric alloy, bismuth telluride, in the development of nonmechanical refrigerating units. In this type of refrigeration, the thermoelectric alloy produces coldness when an electric current flows through it in one direction and heat when the current flows in the opposite direction.

The relative importance of the various uses of bismuth is shown in Table 4.

Table 4

BISMUTH - UNITED STATES CONSUMPTION, BY PRINCIPAL USES
(pounds)

	1961	1962
Fusible alloys	683,804	795,588
Other alloys	222,241	442,040
Pharmaceuticals	520,723	645,149
Experimental uses	9,742	5,212
Other uses	41,913	21,559
Total	1,478,423	1,909,548

Source: United States Bureau of Mines, Bismuth Preprint 1962.

PRICES AND TARIFFS

No change took place in Canadian or United States prices during 1962. The Canadian price, quoted by The Consolidated Mining and Smelting Company of Canada Limited, was \$2.25 a pound in lots of one ton or more and \$2.50 a pound in lots of less than one ton delivered to eastern Canada points. The United States price of bismuth was the same as the Canadian price.

Bismuth metal enters Canada free of duty. In the United States there is a 1 7/8 per cent ad valorem duty on bismuth metal and a 31 1/2 per cent ad valorem duty on chemical compounds, mixtures and salts. The main source of bismuth in the United States is lead ores and concentrates, which are imported in large amounts. No duty is charged on the bismuth content of these imports.

Cadmium

J.W. Patterson*

Canada's 1962 production of cadmium in all forms, 2,604,973 pounds, was substantially higher than the 1,357,874 pounds in 1961. Refined production remained relatively unchanged at 2,435,299 pounds compared with 2,233,804 pounds the previous year.

Zinc ores and, to a lesser extent, lead ores are the principal sources of cadmium. It is present in both types of ores, in minor amounts as a sulphide intimately associated with sphalerite. In Canada, metal production is from two refineries - one at Trail, British Columbia, operated by The Consolidated Mining and Smelting Company of Canada Limited (COMINCO), and the other at Flin Flon, Manitoba, operated by Hudson Bay Mining and Smelting Co., Limited. While the principal sources of concentrates treated at these plants are mines operated by COMINCO and Hudson Bay, important amounts come from mines operated by other companies. In addition to the cadmium metals produced in Canada from domestic concentrates, some cadmium, not all of which is reported, is recovered by foreign smelters from lead and zinc concentrates received from Canadian producers.

Because of the growing demand for cadmium and because it is a byproduct of zinc production which has remained relatively constant in recent years, shortages of cadmium have been reported in Britain, the United States and in western European countries. As a consequence, prices have risen in Britain and the United States. Based on ton lots, the United States prices at year-end ranged from $1.70 to $1.80 a pound compared with $1.60 at the beginning of the year. In Britain over the same 12-month period, the price per pound for Commonwealth cadmium based on one-hundredweight lots advanced from 11 shillings 6 pence to 14 shillings. Because of the shortages, consumers in the United States urged Congress to authorize the release of part of the 10 million pounds of cadmium declared to be excess to national stockpile requirements. A bill was introduced to Congress in mid-year calling for the release of 2 million pounds and in October the General Services Administration submitted to Congress for consideration a plan to dispose of a like amount. By year-end, Congress had not yet fully considered either of the submissions.

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*Mineral Resources Division.

75807—11½

Table 1

CADMIUM - PRODUCTION, EXPORTS AND CONSUMPTION

	1961		1962	
	Pounds	$	Pounds	$
PRODUCTION				
All forms(a)				
British Columbia	907,432	1,451,891	2,086,692	3,839,513
Manitoba	182,622	292,195	189,272	325,548
Yukon	142,685	228,296	134,493	231,328
Saskatchewan	125,135	200,216	128,223	220,544
Quebec	-	-	66,293	114,024
Total	1,357,874	2,172,598	2,604,973	4,730,957
Refined(b)	2,233,804		2,435,299	
EXPORTS				
Cadmium in ores and concentrates	88,300	120,733	c	c
Cadmium metal				
Britain	1,374,009	1,616,849	1,467,650	2,274,901
United States	517,450	707,414	829,664	1,270,233
Netherlands	-	-	22,400	33,152
Brazil	6,439	9,048	13,820	25,730
Argentina	-	-	3,306	5,552
India	4,047	5,876	2,997	4,869
Other countries	17	419	452	998
Total	1,901,962	2,339,606	2,340,289	3,615,435
CONSUMPTION (cadmium content)(d)				
Plating	147,326		195,694	
Solders	18,574		14,694	
Other products(g)	5,076		21,488	
Total	170,976		231,876	

Source: Dominion Bureau of Statistics. (a) Production of refined cadmium from domestic ores plus the cadmium content of some of the ores and concentrates exported. (b) Includes metal derived from foreign lead and zinc ores. (c) Not available as a separate class in 1962. (d) As reported by consumers. (g) Includes chemicals, pigments and alloys other than solder.
Symbol: - Nil.

Table 2

CADMIUM - PRODUCTION, EXPORTS AND CONSUMPTION, 1952-62
(pounds)

	Production		Exports Cadmium Metal	Consumption(c)
	All Forms(a)	Refined(b)		
1952	948,587	820,000	620,344	232,000
1953	1,118,285	978,000	969,563	254,000
1954	1,086,780	1,058,000	776,391	196,000
1955	1,919,081	1,714,000	1,562,337	220,000
1956	2,339,421	1,932,000	1,922,685	206,000
1957	2,368,130	2,018,000	1,941,680	177,000
1958	1,756,050	1,634,000	1,263,617	170,000
1959	2,160,363	2,528,000	1,979,638	226,000
1960	2,357,497	2,238,000	2,056,333	190,000
1961	1,357,874	2,234,000	1,901,962	171,000
1962	2,604,973	2,435,000	2,340,289	232,000

Source: Dominion Bureau of Statistics.
(a) Production of refined cadmium from domestic ores plus the cadmium content of some of the ores and concentrates exported.
(b) Includes metal derived from foreign lead and zinc ores.
(c) Consumption as reported by consumers.

Domestic shipments to consumers in the United States rose 1,690,870 pounds to 11,560,973 pounds in 1962; production at 10,640,689 pounds was somewhat higher than the 10,114,644 pounds produced in 1961. Little change was reported in imports of cadmium metal, which, in 1962, was 1,122,513pounds.

The United States is the largest producer of cadmium - followed by Canada. In addition to the countries listed in Table 3, Mexico and South West Africa are also important producers. Most of Mexico's production is exported to the United States in zinc concentrates, and lead- and zinc-smelter flue dusts; some metal is produced in Mexico from flue dust. All South West African production is in lead and zinc concentrates that are shipped principally to the United States, Britain and Belgium. The cadmium content of the flue dust and concentrates exported in 1961 by Mexico and South West Africa amounted to approximately 2,500,000 and 1,747,000 pounds, respectively. In 1963, part of South West Africa's production will be treated in a cadmium recovery plant that will be operated in conjunction with a lead smelter, construction of which began in 1961.

Britain and the United States continued to be Canada's most important cadmium customers, accounting for 98 per cent of total exports. Most of Canada's production is exported.

Table 3

WORLD PRODUCTION OF CADMIUM METAL
('000 pounds)

	1961	1962
United States	10,115	10,640
U.S.S.R.	4,409	4,409
Canada	1,358	2,605
Japan	1,596	1,940
Belgium	1,988	1,521
Republic of the Congo	1,168	992
Other countries	4,714	3,969
Total	25,348	26,076

Source: U.S. Bureau of Mines Mineral Trade Notes, November 1963, and for Canada, Dominion Bureau of Statistics.

DOMESTIC SOURCES

British Columbia

Most of Canada's cadmium originates in the lead-zinc ores from COMINCO's Sullivan mine, at Kimberley. Of the 1,059 tons of cadmium recovered at the Trail refinery, by far the largest part came from zinc concentrate produced at the Sullivan mill. Cadmium was also obtained from zinc concentrates produced at other lead-zinc mines in British Columbia including COMINCO's H.B. mine at Salmo and its Bluebell mine at Riondel.

Companies other than COMINCO whose ores were the source of important amounts of cadmium are listed in Table 4.

Table 4

Company	Location of Mine	Cadmium Production (pounds)
Canadian Exploration, Limited	Salmo	239,083
Mastodon-Highland Bell Mines Limited	Beaverdell	8,359
Reeves MacDonald Mines Limited	Remac	166,834
Sheep Creek Mines Limited	Toby Creek	88,900

Yukon Territory

During the 12-month period that ended on September 30, 1962, the territory's only important non-ferrous metal producer, United Keno Hill Mines Limited, produced 184,364 pounds of cadmium in zinc concentrate obtained from 184,123 tons of ore. During the previous 12-month period, the company produced 202,432 pounds from 186,116 tons of ore.

Saskatchewan and Manitoba

Cadmium metal output of Hudson Bay Mining and Smelting Co., Limited was 317,495 pounds. It was recovered from the company's copper-zinc ores from the Flin Flon mine at Flin Flon; the Coronation and Schist Lake mines in the Flin Flon area; and from the zinc-lead-copper ore from its Chisel Lake mine at Snow Lake, Manitoba.

Eastern Canada

All zinc concentrates produced in eastern Canada were exported. Although the concentrates do contain recoverable amounts of cadmium, payment normally is not made for the cadmium and, hence, production is not reported.

USES

Cadmium is used extensively as a resistant rustproof coating on iron and steel and, to a lesser extent, on copper-base alloys and other metals and alloys. Like zinc coatings, cadmium coatings on less-active metals protect the metals electrochemically as well as by physical enclosure. Thus, metals that are commonly used as protective coatings, other than cadmium and zinc, must be applied in greater thicknesses to give the same protection. Where price is not important, cadmium is preferred to zinc as a coating because it can be deposited more uniformly especially in recesses of intricately shaped parts, is more ductile, is slightly more resistant to atmospheric corrosion and can be electrodeposited with less electric current per unit of area covered.

Cadmium-plated articles include a wide range of parts and accessories used in the construction of aircraft, automobiles, military equipment and household appliances.

Cadmium is also used in making solders, particularly of the cadmium-silver type. Low-melting-point fusible alloys of the cadmium-tin-lead-bismuth type have long been used in automatic sprinkler systems, fire-detection apparatus and valve seats for high-pressure gas containers. Owing to its high strength, high conductivity, ductility and resistance to wear, low-cadmium copper (about 1 per cent) is used in the manufacture of trolley and telephone wires. Cadmium is also used in devices to control the fissionable elements in atomic reactors. Cadmium, because it has a hardening effect when small amounts are added to silver, is used in the manufacture of sterling silverware.

Production of nickel- and silver-cadmium storage batteries is increasing. These batteries have a longer life than the standard lead-acid battery, are smaller and are superior during low-temperature operation. Because of these characteristics, they are being used in airplanes, earth satellites, missiles, and ground equipment for polar regions as well as in small portable items such as battery-operated shavers, toothbrushes, drills and handsaws.

Cadmium sulphide and cadmium sulphoselenide are used where bright, high-quality yellow or red colors are employed in electroplating solutions. Cadmium bromide and iodide are used in the making of photographic films and in photoengraving and photolithography. Cadmium stearate goes into the making of vinyl plastics.

PRICES AND TARIFFS

During 1962, the United States price per pound of cadmium in commercial sticks, according to E & M J Metal and Mineral Markets was as follows:

	Jan. 1 to Feb. 19	Feb. 20 to April 1	April 2 to Year-end
Ton lots	$1.60	$1.65	$1.70 - $1.80
Less than a ton	$1.70	$1.75	$1.75 - $1.85

Cadmium metal in crude form entered Canada duty-free from Commonwealth countries. The most-favored-nation and general duties were respectively 15 and 25 per cent ad valorem.

The United States duty on cadmium metal during 1962 was 3.75 cents a pound. Cadmium flue dust was duty-free.

Calcium

W.H. Jackson*

In the last few years demand for calcium has been increasing. In 1962, factory shipments were 123,511 pounds. Canadian demand was only a few hundred pounds and most of the production was exported. Production and export statistics are shown in the accompanying tables.

The slump in demand in 1956-57 was caused by the replacement of calcium by magnesium as a reducing agent in the large-scale production of uranium. Since then, other uses have become more important.

Dominion Magnesium Limited is Canada's sole producer of calcium. The main product of the company's smelter at Haley, Ontario, is magnesium; other metals smelted are thorium, zirconium, titanium and master alloys of these, as well as barium, strontium and lithium.

The four grades of calcium metal produced at Haley range in purity from the 98 per cent of Commercial Grade to the nominal 99.9 per cent of Chemical Standard Grade. The maximum impurities in calcium of Commercial Grade are 0.5 to 1.5 per cent magnesium, 1.0 per cent nitrogen and 0.35 per cent aluminum. They become progressively less in other grades and are present only in trace amounts in Chemical Standard Grade which is available only in the form of granules in the size range of minus 4 to plus 80 mesh. Other grades are produced as granules, crystalline lumps, ingots, billets and extruded shapes. Wire, tubes or other shapes, and strip are also manufactured.

To produce Commercial Grade calcium, powdered lime (200-mesh) and commercial-purity aluminum (20-mesh) are briquetted and then charged into horizontal retorts made of chrome-nickel iron alloy. Under vacuum and at temperatures of about 1,170°C, the aluminum reduces the lime. The water-cooled head sections of the retorts project through the furnace wall and calcium vapor condenses as crystalline rings in a temperature range of 680 to 740°C. Higher purities are obtained in subsequent refining operations.

Production by country is not reported. Dominion Magnesium is the world's main producer. Other commercial sources are Nelco Metals Inc., U.S.A., and Societe Planet, France. There is a small captive production in the United States by American Smelting and Refining Company and Union Carbide Metals Company.

* Mineral Resources Division.

Table 1

PRODUCTION AND EXPORTS

	1961		1962	
	Pounds	$	Pounds	$
PRODUCTION (metal shipments)	99,355	100,881	123,511	124,412
EXPORTS (metal)				
United States..................	24,400	30,439	44,700	54,002
Britain.......................	9,200	10,803	28,000	44,059
West Germany	9,900	10,890	20,000	23,362
India..........................	18,700	28,171	14,900	22,345
Belgium and Luxembourg.......	43,800	31,525	9,100	5,100
Republic of South Africa........	-	-	4,500	5,900
Other countries	4,700	5,013	2,900	2,454
Total........................	110,700	116,841	124,100	157,222

Source: Dominion Bureau of Statistics.
Symbol: - Nil.

Table 2

PRODUCTION AND SHIPMENTS OF CALCIUM METAL, 1956-62*

	Production		Shipments	
	Pounds	$	Pounds	$
1956	394,900	515,305		
1957	221,225	282,378		
1958	25,227	31,256		
1959	67,429	76,409		
1960	134,801	159,241	86,158	
1961	114,029		99,355	100,881
1962			123,511	124,412

Source: Dominion Bureau of Statistics.

*Actual production to 1961; for convenience a production - shipment comparison is given for 1960 and 1961; shipments only are available for 1962.

USES

Calcium metal is a reducing agent in the manufacture of uranium, thorium and their compounds. The metal can also be used to reduce chromium, vanadium, zirconium, titanium and beryllium.

In non-ferrous metals, the main use apart from de-oxidizing is in the fire refining of lead; as an additive to lead alloys for cable sheaths to improve strength, fatigue and hardness; and for lead storage-battery grids to improve strength and resist sulphating. Minor amounts are used for general alloying, particularly in aluminum and magnesium alloys, and the preparation of catalysts from silver.

To ferrous metals it is usually added as calcium-silicon or calcium-manganese-silicon. These low cost alloys are made by reducing a charge of lime and silica in an electric furnace. Higher cost calcium metal is used when impurity control is important. The calcium helps to de-oxidize, desulphurize and scavenge the melt, reducing the effect of non-metallic impurities in steel and controlling the size and distribution of graphitic carbon in cast iron.

In chemical processes it is an absorbant for oxygen, nitrogen and hydrogen in purifying argon and other rare gasses. It is also used for sulphur removal in petroleum products. The manufacture of calcium hydride is a major outlet for production, about equivalent in importance to use as a reducing agent.

PRICES

The Canadian prices quoted by Dominion Magnesium Limited throughout 1962 ranged from 80 cents a pound for Commercial Grade to $3.50 a pound for Chemical Standard Grade, f.o.b. Haley.

The nominal price for calcium, 97-98 per cent pure quoted in New York, as reported by E & M J Metal and Mineral Markets was $2.05 a pound in ton lots, slabs, etc. In Britain, the Metal Bulletin quotation was 40 shillings a pound for lump in 1 cwt. lots, grade not specified.

TARIFFS

	British Preferential	Most Favored Nation	General
Canada			
Calcium metal, pure, in lumps, ingot, powder	free	15%	25%
Calcium-metal alloys, or calcium metal in rods, sheet or any semiprocessed form	15%	20%	25%
United States			
Calcium metal		15 1/2%	

Cement

J.S. Ross*

The cement industry attained record production in 1962; its value of production rose to ninth place in the mineral industry. Shipments increased 11 per cent over those for 1961 and were 9 per cent greater than in the previous peak year, 1959. Most of the increased output was in Ontario and Quebec owing to a general rise in demand by the construction industry, and in particular, by dam construction in Quebec, Manitoba and Saskatchewan.

The only major expansion in clinker output was initiated at one Quebec plant, however, operators of four other cement plants reported minor increases in rated capacities. Canada's annual rated output of cement at clinker-producing operations increased by one per cent to 52.5 million barrels or 9.2 million short tons. For 1962, the year-end capacity in excess of consumption was 25 per cent of total capacity or 2,300,271 tons, as compared with 32 per cent and 2,859,000 tons for the previous year. Considering that cement demand varies appreciably between winter and other seasons, the capacity in excess of consumption in 1962 was not unusually high.

As in the United States, the trend continued toward the establishment of additional cement-distribution terminals. These terminals allow participating companies to increase their marketing areas by having sufficient quantities of cement on hand at convenient locations for consumers. In 1962, distribution plants were constructed at Regina, Saskatchewan, and New Westminster, British Columbia. Additional distribution facilities were completed at a cement plant in Quebec and at one in Ontario.

Additional integration of cement- and concrete-products companies, which was intensive in 1959, 1960 and 1961, was not common in 1962.

The use of cement to stabilize hydraulically placed fill in underground mining was one of the most important new developments in the industry in recent years.

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* Mineral Processing Division, Mines Branch.

Table 1

PRODUCTION AND TRADE

	1961		1962	
	Short Tons	$	Short Tons	$
PRODUCTION*				
Ontario	2,226,923	35,671,569	2,510,783	38,704,090
Quebec	2,029,159	31,412,617	2,242,591	33,330,630
Alberta	677,914	12,420,025	799,030	14,780,423
Manitoba	395,134	7,768,334	432,079	8,715,034
British Columbia	417,366	7,122,046	397,435	7,112,890
Saskatchewan	201,950	4,985,021	230,072	5,830,227
New Brunswick	170,953	2,754,052	169,823	2,774,908
Newfoundland	86,549	1,789,980	96,916	1,985,524
Total	6,205,948	103,923,644	6,878,729	113,233,726
EXPORTS				
Portland cement				
United States	249,294	3,864,477	217,721	3,437,627
Japan	-	-	1,400	25,200
Other countries	83	1,756	43	1,384
Total	249,377	3,866,233	219,164	3,464,211
Cement and concrete basic products				
United States		250,866		1,042,991
Hydraulic cement clinker imported by United States from Canada**	-	-	80,759	892,692
IMPORTS				
Portland cement, normal				
United States	1,037	30,246	173	5,196
Britain	132	3,100	1,581	23,246
Netherlands	110	2,258	55	1,137
West Germany	73	1,037	-	-
Japan	29	324	-	-
Cuba	-	-	1,164	18,804
Total	1,381	36,965	2,973	48,383

Table 1 (cont'd)

	1961		1962	
	Short Tons	$	Short Tons	$
Imports (cont'd)				
White cement				
Britain...............	5,676	165,928	5,200	163,395
West Germany	3,188	105,879	1,654	56,569
Belgium and Luxembourg	2,758	82,960	2,289	68,296
Denmark	1,568	46,135	2,298	72,584
France...............	1,706	48,560	1,881	53,781
United States	1,161	49,990	830	36,196
Japan	37	895	590	13,600
Total	16,094	500,347	14,742	464,421
Cement, not otherwise provided for				
Britain...............	9,982	288,011	5,962	204,583
United States	1,367	74,994	1,664	126,309
West Germany	386	20,477	1,184	65,376
Denmark	7	220	-	-
Total	11,742	383,702	8,810	396,268
Total, cement				
Britain...............	15,790	457,039	12,743	391,224
United States	3,565	155,230	2,667	167,701
West Germany	3,647	127,393	2,838	121,945
Belgium and Luxembourg.........	2,758	82,960	2,289	68,296
Denmark	1,575	46,355	2,298	72,584
France...............	1,706	48,560	1,881	53,781
Netherlands	110	2,258	55	1,137
Japan	66	1,219	590	13,600
Cuba.................	-	-	1,164	18,804
Total	29,217	921,014	26,525	909,072

Table 1 (cont'd)

	1961		1962	
	Short Tons	$	Short Tons	$
Imports (cont'd)				
White-cement clinker				
Denmark..............	14,560	268,521	14,941	288,069
United States	5,243	120,249	1,726	41,886
Total................	19,803	388,770	16,667	329,955

Source: Dominion Bureau of Statistics.
* Producers' shipments plus quantities used by producers.
** U.S. Department of Commerce, United States Imports of Merchandise for Consumption (Report FT 110).
Symbol: - Nil.

Table 2

PRODUCTION, TRADE AND CONSUMPTION, 1952-62
(short tons)

	Production(a)	Exports(b)	Imports(b)	Apparent Consumption(c)
1952	3,241,095	754	509,947	3,750,288
1953	3,891,708	2,577	434,487	4,323,618
1954	3,926,559	21,638	401,135	4,306,056
1955	4,404,480	168,907	517,890	4,753,463
1956	5,021,683	124,566	599,624	5,496,741
1957	6,049,098	338,316	92,380	5,803,162
1958	6,153,421	141,250	41,555	6,053,726
1959	6,284,486	303,126	29,256	6,010,616
1960	5,787,225	181,117	22,478	5,628,586
1961	6,205,948	249,377	29,217	5,985,788
1962	6,878,729	219,164	26,525	6,686,090

Source: Dominion Bureau of Statistics.
(a) Producers' shipments plus quantities used by producers. (b) Does not include cement clinker. (c) Production plus imports less exports.

PRODUCTION

Portland, masonry and oil-well cement and white cement from imported clinker are produced in Canada. Most of the output is of normal portland cement used mainly in general construction. Other types of portland cement are available from most plants and the air-entrained equivalents are available from a few or, upon request, from most. Special cements for large projects are produced as required. In 1961, 93 per cent of total shipments were of normal portland cement, 3 per cent were of masonry cement, and the remainder was other types.

In 1962, production was 75 per cent of rated capacity amounting to a record 6,878,729 tons valued at $113,233,726. This was 11 per cent higher in quantity and 9 per cent higher in value than in 1961. Thus the industry has recovered from the period of lower shipments, experienced since the previous record of 1959, to re-establish the favorable trend of production increase that took place from 1944 to 1959. The value of cement shipments reached ninth place in Canadian mineral production in 1962 after being in tenth place for the three previous years. Gains in shipments over 1961 were registered by all producing provinces except British Columbia and New Brunswick but most of the total increase was in Ontario and Quebec. As in recent years, Ontario was the largest producer, and with Quebec, accounted for 69 per cent of the total. In addition, Canada produced 80,759 tons of cement clinker valued at $892,692 for export to the United States.

Cement was manufactured in all provinces except Nova Scotia and Prince Edward Island. Nineteen plants with a total of 45 kilns produced cement clinker, four of these employing dry processing methods. All plants are listed in Table 3 and their locations are indicated on the accompanying map. The eleven in Ontario and Quebec produced 67 per cent of the total capacity. In 1961 they consumed 8,145,376 tons of limestone, 909,227 tons of clay, 297,785 gypsum, 265,206 tons of shale, 207,118 tons of rocks high in silica, and tons of iron oxide.

In addition, two separate clinker-grinding plants were in operation. Clinker from the Exshaw, Alberta, plant is ground by Canada Cement Company, Limited, at Clover Bar, Alberta. Medusa Products Company of Canada, Limited, grinds imported clinker at Paris, Ontario, for the production of white cement.

According to Minerals Yearbook 1962, published by the United States Bureau of Mines, Canada remained in twelfth place in world cement production in 1962. World output amounted to a record 394 million short tons for that year with the United States, Russia, and Japan remaining as leading producers in that descending order.

TRADE

Because raw materials for its manufacture are readily available, cement is produced in large quantities by many countries. For this reason, and because cement has a relatively low unit value, trade in this commodity is usually small compared with production. In 1962 Canada, one of the world's largest cement-exporting countries, exported only three per cent of production,

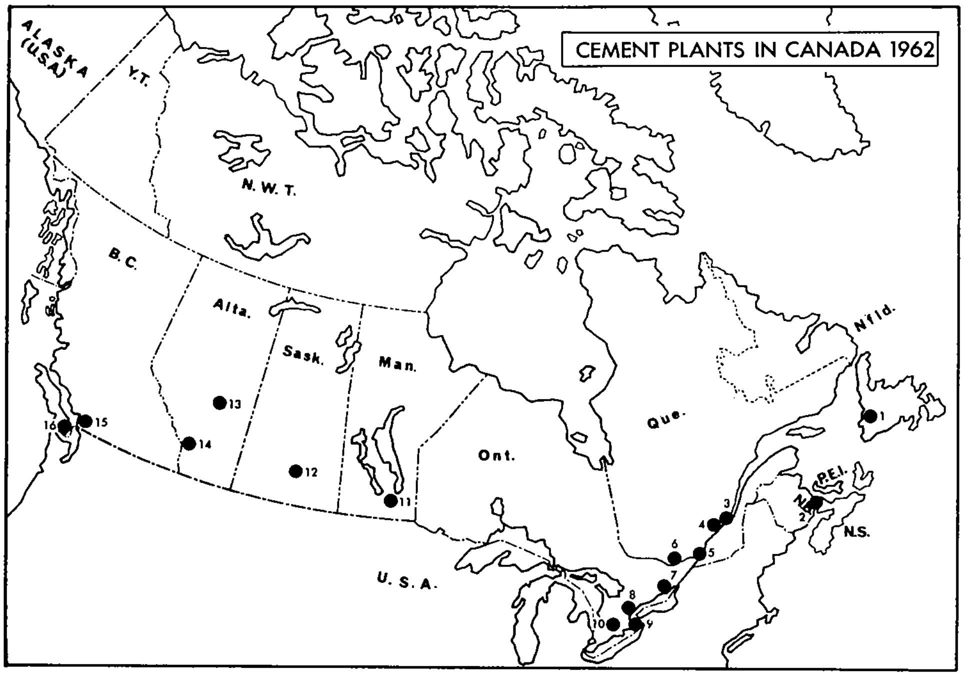
Table 3

APPROXIMATE PLANT CAPACITIES* AT END OF 1962

(Numbers in parentheses refer to locations on the accompanying map)

Company and Location	Barrels/ Year	Short Tons/ Year**
Newfoundland		
North Star Cement Limited, Corner Brook(1)	600,000	105,000
New Brunswick		
Canada Cement Company, Limited, Havelock(2)	1,000,000	175,000
Quebec		
St. Lawrence Cement Company, Villeneuve(3)	2,000,000	350,000
Ciment Quebec Inc., St. Basile(4)	1,800,000	315,000
Miron Company Ltd., St. Michel(5)	4,000,000	700,000
Canada Cement Company, Limited, Montreal(5)	7,500,000	1,313,000
Canada Cement Company, Limited, Hull(6)	1,100,000	193,000
Ontario		
Lake Ontario Portland Cement Company Limited, Picton(7)	2,600,000	455,000
Canada Cement Company, Limited, Belleville(7)	4,000,000	700,000
St. Lawrence Cement Company, Clarkson(8)	4,200,000	735,000
Canada Cement Company, Limited, Port Colborne(9)	1,200,000	210,000
Canada Cement Company, Limited, Woodstock(10)	3,250,000	568,000
St. Mary's Cement Co., Limited, St. Mary's(10)	3,500,000	613,000
Manitoba		
Canada Cement Company, Limited, Fort White(11)	3,200,000	560,000
Saskatchewan		
Saskatchewan Cement Company Limited, Regina(12)	1,300,000	228,000
Alberta		
Inland Cement Company Limited, Edmonton(13)	3,400,000	595,000
Canada Cement Company, Limited, Exshaw(14)	3,000,000	525,000
British Columbia		
Lafarge Cement of North America Ltd., Lulu Island(15)	1,500,000	262,000
British Columbia Cement Company Limited, Bamberton(16)	3,300,000	577,000
Total	52,450,000	9,179,000

Source: Company correspondence. * Not including the capacities of the separate grinding plants. ** Calculated.



219,164 tons valued at $3,464,211, almost all of which went to the United States. About three-quarters of U.S. imports from Canada normally goes to New York state. Also in 1962, Canada exported to the United States 80,759 tons of cement clinker valued at $892,692. Cement and concrete basic products exported to the United States were valued at $1,042,991.

Imports continued to be low consisting chiefly of special types such as white cement. Britain, West Germany and the United States were the principal suppliers.

DEVELOPMENTS

There was little activity in clinker-plant expansion in 1962, although minor increases were made to the rated capacities of the Havelock, New Brunswick; Exshaw, Alberta; Picton, Ontario; and St. Mary's, Ontario plants. At the St. Basile, Quebec, operation of Ciment Quebec Inc., the capacity was being increased by the enlargement of one kiln. Upon scheduled completion in the latter part of 1963, this expansion will increase the plant's rated capacity from 1.8 to about 2.5 million barrels a year.

As in the United States the trend toward the establishment of more cement-distribution plants continues. Such facilities allow cement companies to enlarge their marketing areas by reducing transportation and handling costs and by having substantial quantities of cement more easily available to consumers. This method of distribution increases competition and for several reasons is as advantageous to the consumer as to the supplier. Canada Cement Company, Limited, constructed a distribution station at Regina, Saskatchewan, in 1962. The company has no cement-producing facilities in that province. British Columbia Cement Company Limited constructed a distribution station at New Westminster, British Columbia. Two bulk storage silos were added to the Montreal plant of Canada Cement Company, Limited, and bulk storage facilities were being expanded by Ciment Quebec Inc. at St. Basile.

Two new plants started to produce pozzolanic shale. Canadian Pozzolan Industries Ltd. began operating a second plant at Coalhurst, Alberta, and Holdfast Natural Resources Ltd. started production from a $1 million plant at Saltspring Island, British Columbia.

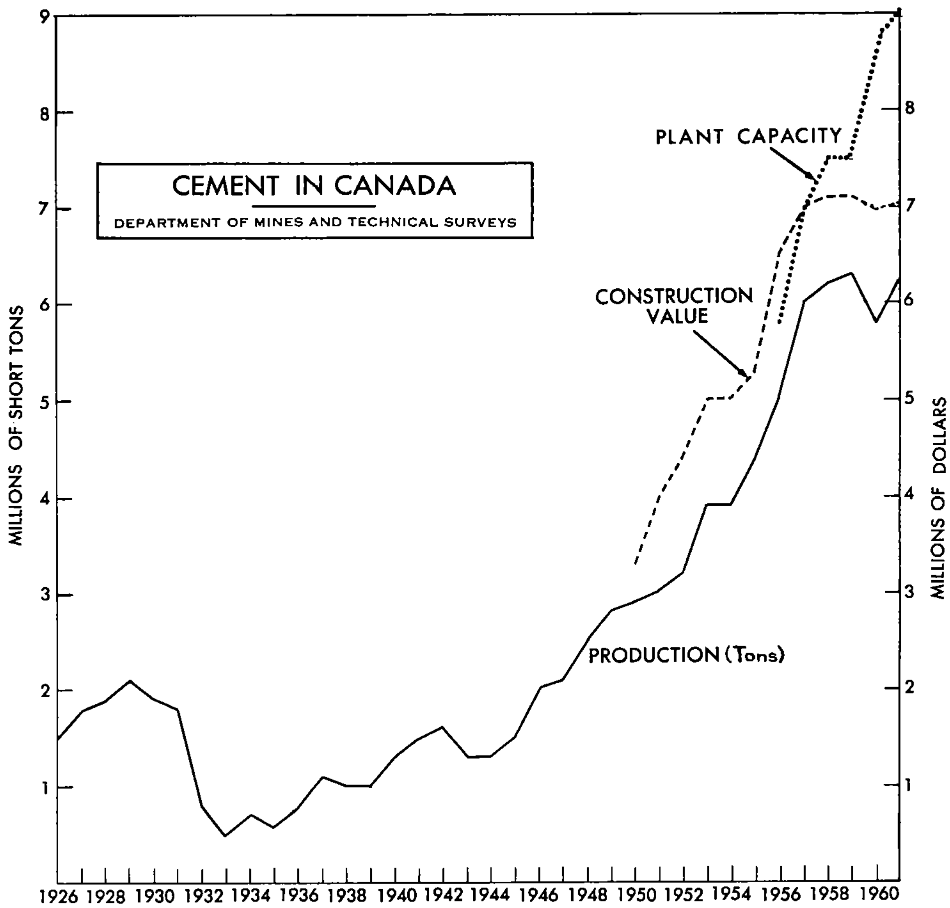
Vertical integration of cement- and concrete-products companies, common since 1959, was not significant in 1962.

The most important new development to the industry as a whole was not in the expansion of production and distribution facilities but was consumption - the adaption of cement as a stabilizer in hydraulically placed fill in underground mining. The International Nickel Company of Canada, Limited, started to use cement-stabilized fill at its Frood mine, Sudbury, Ontario. Falconbridge Nickel Mines, Limited, experimented with the application during the year. This use is a natural development from the employment of concrete floors in stopes in use in Canada for over a decade and becoming more popular. Concrete stope floors require a sand-cement ratio of about 5:1. For cement-stabilized fill, a much smaller proportion of cement is used. This type of fill is used to reduce ore dilution, stoping time, and the amount of timber used. The result is a more flexible and less costly operation.

CONSUMPTION AND USES

Almost all cement is used for construction purposes. As a result, plant shipments and consumption vary directly with construction expenditures, as indicated by the accompanying graph. For 1962 the preliminary value of construction reached a new high of $7,326 million and cement shipments also set a record. According to the Dominion Bureau of Statistics, the estimated value of construction planned for 1963 is $7,608 million. Thus, cement production should also reach a record for that year.

One of the greatest factors in the increase in Quebec cement production was the start of construction on Manicouagan 2 and Manicouagan 5 dams north-east of Baie Comeau, Quebec. The complete project, being carried out for the Quebec Hydro-Electric Commission, will cost $2,000 million and will be completed about 1974. It is one of the world's largest power-dam projects, involving the erection of three dams on the Manicouagan River and two on the Outardes River. About one million tons of cement, equivalent to almost half the 1962 Quebec production, will eventually be required for the dams Manicouagan 2 and 5.



In 1963 the Peace River project will provide an extra market for British Columbia cement. These two projects will assist the cement industry in reaching an anticipated production record for 1963.

Most cement is used in general construction. Available statistics indicate that more than one-third of all cement goes into ready-mixed concrete and other concrete products such as blocks, bricks, pipe, tile, and other shapes.

Table 4 indicates a large net increase in the production of concrete blocks, pipe, and tile and a decrease in concrete brick output for 1962. The output of ready-mixed concrete rose appreciably - 13 per cent.

The use of cement in soil-cement for road bases continues to increase. Alberta is the largest user but its use in all Maritime provinces and Saskatchewan is growing rapidly. Lesser amounts are used in Manitoba and Ontario.

Cement is also used in grouting, in cementing oil and gas wells, in certain paints, and in the manufacture of many asbestos products. In underground mining, as previously mentioned, it is employed in general construction, concrete stope floors, and hydraulically placed fill.

Table 4

PRODUCTION OF CONCRETE PRODUCTS

	1961	1962
Concrete bricks (number)	103,631,717	102,480,161
Concrete blocks (except chimney blocks)		
Gravel (number)	102,011,164	113,590,083
Cinder (number)	8,960,377	5,087,579
Other (number)	35,391,748	42,100,958
Concrete drain pipe, sewer pipe, water pipe, and culvert tile (tons)	820,612	1,039,719
Concrete, ready-mixed (cubic yards)	8,333,706	9,447,894

Source: Dominion Bureau of Statistics.

SPECIFICATIONS, PRICES AND TARIFFS

Canadian cement conforms to the specifications of the Canadian Standards Association. The types not covered by the Association generally meet the specifications of the American Society for Testing Materials.

Prices vary, depending on supply and demand, location and the type of cement.

Canadian import tariffs per 100 pounds, unchanged from 1961, were as follows:

	British Preferential	Most Favored Nation	General
Portland cement and hydraulic (water) lime, in bulk or barrels or in casks, the weight of the barrel, bag or cask to be included in the weight for duty	5¢	8¢	8¢
White portland-cement clinker for use in the manufacture of white portland cement	2¢	3 1/2¢	6¢

The United States import tariff on portland, roman and other hydraulic cements or cement clinker remained at 2 1/4 cents per 100 pounds including the weight of the containers. For white, nonstaining portland cement it is 3 cents per 100 pounds including the weight of the containers.

Chromium

V. B. Schneider*

Chromium ore (chromite) imports increased in 1962, for the fourth consecutive year, to 72,000 tons valued at $2.1 million. Domestic consumption of both chromite and ferrochromium increased in 1962 over that of 1961 as did exports of ferrochromium which were the highest since 1959. Ferrochromium consumption amounted to 9,452 tons, the highest since 1936 when the Dominion Bureau of Statistics (DBS) first listed it as a separate item. DBS does not list imports of ferrochromium as a separate item but in 1962 such imports from overseas, particularly of the low-carbon type, seriously affected domestic production.

Canada has no known deposit of commercial-grade chromium ore. During the period 1940-50 some chromite was produced in the Province of Quebec; peak production, reached in 1943, amounted to 29,595 tons. The Bird River deposits in the Lac du Bonnet district of southeastern Manitoba are large but of low grade - about 26 per cent chromic oxide (Cr_2O_3) and 12 per cent iron with a chromium-to-iron ratio of about 1.4:1.

Chromite is consumed in Canada by Union Carbide Canada Limited, Metals and Carbon Division, at Welland, Ontario, where low- and high-carbon ferrochromium and ferrochromium silicon are produced; by Chromium Mining & Smelting Corporation, Limited, at Beauharnois, Quebec, where high-carbon and charge-grade ferrochromium and ferrochromium silicon are produced, and at Sault Ste. Marie, Ontario, where exothermic chromium alloys are produced; by Canadian Refractories Limited at its refractories plant at Marelan, Quebec, about 50 miles west of Montreal; and by General Refractories Company of Canada Limited, Smithville, Ontario.

WORLD PRODUCTION AND TRADE

According to the United States Bureau of Mines, world production of chromite in 1962 amounted to 4.8 million tons**, an increase of approximately 0.1 million tons from 1961. With an increase expected in the production of stainless steels in 1963 production and consumption of chromite will probably rise.

*Mineral Resources Division.

**U.S. Bureau of Mines, Mineral Industry Surveys Chromium in 1962 .

Table 1

CHROMIUM - TRADE AND CONSUMPTION

(short tons - 2,000 pounds)

	1961		1962	
	Tons	$	Tons	$
IMPORTS (chromite)				
United States	22,341	702,159	27,402	929,934
Philippines	34,861	790,568	19,040	453,301
Rhodesia and Nyasaland...	5,456	173,004	14,312	466,471
Republic of South Africa ..	4,690	79,633	5,219	63,576
Cuba.....................	-	-	3,196	87,275
Cyprus	3,920	163,556	2,800	121,850
Total	71,268	1,908,920	71,969	2,122,407
EXPORTS (ferrochromium)				
United States	1,546	335,555	6,437	1,135,641
Britain...................	-	-	165	36,540
West Germany	71	14,050	-	-
Other countries	25	9,421	-	-
Total	1,642	359,026	6,602	1,172,181
CONSUMPTION (chromite)	52,134		70,342	

Source: Dominion Bureau of Statistics.
Symbol: - Nil.

Although official data have not yet been released it is apparent from trade reports that good quality, extremely low-priced Russian chromite is replacing Turkish and Rhodesian chromite in such traditional markets as Japan and Western Europe. This vigorous effort by Russia to develop export markets for its chromite has created major problems in Turkey and Southern Rhodesia where many mines are reported to have curtailed or suspended operations.

In the United States, reports indicated that Russian ore was sold at prices ranging from $4 to $18 a ton cheaper than Rhodesian ore (an $18 undersell for anything except a small trial shipment seems highly unlikely). It should also be noted that imports of chromite to the United States from the U.S.S.R, reported in the U.S. Bureau of Mines, Mineral Industry Surveys, Chromium in 1962, June 10, 1963, amounted to 74,076 tons out of a total of 1,445,575 tons from all sources. Russian sales in western Europe have been reported at less than £10 a long ton; this is as much as £3 cheaper than corresponding Rhodesian and Turkish material. Because of its high quality, Russian chromite could undoubtedly compete in consumer markets with ore from any other source; in addition the price discount makes the threat of Russian ore to other chromite producers formidable indeed.

Table 2

CHROMIUM - TRADE AND CONSUMPTION, 1953-62

(short tons - 2,000 pounds)

	Imports	Exports	Consumption	
	Chromite	Ferrochromium	Chromite	Ferrochromium
1953	118,092	33,824	92,678	4,986
1954	37,517	15,304	64,782	3,500
1955	51,854	12,354	49,176	6,406
1956	64,965	9,897	69,835	7,091
1957	111,453	10,332	70,971	7,000
1958	38,136	10,460	36,297	4,714
1959	48,678	7,514	58,532	8,150
1960	59,023	4,611	54,331	8,827
1961	71,268	1,642	52,134	8,046
1962	71,969	6,602	70,342	9,452

Source: Dominion Bureau of Statistics.

Table 3

WORLD PRODUCTION OF CHROMIUM ORE 1961 and 1962

(short tons - 2,000 pounds)

	1961	1962
U.S.S.R.	1,015,000	1,265,000
Republic of South Africa	989,718	1,006,167
Philippines	705,811	583,891
Southern Rhodesia	590,888	507,685
Turkey	443,932	517,148
Albania	330,000	330,000
Yugoslavia	119,188	106,974
United States	82,000	-
Japan	77,350	64,145
India	50,625	64,390
Other countries	315,488	359,600
Total	4,720,000	4,805,000

Source: United States Bureau of Mines, Mineral Industry Surveys <u>Cobalt in 1962</u> .
Symbol: - Nil.

The United States is the leading importer and consumer of chromite, importing about 1.3 million tons in 1962. The Republic of South Africa, the Philippines, Southern Rhodesia and Turkey were, in that order, the leading suppliers. Rhodesia supplied most of the metallurgical grade, the Philippines most of the refractory grade and the Republic of South Africa most of the chemical grade.

Southern Rhodesia's second ferroalloy plant was commissioned at Que Que in November 1962; rated production capacity has not been announced. It is expected that the plant will specialize in high-carbon ferrochromium. Also in 1962, Electro-Metalurji Sanayii Sa started its new high-carbon ferrochromium plant at Antalya, Turkey; capacity is reported to be 8,000 tons a year.

In only a few countries have chromium-ore resources been thoroughly explored and estimates of reserves are mostly broad approximations. Some important producing countries have published nothing on their reserves. In 1960, the chromite reserves of Southern Rhodesia were estimated at 608 million tons, of which some 300 million were considered to be of metallurgical grade. South Africa's reserves of chromium ore were recently estimated at several hundred million tons. The U.S.S.R. and Albania, of the Soviet bloc, are known to have large economic deposits of chromium ore.

USES

Chromite consumed in industry is graded as metallurgical, refractory or chemical. These grades are based on physical and chemical properties but technological advances are making them interchangeable to an ever-increasing extent. In the United States over the last five years the metallurgical industry has accounted for 62 per cent of all chromite consumed, the refractory industry for 27 per cent and the chemical industry for 11 per cent. In Canada during 1961 and 1962 the metallurgical industry accounted for about 37 per cent of the chromite consumed.

Metallurgical-grade Chromite

Metallurgical-grade chromite should contain 45 to 50 per cent Cr_2O_3 and have a chromium-iron ratio of at least 2.8:1. It is consumed in the steel industry as ferrochromium alloys made by electric smelting processes. Manufacturers of chromium exothermic additives may use ores of less-rigid specifications than those outlined.

Several grades of ferrochromium are made. They are distinguished by their carbon and silicon content. Low-carbon ferrochromium of various grades ranging from 0.02 to two per cent carbon maximum is used in stainless and heat-resistant steels. High-carbon ferrochromium, in which the carbon content varies from four to nine per cent, is used in the production of other chromium-bearing steels and alloy cast irons. Chromium greatly increases corrosion resistance in steels, and hardness, strength and resistance to corrosion in cast irons.

Chromium metal is used in high-temperature corrosion-resistant alloys and in chromium bronze, hard-facing alloys, welding-electrode tips, certain high-strength aluminum electrodes and aluminum-base hardener alloys used by fabricators and foundries making up their own alloys. High-temperature alloys contain from 13.5 to 27 per cent chromium, together with varying amounts of cobalt, columbium, nickel, tungsten, molybdenum, manganese, titanium and vanadium. High-temperature alloys are used mainly in the highly-stressed parts of missiles and in gas and steam turbines, jet-engine compressor blades and jet-engine exhaust systems.

Chromium plating is extensively used to produce brilliant, nontarnishing and durable finishes. Many articles such as dies, gauges and punches are plated with a relatively thick layer to improve their wear-resisting qualities and their performance.

Refractory-grade Chromite

Specifications for refractory-grade chromite are not as rigid as for metallurgical grade. For brick of the best quality, the mineralogical constitution is nevertheless of great importance. Because it is desirable to keep the silica content as low as possible and because refractoriness is inversely proportional to the iron content, the chromic oxide and alumina combined should not be less than 57 per cent and the iron and silica should not be above ten and five per cent respectively. The ore must be hard and lumpy and above 10 mesh. Chromite fines are suitable for the manufacture of brick cement or chrome-magnesite brick. Bricks made from refractory-grade chromite are used extensively for lining furnaces. Chrome refractory materials are also used for patching brickwork and in making ramming mixtures for furnace bottoms.

Chemical-grade Chromite

In chemical consumption, specifications are not as rigid as for metallurgical and refractory grades. Standard chemical ores contain a minimum of 45 per cent Cr_2O_3 and within reasonable limits iron is not a problem. The ores should not contain more than 15 per cent aluminum oxide (Al_2O_3) and 20 per cent iron oxide (FeO), or less than eight per cent silicon dioxide (SiO_2); the sulphur must be low. The chromium-iron ratio is usually about 1.6:1. Fines are preferred because the ore is ground in processing to make sodium and potassium chromates and bichromates.

Sodium bichromate or its derivatives are used as pigments in the paint and dye industries, as mordants and waterproofing material in the textile industry, in the surface treatment of metals and as a source of electrolytic chromium.

PRICES

E & M J Metal and Mineral Markets of December 31, 1962, quotes chrome prices in United States currency as follows:

	Dollars
Chrome metal, electrolytic, 99.8% according to size of lot, per lb delivered	1.15 - 1.19
Chrome ore, dry basis, subject to penalties if guarantee not met, f.o.b. Atlantic ports, per long ton, Rhodesian (term contracts)	
48% Cr_2O_3, 3:1 ratio	35.75 - 36.25 (nominal)
48% Cr_2O_3, 2.8:1 ratio	32.00 - 33.50 (nominal)
48% Cr_2O_3, no ratio	27.00 - 28.00 (nominal)
South African (Transvaal)	
48% Cr_2O_3, no ratio	25.50 - 27.00
44% Cr_2O_3, no ratio	19.75 - 20.50
Turkish (basis 48%, 3:1) lump and concentrates	
48% Cr_2O_3, 3:1 ratio	36.00 - 38.00 (nominal)
46% Cr_2O_3, 3:1 ratio	33.50 - 34.00 (nominal)
Ferrochrome, carload lots, delivered, lump, continental U.S. per lb contained Cr	
High carbon, all grades C, 67-71% Cr	00.24
Low carbon, 0.75% C, 67-73% Cr	00.3350
Special, 0.025% C, 68-73% Cr	00.33
Charge chrome, 5.25% C, 58-65% Cr	00.22
Refined chrome, 4.25% C, 58-65% Cr	00.24

Note: These 'quoted' prices are nominal and are the same as those reported on December 28, 1961; however, few sales are completed at these prices and each sale is subject to negotiation between buyer and seller.

TARIFFS

Canada	British Preferential	Most Favored Nation	General
Chrome ore	free	free	free
Chrome metal in lumps, powder, ingots, blocks or bars and in scrap of alloy metal containing chromium for use in alloying	free	free	free
Ferrochrome	free	5%	5%
Materials for use in the manufacture of chromium oxide (expires June 30, 1963)	free	free	20%

United States	
Chrome ore	free
Chromium metal	10 1/2%
Ferrochrome	
Less than 3% C	9 1/2%
3% or more C	5/8¢ per lb on Cr content
Chromic acid	12 1/2%
Chromium carbide; chromium-nickel, -silicon and -vanadium	12 1/2%
Chrome brick	25%
Chrome colors	11 %

Clays and Clay Products

J. G. Brady*

Clays and shales suitable for a variety of clay products occur in most parts of Canada. However, because such high-quality clays as china clay (kaolin), ball clay and very refractory fire clay are scarce in Canada, they are imported. Also imported are some low-grade fire clays and stoneware clays for the manufacture of facing brick and sewer pipe, particularly in Ontario and Quebec.

Several deposits of fire clay occur in Canada. Some of the most refractory clays are used for the manufacture of medium- or high-duty refractories. There are no known fire-clay deposits in the populated areas of Ontario and Quebec. As a result, most of the fire-clay refractories consumed in Canada are imported, as are most other fire-clay requirements.

There are few kaolin-bearing deposits in Canada; none has been successfully exploited as a source of china clay.

PRODUCTION, TRADE AND CONSUMPTION

The value of imported clay, at $5.6 million, was about 19 per cent higher than in 1961. As in previous years, production values of Canadian clays were low.

The value of clay products manufactured from domestic clays rose by 2.2 per cent to about $36.5** million, which is 13 per cent below the high of 1959. No production figures were available for clay products manufactured from imported clays. In 1961 their value was estimated at $25.9 million. The principal products manufactured from imported clays are refractory specialties and products, and whiteware products such as floor and wall tile, sanitary ware, electrical porcelain, dinnerware and pottery.

The value of imported clay products was $42.7 million, up slightly from 1961 and about 11 per cent below the high of 1956.

The value of clays exported was negligible. The value of exported clay products, at about $5.4 million, was down slightly from 1961.

Because the value of clay products manufactured from imported clays is not available, an estimate of the value of clay products consumed during the year is not possible.

Seventy-seven plants were producing such clay products as facing brick (glazed and unglazed), common brick, structural tile, drain tile and quarry tile.

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*Mineral Processing Division, Mines Branch.

**Value of manufactured products only. Does not include sales of clay as such.

Table 1

CLAYS AND CLAY PRODUCTS - PRODUCTION AND TRADE

	1961	1962
PRODUCTION (domestic sources)	$	$
Clays including bentonite	1,275,963	na
Clay products from:		
Common clay	29,008,821	na
Stoneware clay	5,002,263	na
Fire clay	778,272	na
Other	917,629	na
Total	36,982,948	37,816,878
IMPORTS		
Clay		
Fire clay, ground	373,613	443,161
China clay, ground	2,666,656	3,166,629
Pipe clay, ground	32,640	57,361
Clays, ground, not otherwise provided for	602,529	975,316
Activated clay for refining of oils	1,006,916	934,465
Total	4,682,354	5,576,932
Clay Products		
United States	22,404,491	21,581,980
Britain	14,672,251	14,848,005
Japan	3,471,501	3,956,461
West Germany	906,251	1,296,975
Other countries	975,836	1,004,015
Total	42,430,330	42,687,436
EXPORTS		
Clays Ground or Unground*		
West Germany	5,717	39,903
United States	6,159	10,049
Britain	1,500	5,054
Other countries	4,490	734
Total	17,866	55,740
Clay Products		
United States	3,663,604	3,349,176
Chile	200,771	487,705
Britain	107,707	123,719
India	346	111,418
Greece	24,961	102,173
Puerto Rico	78,979	92,033

Table 1 (cont'd)

EXPORTS	1961	1962
	$	$
Clay Products (cont'd)		
Argentina	74,373	91,673
Italy	13,710	88,088
Brazil	175,337	84,581
Sweden	57,849	73,995
Other countries	1,379,977	762,687
Total	5,777,614	5,367,248

Source: Dominion Bureau of Statistics.
*For 1961 and subsequent years activated clays are excluded.
na Not available.

Most of the brick plants are modern tunnel-kiln operations which are capable of operating the entire year, whereas the drain tile plants usually close during the winter months. The brick and tile plants generally use domestic raw materials, particularly common clay and shale and stoneware clay. A few plants import stoneware or low-grade fire clay for brick production.

Eight plants manufactured such products as clay sewer pipe, flue liners, conduits and wall coping. Their raw materials were mainly domestic low-grade fire clay, stoneware clay, common clay and plastic shale. Two plants in Ontario imported low-grade fire clay from the United States for production of these products; one of them mixed local clay with the imported fire clays to form a suitable production mix.

Fifteen plants manufacturing refractories used refractory clay as the principal ingredient in many of the products produced. Only four, all in western Canada, used domestic clays.

Three sanitary-ware plants, seven electrical porcelain plants, three wall-tile plants, two dinnerware plants and numerous souvenir and art potteries were the principal users of ceramic-grade china clay and ball clay.

Consumption statistics are not available for any clays except kaolin.

USES, NATURE AND LOCATION OF CLAYS AND SHALE DEPOSITS

China Clay (Kaolin)

China clay, frequently referred to as kaolin, is a high-quality material used as a filler and coater in the paper industry, a raw material in ceramic products and a filler for rubber and other products. The properties needed in the paper industry are intense whiteness, freedom from abrasive grit and high coating-retention. In the ceramic industry it is used as a refractory raw material. In prepared whiteware bodies it is used along with such materials as nepheline syenite, silica, feldspar and talc, for the manufacture of such products as wall tile, floor tile, sanitary ware, dinnerware, pottery and electrical porcelain. China clay is used as a source of alumina and silica in the whiteware industries. It also imparts a degree of plasticity to the unfired body and helps to maintain a white fired color.

Table 2

CLAYS AND CLAY PRODUCTS - PRODUCTION AND TRADE, 1953-62
($ millions)

	Production			Imports	Exports
	Domestic Clays	Imported Clays	Total		
1953	29.8	14.9	44.7	36.5	1.9
1954	32.4	16.0	48.4	35.0	2.2
1955	35.3	18.4	53.7	41.0	2.7
1956	37.8	20.9	58.7	52.4	3.5
1957	35.9	19.9	55.8	47.4	4.3
1958	41.7	23.7	65.4	44.8	4.2
1959	42.5	23.9	66.4	48.1	5.1
1960	38.2	21.5	59.7	46.7	5.3
1961	37.0	25.9e	62.9	47.1	5.8
1962	37.8	na	na	48.3	5.4

Source: Dominion Bureau of Statistics.
Symbols: e Estimate; na Not available.

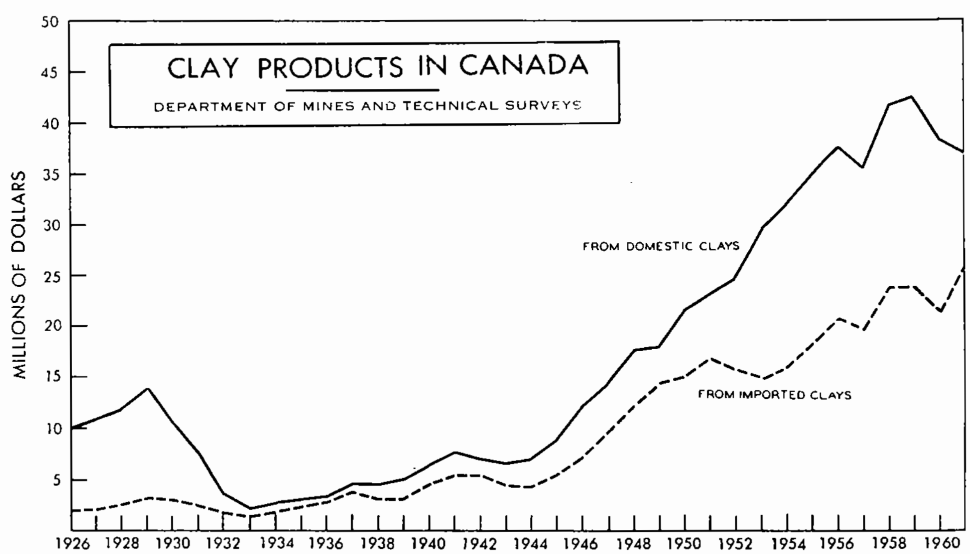


Table 3

CONSUMPTION OF CHINA CLAY, BY INDUSTRIES

(short tons)

	1960	1961	1962
Paper	85,432	80,447	84,079
Rubber and linoleum	11,814	11,583	12,247
Paint	a	10,374	13,906
Ceramics	6,736	1,707	2,306
Other products(b)	5,596	4,167	8,762
Total	109,578	108,278	121,300

Source: Dominion Bureau of Statistics.
(a) Not available separately. (b) Includes paint (1960), chemicals, cosmetics and other miscellaneous products.

China clay usually requires beneficiation to separate the clay from undesirable impurities. Purified china clay consists almost entirely of the clay mineral kaolinite. The theoretical composition of pure kaolinite - silica 46.54 per cent, alumina 39.5 per cent and combined water 13.96 per cent - gives a very refractory mixture that is nearly white both as unfired and as fired. Good-quality commercial kaolins have minor amounts of alkalis, alkaline earth material, and iron and titanium compounds and usually closely approach the theoretical composition of kaolinite.

Because of the problems of beneficiation and because of the small size of some deposits, none of the crude kaolins known to exist in Canada have been developed. Most occurrences contain a high proportion of quartz, whose particles vary in size from coarse to very fine, and such substances as mica, feldspar, magnetite, pyrite and colloidal iron. In the crude material the percentage of clay, which is made up principally of kaolinite, is frequently small. Attempts at removing impurities from Canadian kaolins have so far not been successful.

Extensive deposits of sandy kaolin occur near Wood Mountain, Fir Mountain, Knollys, Flintoft and other localities in southern Saskatchewan. Considerable work has been carried out by the Government of Canada, the University of Saskatchewan and the Government of Saskatchewan, but so far beneficiation has not been successful.

A deposit of refractory clay similar to a secondary china clay occurs along the Fraser River near Prince George, British Columbia. The material varies from very plastic to very sandy. The upper beds are considerably iron-stained. During the year a pit was opened in the deposit to provide raw material for production of buff facing brick.

A clay deposit at Arborg, Manitoba, contains colloidal iron, a considerable quantity of quartz and some other impurities in addition to kaolinite. Kaolin-bearing rock occurs in Quebec at St. Remi d'Amherst, Papineau county; Brebeuf, Terrebonne county; Lac Labelle, Labelle county; Point Comfort, on Thirtyone Mile Lake, Gatineau county; and Chateau Richer, Montmorency county.

The Quebec deposits, in general, contain an excessive amount of quartz and iron minerals. The kaolinite content is variable but is usually less than 50 per cent. The Chateau Richer material is mainly feldspar with about 25 per cent kaolinite. In the past two or three years, various companies have shown considerable interest in Quebec's kaolin-bearing deposits because of their kaolinite content and because of the possible uses of the unbeneficiated material for the facing-brick and other industries.

Some of the china clay in the kaolin deposit at St. Remi d'Amherst is white, but exploration has revealed a considerable amount of a light-brown iron-stained type containing excessive quartz. Kaolinite also occurs in the quartzite of this area. At St. Remi d'Amherst, restricted development by open-pit and underground mining and by beneficiation through the removal of china clay from quartzite were discontinued in 1948 because of operational difficulties. Many years ago some of this clay was used for manufacturing low-grade refractories.

The Laurentian Art Pottery Inc., St. Jerome, Quebec, stopped using clay from the Brebeuf deposit about 15 years ago, mainly because of beneficiation difficulties and the cost of hauling the crude clay to St. Jerome. When washed, this clay fires from white to a light buff.

Ball Clay

Ball clays are used in whiteware slips. These clays impart plasticity and a high green strength to whiteware bodies. They fire to a white or light-cream color and so do not interfere with the fired color of the whiteware products. Being extremely refractory, they are used as a plastic bond clay in various types of refractory products.

Ball clays obtained in Canada are mineralogically similar to high-grade plastic fire clays. They are made up principally of fine-particle kaolinite and quartz.

In Canada, ball clays are known to occur only in the Whitemud formation of southern Saskatchewan. Good-quality deposits are known to exist at Willows, Readlyn, Big Muddy Valley, Blue Hills, Willow Bunch and Flintoft and in other areas. Clay from the Willows area has been used for many years in the potteries at Medicine Hat, Alberta, and in Vancouver; it has been tested in the United States. The lack of proper quality control and the distance from large markets have been the principal disadvantages affecting the use of this material. A processing plant near the Willows deposits at Assiniboia, suspended operations in 1960 because of operational difficulties. Some ball clay from the Flintoft area is being used for white to buff facing brick.

Fire Clay

Canadian fire clays are used principally for the manufacture of medium-duty and high-duty firebrick and refractory specialties. High-duty refractories require raw materials having a PCE (pyrometric cone equivalent) of about 31 1/2 to 32 1/2 (approximately 1,699° C to 1,724° C). Intermediate-duty refractories require raw materials having a PCE of about 29 (approximately 1,659° C) or higher. Clays having a PCE of less than 29 but greater than 15 (approximately 1,430° C) may be suitable for low-duty refractories or ladle brick as well as for other clay products. No known Canadian fire clays are sufficiently refractory for the manufacture of super-duty refractories without the addition of some very refractory material such as alumina.

Good-quality fire clays are low in alkali, alkaline-bearing materials and iron-bearing minerals. The Canadian deposits are made up mainly of a kaolinite-group mineral and quartz. The clays usually fire to a cream or buff color, and the products generally have dark specks owing to the presence of iron-bearing minerals. Ordinarily, fire clay is not beneficiated.

Various grades of good-quality fire clays occur in the Whitemud formation, in Saskatchewan. At a large plant at Claybank, Saskatchewan, fire clays from nearby pits are used for the manufacture of medium- and high-duty refractories and refractory specialties. Good-quality fire clays occur on Sumas Mountain, in British Columbia. At a large neighboring plant, the better grades are used in the manufacture of products similar to those produced at the Saskatchewan plant. Some fire clay from the Sumas Mountain deposit is exported to the United States, and a small quantity is used at plants in Vancouver.

Fire clay and kaolin occur in the James Bay watershed of northern Ontario, along the Missinaibi, Abitibi, Moose and Mattagami rivers. In the past, exploration work has been done in this area, but adverse terrain and climate have made it difficult. One of the various interested companies did some sampling in the area in 1962.

Some seams of clay in the deposit at Shubenacadie, Nova Scotia, are sufficiently refractory for medium-duty refractories, and preliminary work has been carried out on their use for the production of ladle brick. Clay from Musquodoboit, Nova Scotia, is being used by a few foundries in the Atlantic Provinces.

Ontario and Quebec have no domestic sources of fire clay. These industrial provinces import most of their requirements from the United States.

Stoneware Clays

Stoneware clays are similar to low-grade plastic fire clays. They are used extensively in sewer pipe, flue liners, facing brick, pottery, stoneware crocks and jugs, and chemical stoneware.

Stoneware clays are plastic buff-firing materials that fire to a dense condition over a long temperature range. In general, they are of intermediate composition, being between common noncalcareous clays and good-quality fire clays. They usually contain more alkalis, alkaline-bearing materials and other low-melting substances than fire clays. The main clay mineral found in Canadian stoneware clays is of the kaolinite group. The principal impurities are quartz and small quantities of such nonplastic materials as mica, feldspar and pyrite.

The principal source of stoneware clay in Canada is the Whitemud formation of southern Saskatchewan and southeastern Alberta. The Eastend, Saskatchewan, area was formerly the source of much of the clay used at Medicine Hat, Alberta. Stoneware-clay pits are now located in the Alberta Cypress Hills, southeast of Medicine Hat, and at Avonlea, Saskatchewan.

Stoneware or low-grade fire clays occur on Sumas Mountain, near Abbotsford, British Columbia. They are used in the manufacture of sewer pipe, flue lining, facing brick and tile. Similar types of materials occur at Shubenacadie and Musquodoboit, in Nova Scotia. The Shubenacadie clays, which were developed only recently, are used principally for the manufacture of buff facing brick. Musquodoboit clay is used in small quantities by foundries in the Maritimes. Other similar deposits occur at Swan River, Manitoba, where some buff brick has been manufactured, and in British Columbia at Chimney Creek bridge, Williams Lake, Quesnel and close to the Alaska Highway. Quebec and Ontario import their stoneware clay.

Common Clays and Shales

Common clays and shales are the principal raw materials available in Canada for the manufacture of clay products. They are used mainly for the manufacture of common and facing brick, structural tile, partition tile, conduit, quarry tile and drain tile. Some common Canadian clays are mixed with stoneware clay for the manufacture of such products as facing brick, sewer pipe and flue lining.

Because of the presence of iron, common clays and shales usually fire to a salmon or red color. Their fusion points are low - usually well below cone 15 (approximately 1,430° C), which is considered to be the lower limit of the softening point for fire clays. Ordinarily, they are a heterogeneous mixture including clay minerals and various other minerals such as quartz, feldspar, mica, goethite, siderite, pyrite, carbonaceous material, gypsum, calcite, dolomite, hornblende and many others. The clay minerals are chiefly illitic, chloritic or illitic-chloritic, although frequently a member of the montmorillonite or kaolinite group and various mixed layer clay minerals are found in them.

Clays and shales suitable for the manufacture of clay products usually contain 15 to 35 per cent small-particle quartz. If the quartz exceeds this proportion and there are other nonplastic materials, the plasticity of the clay is reduced and the quality of the ware is lowered. Many clays and shales contain calcite or dolomite or both. If present in sufficient quantities these cause the clay to fire to a buff color and adversely affect its strength and density. Common clays and shales are usually higher in alkalis, alkaline materials and iron-bearing minerals and much lower in alumina than the higher-quality stone-ware clays, fire clays and ball clays. Since shales are less plastic than clays, they must be finely ground when used for extruded ware so that plasticity may be developed if possible, or they must be combined with a plastic clay or some other plasticizer.

Common clays and shales are found in all parts of Canada, but deposits having excellent drying and firing properties are generally scarce, and new deposits are continually being sought. Good plasticity and suitable drying and firing properties are all essential for such extruded products as stiff-mud brick, building tile and drain tile. The raw materials for dry-press clay products need not be very plastic, and drying is not a critical problem. In the clays used in soft-mud bricks, which are made in Canada only in small quantities, good drying and firing properties are essential.

Bentonite

Bentonite is the subject of another review in the present series.

PRICES

Prices are not available for all types of clays. China clay generally commands the highest prices because of the cost of its beneficiation and the special processes necessary to produce it for use by the various industries. For example, the paper industry's specifications and requirements for china clay are different from those of the ceramic industry. The prices of ball clays and high-quality fire clays are about the same as those of most china clays. Low-grade fire clays and stoneware clays generally sell for less than ball clays but are priced higher than common clays and shales. Ball clays and kaolins are sold in bags or in bulk; low-grade fire clays, stoneware clays, and common clays and shales are usually sold in bulk.

The following, are typical of U.S. prices of china and ball clay according to the Oil, Paint and Drug Reporter of December 31, 1962:

Ball clay	
Domestic, airfloated, bags, car lots, f.o.b. Tennessee, per short ton	\$17.50 to \$21.50
Crushed, moisture repellant, bulk, car lots, f.o.b. Tennessee, per short ton	\$ 8.00 to \$11.25
China clay	
Domestic, dry-ground, calcined, airfloated, bags, car lots, f.o.b. works, per short ton	\$43.00 to \$68.00
Domestic, dry-ground, uncalcined, airfloated, 99%, 325 mesh, f.o.b. Georgia, bags, car lots per short ton	\$11.00 to \$17.00
Water-ground, washed, bags, car lots, f.o.b. works	\$21.50 to \$50.00
Imported, white, lump, bulk, car lots ex dock Philadelphia, Portland, Me., per long ton	\$23.00 to \$35.00
White, powdered, bags, car lot, ex dock, per net ton	\$43.50 to \$45.00

Coal and Coke

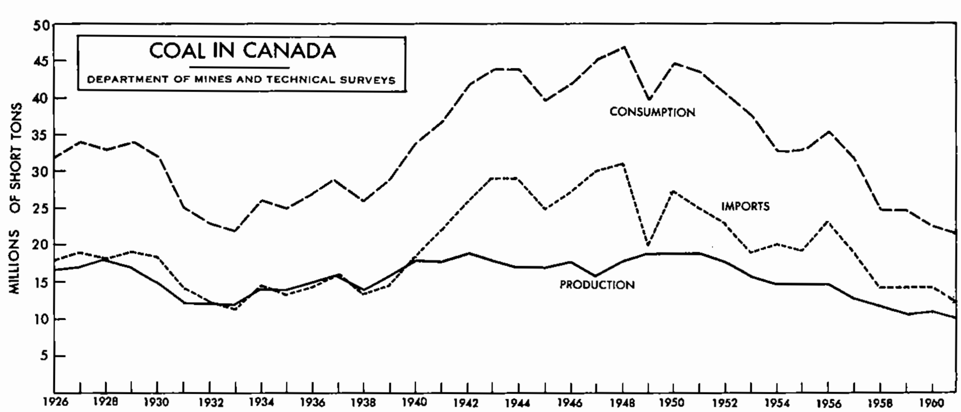
COAL

T.E. Tibbetts*

Some encouragement for the coal industry may be derived from the fact that production in 1962 was only slightly less than that in 1961. Total production was about 10.3 million tons. The production of other than bituminous coal increased. Productivity per man-day increased in practically all coal mining regions leading to lower or relatively steady values for all coals despite higher cost in most other industries.

Imports of coal in 1962 amounted to about 12.6 million tons - an increase from the previous year.

Exports of coal, although only 8.7 per cent of production, decreased, thus interrupting the upward trend of the past few years. The exports are dependent upon the demand for bituminous coking coal in the western United States and Japan.



*Fuels and Mining Practice Division, Mines Branch.

Table 1

COAL - PRODUCTION, TRADE AND CONSUMPTION, 1953-62
(short tons)

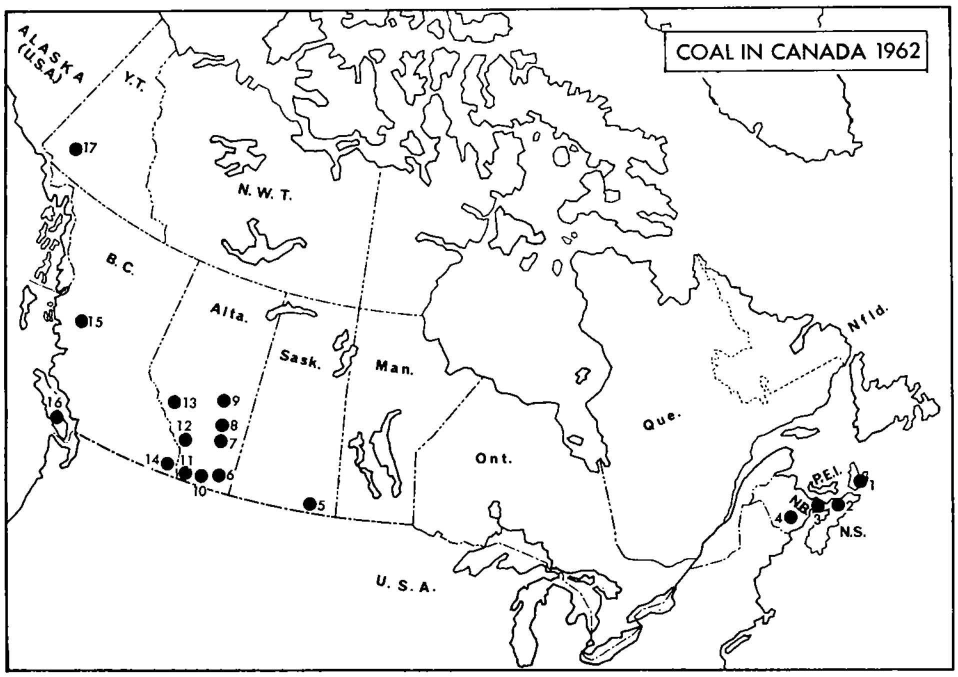
	Production	Imports(a)	Exports	Consumption		
				Domestic(b)	Imported(c)	Total
1953	15,900,673	23,265,541	255,274	15,240,105	22,900,392	38,140,497
1954	14,913,579	18,579,989	219,346	14,466,212	18,322,056	32,788,268
1955	14,818,880	19,742,531	592,782	14,060,039	19,322,134	33,382,173
1956	14,915,610	22,613,374	594,166	14,115,095	22,198,049	36,313,144
1957	13,189,155	19,476,249	396,311	12,478,626	19,041,030	31,519,656
1958	11,687,110	14,491,315	338,544	11,054,757	14,154,121	25,208,878
1959	10,626,722	14,236,118	473,768	10,589,263	13,958,996	24,548,259
1960	11,011,138	13,564,836	852,921	9,973,308	13,276,599	23,249,907
1961	10,397,704	12,306,498	939,336	9,572,805	12,057,086	21,629,891
1962	10,284,769	12,614,189	893,919	9,510,293	12,377,965	21,888,258

Source: Dominion Bureau of Statistics Trade of Canada. (a)Imported coal refers to amounts cleared from custon ports, duty paid. (b)The sum of Canadian coal-mine sales, colliery consumption, coal supplied to employees and coal used in making coke and briquettes, less the tonnage of coal exported. (c)Deductions have been made to take into account foreign coal re-exported from Canada and bituminous coal removed from the warehouse for ships' stores. Imports of briquettes are not included.

PRODUCTION

Production of bituminous coal decreased by 4.3 per cent. Subbituminous coal mines, located only in Alberta, increased their production by almost 10 per cent; production of lignite, mined only in Saskatchewan, increased by about 2.1 per cent. The result was an over-all decrease of just over one per cent in production. Production for 1962, at 10.3 million tons, however, was less than 59 per cent of the production in 1952.

In 1962, provincial production as a percentage of the national output was: Nova Scotia, 40.9 per cent; Saskatchewan, 22 per cent (all lignite); Alberta, 20.2 per cent; British Columbia, 9 per cent (including a small amount produced in the Yukon Territory); New Brunswick, 7.9 per cent. Nova Scotia's production, all bituminous coal, was down by about 2.2 per cent, mainly as a result of the closure by Dominion Coal Company, Limited, of its No. 16 colliery at New Waterford. Saskatchewan increased its production of lignite by 2 per cent. In Alberta the decrease in production of bituminous coal of 11.4 per cent and the increase in the output of subbituminous coal of almost 10 per cent resulted in an over-all increase of 2.9 per cent. In British Columbia, production decreased 5.3 per cent; in New Brunswick it decreased 8.2 per cent.



DEPARTMENT OF MINES AND TECHNICAL SURVEYS

COAL AREAS AND PRINCIPAL PRODUCERS
(with approximate production in thousands of short tons)

Nova Scotia

1. Sydney and Inverness areas (high-volatile bituminous)
    - Bras d'Or Coal Co. Ltd. (Four Star mine) 117
    - Chestico Mining Corporation Limited 19
    - Dominion Coal Company, Limited 2,988
    - Evans Coal Mines Limited 32
    - Indian Cove Coal Company, Limited 32
    - Dominion Steel and Coal Corporation, Limited, Old Sydney Collieries, Division 610

2. Pictou area (medium- and high-volatile bituminous)
    - Acadia Coal Company Limited 226
    - Drummond Coal Company Limited 67
    - Greenwood Coal Company, Limited 9
    - Linacy Coal Company Limited 1

3. Springhill and Joggins areas (high-volatile bituminous)
    - River Hebert Coal Company Limited 58
    - Springhill Coal Mines Limited 45

New Brunswick

4. Minto area (high-volatile bituminous)
   Avon Coal Company, Limited 233
   A.W. Wasson, Limited 25
   Dufferin Mining Limited 87
   D.W. and R.A. Mills Limited 184
   MacDonald, J.F. 4
   Michiels Limited 8
   Miramichi Lumber Company Limited 179
   Newcastle Coal Co., Ltd. 34
   New Haven Coal Company 1
   V.C. McMann, Ltd. 54
   Swift, N.L. 7

Saskatchewan

5. Souris Valley area (lignite)
   Great West Coal Company, Limited 755
   Manitoba and Saskatchewan Coal Company Limited 393
   North West Coal Co. Ltd. 76
   Utility Coals Ltd. 1,032

Alberta

6. Brooks and Taber areas (subbituminous)
   Alberta Coal Sales Limited 38
   The Kleenbirn Collieries, Limited 7

7. Drumheller, Sheerness and Carbon areas (subbituminous)
   Amalgamated Coals Ltd. 151
   Century Coals Limited 166
   Federated Co-operatives Limited 11
   Fox, Alfred 3
   Great West Coal Company, Limited 174
   Halbert Coal mine 4
   Nottal Bros. 11
   Subway Coal Co. 14

8. Castor, Ardley and Camrose areas (subbituminous)
   Allyn Mann Construction Co. 16
   Battle River Coal Company Limited 186
   Burnstad Coal Ltd. 7
   Camrose Collieries Ltd. 18
   Conger mine 13
   Forrestburg Collieries Limited 318
   Lynass, John 12
   Stettler Coal Company Limited 8

Alberta (cont'd)

9. Edmonton, Tofield and Pembina areas (subbituminous)
   Alberta Coal Ltd. (Mines Nos. 419 & 1757) 178
   Black Gem Coal Company Ltd. 13
   Black Nugget Coal Ltd. 8
   Egg Lake Coal Company Limited 12
   Jet Construction Ltd. 11
   Ostertag, C. 6
   Slide Hill Coal Co. Ltd. 2
   Star-Key Mines Ltd. 46
   Warburg Coal Co. Ltd. 12
   Whitemud Creek Coal Co. Ltd. 17

10. Lethbridge area (high-volatile bituminous)
    Lethbridge Collieries Limited 66

11. Crowsnest area (medium-volatile bituminous)
    Coleman Collieries Limited 294

12. Cascade area (low-volatile bituminous and semianthracite)
    The Canmore Mines, Limited 217

13. Coalspur area (high-volatile bituminous)
    The MacLeod River Hard Coal Company, Limited 6

British Columbia

14. East Kootenay (Crowsnest) area (medium-volatile bituminous)
    The Crow's Nest Pass Coal Company, Limited 824

15. Northern Area (medium- and high-volatile bituminous)
    Bulkley Valley Collieries, Limited 7

16. Vancouver Island (Comox) (high-volatile bituminous)
    Comox Mining Company Limited 79

Yukon Territory

17. Carmacks area (high-volatile bituminous)
    Yukon Coal Company Limited 8

The average output per man-day for all coal mines in Canada increased 0.255 tons to 4.791 tons. Most significant was strip mining, which accounted for 40 per cent of the coal production, and which increased the average output to 17.097 tons per man-day in 1962 from 15.413 tons the previous year. Average output for underground mines was 3.239 tons per man-day. Productivity has shown a steady increase during the last few years reflecting the influence of increasing and improved mechanization in both types of mining; this was particularly demonstrated in the past year by the underground mines of British Columbia where average output per man-day increased 11.5 per cent to 5.218 tons.

Table 2

COAL PRODUCTION, BY TYPES, PROVINCES AND TERRITORIES
(short tons and dollars)

		Bituminous*	Subbituminous*	Lignite*	Total
Nova Scotia	1962	4,204,779	-	-	4,204,779
	1961	4,300,758	-	-	4,300,758
New Brunswick	1962	815,529	-	-	815,529
	1961	887,903	-	-	887,903
Saskatchewan	1962	-	-	2,256,306	2,256,306
	1961	-	-	2,208,851	2,208,851
Alberta	1962	590,139	1,497,171	-	2,087,310
	1961	666,226	1,361,600	-	2,027,826
British Columbia and Yukon	1962	920,845	-	-	920,845
Territory	1961	972,366	-	-	972,366
Total	1962	6,531,292	1,497,171	2,256,306	10,284,769
	1961	6,827,253	1,361,600	2,208,851	10,397,704
Total value	1962	$58,922,215	$5,684,098	$4,553,900	$69,160,213
	1961	$60,550,410	$5,732,916	$3,769,357	$70,052,683

Source: Dominion Bureau of Statistics. *Coal classification of the American Society for Testing and Materials as in <u>ASTM Standards on Coal and Coke</u>, "Classification of Coals by Rank" (ASTM Designation: D-388-38).
Symbol: - Nil.

Nova Scotia has no strip mines whereas in New Brunswick more than 82 per cent of the production is by stripping. All of Saskatchewan's production is from strip mines. Both Alberta and British Columbia increased the proportion of strip mined coal in 1962 to 51.5 per cent and 11.7 per cent, respectively.

Table 3

COAL PRODUCTION, BY TYPE OF MINING, AND AVERAGE OUTPUT PER MAN-DAY, 1962

	Production		Average Output per Man-day
	Short Tons	%	Short Tons
Nova Scotia			
Underground	4,204,779	100.0	2.877
New Brunswick			
Strip mines	671,522	82.3	5.487
Underground	144,007	17.7	1.834
Saskatchewan			
Strip mines	2,256,306	100.0	44.920
Alberta			
Strip mines	1,074,515	51.5	16.527
Underground	1,012,795	48.5	4.780
British Columbia			
Strip mines	107,785	11.7	38.799
Underground	805,411	88.3	5.218
Yukon			
Underground	7,649	100.0	2.454
Canada			
Strip mines	4,110,128	40.0	17.097
Underground	6,174,641	60.0	3.239
Total, all mines	10,284,769	100.0	4.791

Source: Dominion Bureau of Statistics.

The value of the coal produced in Canada in 1962 averaged $6.72 per ton and totalled more than $69.1 million. Bituminous coal accounted for 85 per cent of the total value, averaging $9.02 per ton, which represents an increase of about 15 cents per ton from the previous year. This increase was due mainly to the average increase of 22 cents per ton in the value of Nova Scotia coal. The value of lignite increased 32 cents per ton and that of subbituminous coal declined about 41 cents a ton. The cost of various coals in terms of heat units was relatively the same as it was the previous year - Nova Scotia coal being the most expensive (except that from the Yukon Territory) and Saskatchewan lignite, at 13.65 cents per million Btu, being by far the cheapest source of coal-derived energy in this country. (See Table 4)

Table 4

COMPARISON OF AVERAGE VALUES OF CANADIAN COALS, 1962

	Average Btu/lb*	Average Value per Short Ton** $	Average Value per Million Btu ¢
Nova Scotia			
Bituminous	13,450	9.92	36.88
New Brunswick			
Bituminous	11,900	8.28	34.79
Saskatchewan			
Lignite	7,400	2.02	13.65
Alberta			
Bituminous	12,950	7.26	28.03
Subbituminous	9,000	3.80	21.11
British Columbia			
Bituminous	13,800	6.63	24.02
Yukon Territory			
Bituminous	11,450	15.06	65.76
Total Canada			
Bituminous	13,260	9.02	34.01
Subbituminous	9,000	3.80	21.11
Lignite	7,400	2.02	13.65
Average, Canada	11,354	6.72	29.59

* Department of Mines and Technical Surveys, Analysis Directory of Canadian Coals. "Supplement No. 2 - 1960" (Mines Branch Monograph No. 868).
** Dominion Bureau of Statistics.

DISPOSITION OF COAL

Nova Scotia and New Brunswick

High-volatile bituminous coking coal is produced in the Sydney, Cumberland and Pictou areas of Nova Scotia; noncoking high-volatile bituminous coal is produced in the Inverness area of the same province. New Brunswick's production - only high-volatile bituminous coking coal - comes mainly from the Minto area but also from strip mines in the Chipman and Coal Creek areas.

A large part of the output of the two provinces is used locally for industrial steam-raising (including that in thermoelectric plants) and household and commercial heating. The greatest single use of Nova Scotia coal, however, is in the manufacture of metallurgical coke for the provincial steel industry. The railways are no longer important consumers of eastern Canadian coal.

Much of the coal produced in Nova Scotia and New Brunswick is shipped to Quebec and Ontario. In 1962, Nova Scotia shipped more than 63 per cent of its output to other parts of the country. More than 87 per cent of this went to central Canada where it was used for industrial steam-raising, commercial heating and thermoelectric power generation. A small amount of Nova Scotia coal was exported to the island of St. Pierre. New Brunswick shipped about 10.5 per cent of its output to central Canada and more than 14 per cent to the United States.

Table 5

INTERPROVINCIAL SHIPMENTS OF COAL, 1962
(short tons)

Destination	Originating Province				
	Nova Scotia	New Brunswick	Saskatchewan	Alberta	British Columbia
Newfoundland	87,628	-	-	-	
Prince Edward Island	23,357	76	-	-	
Nova Scotia	-	842			
New Brunswick	225,956	-	-	-	
Quebec	1,900,153	81,698	-	-	
Ontario	432,156	3,878	88,681	29,952	19,548
Manitoba	-	-	747,841	153,561	150,262
Saskatchewan	-	-	-	347,012	657
Alberta	-	-	-	-	582
British Columbia and Yukon	-	-	-	283,651	-
Total	2,669,250	86,494	836,522	814,176	171,049

Source: Dominion Bureau of Statistics, The Coal Mining Industry.
Symbol: - Nil.

Saskatchewan

The only active lignite coalfields in Canada are in the Bienfait and Estevan areas of Saskatchewan's Souris Valley.

About 37 per cent of Saskatchewan's coal production was shipped to Manitoba and Ontario. The entire output from one operation in the Estevan area, amounting to about 45 per cent of the total lignite production, provided the fuel for the new Boundary Dam thermoelectric generating station. The remainder of the lignite was used within the province for commercial and household heating and industrial purposes.

Alberta

Alberta produced coal ranging from semianthracite, obtained in the Cascade area, to subbituminous (almost lignite).

The largest output was from the subbituminous mines; 48 such mines operating in 1962 produced almost 72 per cent of Alberta's coal. These mines are in the following areas, listed in order of decreasing output: Castor, Drumheller, Pembina, Sheerness, Edmonton, Ardley, Taber, Camrose, Westlock, Tofield, Carbon, Brooks, Champion, Wetaskiwin, Redcliff, Gleichen. More than 78 per cent of the total production of subbituminous coal was from seven mines in the Castor, Drumheller, Pembina and Sheerness areas.

The subbituminous coals were used mainly for commercial and household heating, but increasing quantities are being employed industrially, particularly for thermoelectric power generation.

Bituminous coking coals were produced in the Crowsnest area. In 1962 a large part of this production was exported to Japan where it was used to upgrade the Japanese coal blends for metallurgical use. A total of 316,862 tons of Alberta coal went to Japan and more than 9,200 tons went to the United States. A new bulk-loading dock at Port Moody, B.C., facilitates the export of coal from western Canada.

In the Lethbridge and Coalspur areas, lower-quality bituminous non-coking coals were produced, mainly for household and commercial heating but also for the production of industrial steam.

About 39 per cent of Alberta's coal production was shipped to other provinces, Saskatchewan and British Columbia taking, respectively, 16.6 and 13.6 per cent. About 7.4 per cent went to Manitoba and 1.4 per cent to Ontario.

British Columbia and Yukon Territory

The Crowsnest area (East Kootenay District on the mainland of British Columbia) is the main coal producing area of that province; it accounts for 90 per cent of the production. Nearly 335,000 tons of medium-volatile bituminous coking coal from this area were exported, mainly to Japan with some to the United States, for metallurgical use. Most of the remainder of the province's output, high-volatile bituminous, was mined in the Comox area of Vancouver Island. This was mainly for domestic use as were the small amounts produced in the Northern district of the mainland.

Table 6

EXPORTS OF COAL, 1962
(short tons)

Destination	Shipments from Mines by Province*						
	Nova Scotia	New Brunswick	Saskatchewan	Alberta	British Columbia	All	Total Exports**
Norway	-	-	-	-	-	-	50
St. Pierre	4,538	-	-	-	-	4,538	4,501
United States	-	116,039	246	9,219	3,609	129,113	250,328
Japan	-	-	-	316,862	331,095	647,957	639,040
Total	4,538	116,039	246	326,081	334,704	781,608	893,919
Value							$8,207,354

Source: Dominion Bureau of Statistics. * Direct to destination. ** Cleared through Customs. Differences from the amounts reported as shipped from mines are made up from coal shipped from stock and coal shipped to industrial dealers but ultimately consigned to the export market. The latter circumstance applies to New Brunswick, Alberta, and British Columbia coals going to the United States. The statistics shown in Trade of Canada on shipments to Japan are incomplete. Symbol: - Nil.

About 16.5 per cent of the output of the province was shipped to Manitoba. More than 2.1 per cent went to markets in Ontario and small amounts were shipped to Saskatchewan and Alberta.

All coal produced in the Yukon Territory was for local use.

Subvention Assistance

Payments by the federal government through the Dominion Coal Board, to assist the movement of coal to markets, were continued in 1962. The tonnage to which such assistance was applied decreased by more than a quarter million tons although the value only decreased from $17,854,456 in 1961 to $17,433,355 in 1962.

Subvention assistance amounting to about $2.4 million was applied to the export of 634,855 tons of coal from the Alberta and British Columbia Crowsnest areas.

In addition to the general coal subsidy, more than $1 million was paid to mine operators in Nova Scotia to delay the closing of certain mines. Also, in 1962 a special subsidy was allowed to producers in Nova Scotia and New Brunswick when shipping coal to markets in direct competition with imported residual oil. Under this scheme more than $700,000 was paid to mine operators in Nova Scotia at the rate of 30 cents per ton and more than $39,000 to operators in New Brunswick at a 10 cents per ton rate.

Payments under the Atlantic Provinces Power Development Act, 1958, totalled $1,538,204.

IMPORTS

There was an increase of 2.5 per cent in coal imports in 1962. Imports of bituminous coal from the United States increased 4.0 per cent whereas imports of anthracite, also mainly from the United States with some from the United Kingdom, decreased 13.6 per cent. More than 41 per cent of the bituminous coal imported was high-grade coking coal used in the metallurgical industry, mainly in Ontario.

CONSUMPTION

Consumption of coal in Canada increased 1.2 per cent in 1962 to about 21.9 million tons. More than 56 per cent of the coal consumed was imported.

Railway locomotives, once great consumers of coal, no longer use significant quantities.

In 1943 almost 12 million tons of coal were used by the railways. Total coal used by the railways in 1962, including that for heating purposes, was about 375,000 tons, as reported by the Dominion Coal Board.

Whereas there were substantial increases in the consumption of other fuels, use of coal for household and commercial-building heating decreased by almost a half million tons to about 3.6 million tons.

Table 7

COAL MOVED UNDER SUBVENTION
(short tons and dollars)

Origin of Coal	1961	1962
Nova Scotia	2,323,684	2,191,938
New Brunswick	146,201	114,186
Saskatchewan	104,807	82,511
Alberta and British Columbia	758,011	692,394
Total	3,332,703	3,081,029
Value	$17,854,456	$17,433,355

Source: Dominion Coal Board.

Table 8

IMPORTS OF COAL FOR CONSUMPTION
(short tons and dollars)

Country of Origin		Anthracite	Bituminous*	Total
United States	1962	883,765	11,699,853	12,583,618
	1961	1,004,931	11,248,341	12,253,272
United Kingdom	1962	30,571	-	30,571
	1961	53,226	-	53,226
Total	1962	914,336	11,699,853	12,614,189
	1961	1,058,157	11,248,341	12,306,498
Value	1962	$10,306,348	$63,865,142	$ 74,171,490
	1961	$11,442,615	$60,117,136	$ 71,559,751

Source: Dominion Bureau of Statistics, Trade of Canada. * Includes coal dust and coal not otherwise provided for and coal exwarehoused for ships stores.
Symbol: - Nil.

Industrial consumption of coal, including that used by thermoelectric generating stations, increased 10 per cent in 1962. The proportion of Canadian coal used industrially declined slightly to about 51.8 per cent, the remainder being mainly bituminous coal from the United States.

Table 9

CONSUMPTION OF CANADIAN AND IMPORTED COAL, 1953-62

	Canadian		Imported		Total
	Short Tons*	% of Consumption	Short Tons**	% of Consumption	Short Tons
1953	15,240,105	40.0	22,900,392	60.0	38,140,497
1954	14,466,212	44.1	18,322,056	55.9	32,788,268
1955	14,060,039	42.1	19,322,134	57.9	33,382,173
1956	14,115,095	38.9	22,198,049	61.1	36,313,144
1957	12,478,626	39.6	19,041,030	60.4	31,519,656
1958	11,054,757	43.9	14,154,121	56.1	25,208,878
1959	10,589,263	43.1	13,958,996	56.9	24,548,259
1960	9,973,308	42.9	13,276,599	57.1	23,249,907
1961	9,572,805	44.3	12,057,086	55.7	21,629,891
1962	9,510,293	43.4	12,377,965	56.6	21,888,258

Source: Dominion Bureau of Statistics. * The sum of Canadian coal-mine sales, colliery consumption, coal supplied to employees, and coal used in making coke and briquettes, less the tonnage of coal exported. ** Deductions have been made to take into account foreign coal re-exported from Canada and bituminous coal removed from the warehouse for ships' stores. Imports of briquettes are not included.

There was an increase of about 2.3 per cent to about 5.5 million tons in the use of coal to manufacture coke. The increased consumption was of imported coal; use of Canadian coal declined 9.3 per cent amounting in 1962 to only about 10.5 per cent of the total coal used for coke manufacture.

BRIQUETTES

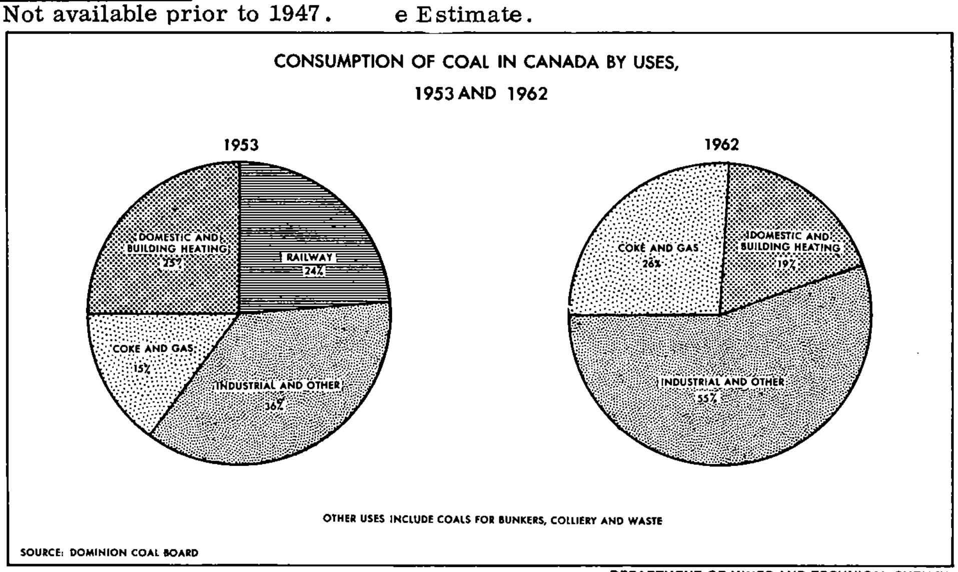
There was a further sharp decline in the production of coal briquettes in 1962, which was 82 per cent of the 1961 production. The decline in production for both lignite and bituminous coal briquettes was similar. Apparent consumption of briquettes was only about 70 per cent of that in 1961.

Table 10

CONSUMPTION OF FUELS FOR HOUSEHOLD AND COMMERCIAL-BUILDING HEATING, 1947-62

	Fuel Oil and Distillate(a) (barrels)	Natural Gas(b) (M cubic feet)	Manufactured Gas(b) (M cubic feet)	Coal and Coke(c) (short tons)
1947	16,273,423	28,198,903	20,525,540	13,117,157
1948	17,036,106	30,824,172	21,570,466	13,429,436
1949	18,733,890	32,164,544	23,864,281	12,473,258
1950	24,669,930	40,004,435	20,363,572	12,653,394
1951	29,787,032	43,048,025	24,072,327	11,436,717
1952	34,863,926	43,328,304	22,527,092	10,515,475
1953	38,585,104	46,390,654	21,418,959	8,941,428
1954	46,808,256	56,864,148	22,090,283	8,599,993
1955	52,861,644	68,591,360	15,742,947	8,283,432
1956	61,276,831	77,937,257	16,392,636	8,048,673
1957	63,170,085	92,217,497	13,478,976	6,952,821
1958	68,108,400	112,939,734	5,232,899	6,061,924
1959	74,003,854	142,682,865	1,318,286	5,751,361
1960	77,375,067	161,298,388	823,734	4,717,156
1961	81,341,806	179,677,388	772,286	4,111,146
1962	87,942,000	202,699,379	753,000e	3,615,311

Source: Dominion Bureau of Statistics. (a) Consumption of Petroleum Fuels. (b) The Crude Petroleum and Natural Gas Industry - manufactured and natural gas for household and commercial purposes. (c) The Coal Mining Industry, Sales of Coal and Coke Reported by Retail Fuel Dealers. Not available prior to 1947. e Estimate.



DEPARTMENT OF MINES AND TECHNICAL SURVEYS

Table 11

INDUSTRIAL CONSUMPTION OF COAL
(short tons)

Type of Coal	1961	1962
Canadian		
Bituminous	3,441,027	3,766,131
Subbituminous	241,660	357,160
Lignite	1,469,079	1,494,246
Total	5,151,766	5,617,537
Foreign		
Anthracite	228,723	215,429
Bituminous	4,468,003	5,003,245
Total	4,696,726	5,218,674
Total, all types	9,848,492	10,836,211

Source: Dominion Bureau of Statistics.

Table 12

BITUMINOUS COAL USED TO MAKE COKE
(short tons)

	1961	1962
Imported	4,696,421	4,877,451
Canadian	634,121	574,869
Total	5,330,542	5,452,320

Source: Dominion Bureau of Statistics.

Table 13

BRIQUETTES -PRODUCTION AND CONSUMPTION
(short tons)

	1961	1962
Production		
Saskatchewan	32,132	
Alberta* and British Columbia	35,195	28,631
Total, Canada	67,327	
Consumption		
Briquettes available for consumption**	77,431	

Source: Dominion Bureau of Statistics. * Alberta production includes 40 tons of char in 1962 and 491 tons of char in 1961. Carbonized briquettes previously known as 'char' are now defined as 'coke'. e Estimate.

COKE

J.C. Botham*

Of the 21.8 million tons of coal consumed in Canada in 1962, about 5,450,000 tons were carbonized to produce coke. The coke was used mainly in the making of primary iron and, to a lesser extent, in foundry practice, base metal recovery, chemical processes and domestic heating.

Canadian-produced byproduct coke is usually manufactured in batteries of slot-type ovens of some 50 units to a battery. At present the plants in operation vary in annual coal capacity from 500,000 to 2 million tons and, with the exception of one coke oven plant built primarily for the production of domestic coke, are owned and operated by the steel plants. Apart from the conventional slot-type byproduct coke ovens, Canada has a Curran-Knowles carbonization plant at the Crow's Nest Pass collieries in Michel, British Columbia. About 95 per cent of the coal used in the production of coke is processed at the 6 plants listed with relevant data in Table 1.

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* Fuels and Mining Practice Division, Mines Branch.

Table 1

CONVENTIONAL COKE OVEN PLANTS IN CANADA

Coke Plant	Battery	Type of Oven	Number of Ovens	Year Built	Coal Capacity of Ovens (tons)	Byproducts Recovered	Capacity	Coke Distribution
The Algoma Steel Corporation, Limited Sault Ste. Marie, Ont.	No. 6	Koppers-Becker Underjet	57	1953	17.5	Tar, sulphate of ammonia, pyridine oil, benzole, toluene, xylene, solvent naphtha, gas, naphthalene, light oil.	4 batteries of 253 ovens with an annual rated capacity of 2,100,000 tons of coal.	Blast furnace use - 3 1/2 x 1 inch; base metal industry - 1 x 1/2 inch and 1/2 x 3/16 inch; sintering - 3/16 x 0 inch.
	No. 5	Koppers-Becker Underjet	86	1943	17.5			
	No. 2	Wilputte gun flue	53	1938	12.5			
	No. 7	Wilputte gun flue	57	1958	17.5			
The Steel Company of Canada, Limited, Hamilton, Ont.	No. 5	Wilputte Underjet	47	1953	16.75	Tar, sulphate of ammonia, naphthalene, pyridine, benzole, toluene, xylene, solvent naphtha, gas	3 batteries of 191 ovens with an annual rated capacity of 1,470,000 tons of coal.	Blast furnace use - plus 7/8 inch; domestic heating - 7/8 x 3/8 inch; sintering - minus 3/8 inch.
	No. 3	Wilputte Underjet	61	1947	16.75			
	No. 4	Wilputte Underjet	83	1952	16.75			
Dominion Foundries and Steel, Limited, Hamilton, Ont.	No. 1	Koppers-Becker Gun Type Comb.	25	1956	16.5	Tar, light oil, gas.	3 batteries of 105 ovens with an annual rated capacity of 930,000 tons of coal.	Blast furnace use - plus 3/4 inch; sintering - 1/8 x 0 inch; other uses - 3/4 x 1/8 inch.

	No. 2	Koppers-Becker Gun Type Comb.	35	1951	16.5			
	No. 3	Koppers-Becker Gun Type Comb.	45	1958	16.5			
Dominion Steel and Coal Corporation, Limited, Sydney works, Sydney, N.S.	No. 5	Koppers-Becker Underjet	53	1949	16.6	Tar, sulphate of ammonia, nitration benzole, industrial benzole, nitration and industrial toluene, xylene, solvent naphtha, gas.	2 batteries of 114 ovens with an annual rated capacity of 900,000 tons of coal.	Blast furnace use - 3 1/2 x 1 1/2 inch, 2 1/2 x 1 1/2 inch domestic heating - 2 1/2 x 1 1/2 inch, 1 1/2 x 7/8 inch, 7/8 x 1/4 inch sintering 1/4 x 0 inch.
	No. 6	Koppers-Becker Underjet	61	1953	16.6			
Quebec Natural Gas Corporation, Ville LaSalle, Que.	No. 1	Koppers-Becker	59	1928	16.5	Tar, sulphate of ammonia, benzole, toluene, crude xylene, pyridine, gas.	2 batteries of 74 ovens with an annual rated capacity of 626,300 tons of coal.	Foundry coke, domestic heating, chemical industry, blast furnace use, base metal industry, rockwool producers.
	No. 2	Koppers-Becker	15	1947	16.5			
The Crow's Nest Pass Coal Company, Limited, Fernie, B.C.	No. 1	Curran-Knowles	10	1939	5.5	Crude tar, gas.	4 batteries of 52 Curran-Knowles ovens with an annual rated capacity of 243,000 tons of coal.	Base metal industry - 4 x 2 inch; beet sugar industry - 5 x 2 inch; iron reduction in electric furnaces 1 1/2 x 3/4 inch, 1/4 x 1/8 inch; sintering use - minus 1/4 inch; chemical industry - 1/4 x 0 inch.
	No. 2	Curran-Knowles	10	1943	5.5			
	No. 3	Curran-Knowles	16	1949	7.5			
	No. 4	Curran-Knowles	16	1952	7.5			

Table 2

NONCONVENTIONAL CARBONIZATION PLANTS IN CANADA

Coke Plant	Type of Unit	No. of Units	Year Built	Coal Capacity of Each Unit (tons/day)	Byproducts Recovered	Capacity	Product Distribution
Dominion Briquettes and Chemicals Ltd., Taylorton, Sask.	Lurgi carbonizing retort	2	1925	350-400	Creosote, lignite tar, lignite pitch	2 units with an annual total rated capacity of 80,000 tons of coal.	Domestic heating fuel - 30,000 tons; barbecue briquettes - 10,000 tons.
Shawinigan Chemicals Limited, Shawinigan, Que.	Travelling grate coking stoker	8	1939	70	Low grade producer gas	8 units with an annual total rated capacity of 200,000 tons of coal.	Manufacture of calcium carbide in electric furnaces.
The Canmore Mines Limited, Canmore, Alta.	Vertical retort	1	Under construction	80	Crude tar, gas	1 unit with an annual rated capacity of 24,000 tons of agglomerated coal.	Chemical industries.
The Crow's Nest Pass Coal Company, Limited, Fernie, B.C.	Mitchell	3	Under construction	7	No byproducts	The 3 ovens under construction are for experimental purposes, mainly to evaluate the foundry coke market.	Foundry market.

Table 3

COKE - PRODUCTION AND TRADE

	1961		1962	
	Short Tons	$	Short Tons	$
PRODUCTION*				
Coal coke				
Ontario	3,138,141		3,247,962	
Other provinces	761,404		773,812	
Total	3,899,545		4,021,774	
Pitch coke	4,466		4,488p	
Petroleum coke**	964,494		966,122p	
Total	4,868,505		4,992,384	
IMPORTS (all types)				
United States	654,423	11,118,960	585,237	10,076,547
Britain	136	4,464	135	3,876
Total	654,559	11,123,424	585,372	10,080,423
EXPORTS (all types)				
United States	156,929	2,349,423	129,551	1,661,566
Britain	5,390	237,687	4,576	186,174
Other countries	64,384	893,652	23,755	258,613
Total	226,703	3,480,762	157,882	2,106,353

Source: Dominion Bureau of Statistics. *Value of coke production and selling price of coke are not available. Practically all coke output is that produced in the primary iron and steel industry as material used in process.
**Includes quantities of catalytic carbon.
p Preliminary.

There is a current trend in North America toward a return to the use of non-recovery ovens of the horizontal-bed internal-combustion type (beehive-type ovens). The Mitchell oven and modifications of this design are the ovens of this type which are of principal interest at present. Their growing popularity stems primarily from the loss of markets for coke oven byproducts to the petrochemical industry. Some incentives for their use are: lower capital cost, lower labor costs than the beehive oven through improved coal and coke handling facilities, and their ability to be shut down if not needed. Three Mitchell ovens have been built in the Crowsnest area of British Columbia on an experimental basis to explore the market for foundry coke in western Canada and western United States.

In the Cascade area of Alberta a carbonizing retort has been built which will be in operation on a commercial scale early in 1963. The intention is to produce a coke product by crushing a carbonized briquette prepared from low volatile and semi-anthracite coals - a form-coke could be produced if desired. Pelletized coal is also being considered as a feed material. The product is intended primarily for the electric smelting process used in the manufacture of elemental phosphorus; however markets other than the chemical industry - mainly for metallurgical applications - are envisaged.

Another nonconventional carbonization process is the Lurgi carbonizing retorts which carbonize and briquette a Saskatchewan lignite coal to produce a high fixed-carbon product for domestic fuel and for use in barbecues. Still another is a distinctive stoker-type coking plant designed and operated by Shawinigan Chemicals Limited, Shawinigan, Quebec. In Table 2 the nonconventional carbonization plants are listed along with relevant data.

In Canada, petroleum coke is used mainly in the production of electrodes for the aluminum industry; pitch coke is obtained only from surplus coal-tar pitch that is not required for such other industrial uses as the production of electrodes or briquettes.

Although few plants still produce manufactured gas and domestic coke, the capacity for the production of metallurgical coke for the steel and base-metal industries has been maintained.

The gas industry, which has continued to expand its facilities for the distribution of natural gas, is contending for space-heating and other domestic and commercial outlets. The gas-retort plants, which for many years were the main producers of manufactured gas and domestic coke, have now been superseded. In areas where natural gas is not available, propane or other liquid petroleum gases are distributed. Liquid petroleum gases are also used for stand-by plants and for peak-load requirements of several natural-gas distribution systems.

In recent years the uses of metallurgical coke have changed due to alterations in the methods of producing pig iron and steel. An increase in the use of sintered ores in the iron blast furnace and a corresponding increase in the fuel requirements for sintering, which is done mainly with coke breeze, have resulted in an increase in the demand for small sizes of coke or coke breeze. This has made possible, to a greater extent than was previously considered practical, the preparation of sized coke for iron blast furnaces.

Developments in the use of supplementary liquid and gaseous fuels in iron blast furnaces have led to an increase in the throughput of standard furnaces and a reduction introduced through the furnace tuyeres in the quantity of by-product coke used for each ton of pig iron produced. An increase in the use of electrical reduction for the production of pig iron has also increased the demand for low-volatile fuels, such as coke breeze, for the carbon required in the process. The changes have contributed materially to a more efficient use of coke in the production of pig iron as well as to a considerable increase in the capacity or throughput of standard blast furnaces.

Cobalt

V.B. Schneider*

In 1962, cobalt production amounted to 3,481,922 pounds valued at $6,345,205 This increase of 299,025 pounds from 1961 was mostly attributable to the opening of a new cobalt-producing section in the Fort Saskatchewan refinery of Sherritt Gordon Mines, Limited.

No cobalt ores have been produced in Canada since 1957 but cobalt has been obtained as a by-product from the smelting and refining of nickel-copper ores from Sudbury, Ontario, and Lynn Lake and Thompson, Manitoba, and as a by-product of silver refining at Cobalt, Ontario, by Cobalt Refinery Limited. Prior to April 1961 it was recovered as a by-product of silver refining at Deloro, Ontario.

PRODUCERS

Ontario

The International Nickel Company of Canada, Limited, (INCO) recovered cobalt from its nickel-refining operations at Port Colborne, Ontario, and Clydach, Wales. High-purity electrolytic cobalt is produced at the Port Colborne refinery; cobalt oxides and salts are produced by The International Nickel Company (Mond) Limited, a British subsidiary, at Clydach. In 1962, INCO reported production of 2,272,149 pounds of cobalt, including the production at the Clydach refinery.

Falconbridge Nickel Mines, Limited, produced electrolytic cobalt at its refinery at Kristiansand, Norway, from the refining of nickel-copper matte produced at Sudbury. Metal deliveries for 1962 were reported as 1,226,000 pounds.

Cobalt Refinery Limited sells the cobalt it recovers in the form of black cobalt oxide, which is 70 to 71 per cent cobalt, and in the form of a mixed cobalt and nickel oxide - approximately 40 to 45 per cent nickel and 20 to 25 per cent cobalt. To increase cobalt production the company reported that it is planning investigations aimed at processing ores of lower silver - higher cobalt content.

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* Mineral Resources Division.

Table 1

COBALT - PRODUCTION, TRADE AND CONSUMPTION

	1961		1962	
	Pounds	$	Pounds	$
PRODUCTION(a)				
All forms, cobalt content ..	3,182,897	4,751,543	3,481,922	6,345,205
EXPORTS				
Cobalt metal				
United States	468,849	836,263	455,717	780,305
Britain	69,681	104,009	36,000	55,742
Sweden	57,750	87,294	28,200	45,080
France	-	-	15,804	26,079
West Germany...........	6,650	9,924	6,818	11,110
India	1,001	1,583	26	767
Total..................	603,931	1,039,073	542,565	919,083
Cobalt oxides and salts(b)				
Britain	1,521,000	2,106,608	1,606,700	2,285,609
United States	-	-	23,200	27,597
Total..................	1,521,000	2,106,608	1,629,900	2,313,206
IMPORTS				
Oxides(b)				
Britain	26,064	30,738	37,736	43,909
United States	2,300	4,086	3,200	3,861
Total..................	28,364	34,824	40,936	47,770
CONSUMPTION(c)				
Cobalt metal and cobalt contained in oxides and salts	390,091	na	383,442	na

Source: Dominion Bureau of Statistics.
(a) Production from domestic ores of cobalt metal and cobalt contained in alloys, oxides and salts. Excludes the cobalt content of nickel-oxide sinter shipped to Britain by International Nickel, but includes the cobalt content of Falconbridge shipments of nickel-copper matte to Norway. (b) Gross weight. (c) As reported by consumers. Symbols: - Nil; na Not available.

Manitoba-Alberta

Sherritt Gordon Mines, Limited, produced 608,580 pounds of cobalt, up 417,537 pounds from 1961. Included in this was cobalt recovered from 3,500 tons of nickel-cobalt calcine purchased in April 1961 in the United States from the General Services Administration. Sherritt Gordon recovers cobalt as a by-product at its nickel refinery at Fort Saskatchewan, Alberta, from its Lynn Lake, Manitoba, nickel-copper ores. It markets cobalt in the form of briquettes, powder and strip. In 1962, it produced for the first time pure cobalt powder in five closely sized grades for powder metallurgy applications such as bearings, welding rods and other pure or pre-alloy powder-metal products.

INCO produced cobalt oxide at its Thompson, Manitoba, refinery as a by-product in its nickel-refining operations.

WORLD MINE PRODUCTION

Reports for 1962 indicate that Free World production of cobalt was about 15,700 tons. This is about 900 tons more than in 1961, but some 200 tons below the all-time high established in 1957. Production increased slightly in Katanga, Morocco and Canada but decreased in Northern Rhodesia, West Germany and the United States.

The Republic of the Congo (Katanga) is by far the largest producer of cobalt. Its output in 1962 was 10,615 tons all derived as a by-product from the copper refining operations of Union Minière du Haut-Katanga. In 1962 the new Luilu electrolytic plant, which started up in June 1961, was brought to its full capacity of 4,000 tons a year. Toward the close of the year, production at the Panda electric smelter was progressively reduced according to schedules.

Cobalt is produced in Northern Rhodesia by Rhokana Corporation Limited and Chibuluma Mines Limited. Due to a change in the treatment process at Chibuluma, cobalt matte produced after March was low grade and was stockpiled for upgrading. This accounts for the drop in Northern Rhodesia's production during 1962.

In French Morocco cobalt is derived from the cobalt-bearing deposits in the Bou Azzer district by the Société Minière de Bou Azzer et du Graaza. Preliminary reports indicate that 1,543 tons of cobalt were produced in 1962. France refines most of French Morocco's cobalt concentrates; the remainder is refined in Belgium. Like the ores of Cobalt, Ontario, those from Morocco are arsenical and must be treated in smelters that specialize in this raw material.

In the United States, Pyrites Company Inc., Wilmington, Delaware, was the only producer of cobalt metal; Bethlehem Cornwall Corp., from its magnetic iron ores at Cornwall and Morgantown, Pennsylvania, was the only domestic producer of cobalt in concentrates. Bethlehem Steel Company announced that it intends to build a new leaching plant at Sparrows Point, Maryland. This will process calcined pyrites from the sulphuric acid plant at the steelworks there and produce a liquid concentrate containing cobalt and copper. The concentrate, containing about 350 tons of cobalt a year, will be

TABLE 2

COBALT - PRODUCTION, TRADE AND CONSUMPTION, 1952-62

(pounds)

	Production(a)	Exports				Imports		Consumption(b)
	All Forms	Cobalt in Ores and Concentrates	Metallic Cobalt	Cobalt Alloys(c)	Cobalt Oxide and Salts(c)	Cobalt Ores	Cobalt Oxides(c)	
1952	1,421,923	-	315,500	20,445	785,976	14,943,400	-	164,000
1953	1,602,545	37,100	769,369	11,874	932,499	4,288,000	28,500	192,000
1954	2,252,965	3,300	1,139,039	4,926	836,205	10,400	6,935	122,000
1955	3,318,637	-	1,542,988	12,357	1,640,282	37,800	8,000	224,000
1956	3,516,670	16,000	1,432,884	11,343	1,289,145	1,900	11,353	262,000
1957	3,922,649	15,100	2,155,742	12,400	620,042	800	10,340	153,000
1958	2,710,429	-	1,024,667	9,712	522,144	-	16,230	260,000
1959	3,150,027	-	680,323	3,280	1,100,734	-	24,716	188,000
1960	3,568,811	-	844,293	1,938	1,175,206	-	20,227	182,000
1961	3,182,897	-	603,931	d	1,521,000	-	28,364	307,000
1962	3,481,922	-	542,565	d	1,629,900	-	40,936	299,000

Source: Dominion Bureau of Statistics.
(a) Production from domestic ores of cobalt metal and cobalt contained in alloys, oxides and salts. Excludes the cobalt content of nickel-oxide sinter shipped to Britain by International Nickel, but includes the cobalt content of Falconbridge shipments of nickel-copper matte to Norway. (b) Producers' domestic shipments, refined metal only; from 1959 consumption of cobalt metal as reported by consumers. (c) Gross weight. (d) Not reported as a separate class after 1960.
Symbol: - Nil.

shipped by tank truck to Pyrites Company Inc., where it will be processed into metal, oxide and hydrate.

Very little is known about the production and consumption of cobalt in the Communist bloc countries. It is generally believed that the use of cobalt is restricted because the bloc is deficient in cobalt, and that Soviet cobalt production is confined to the nickel-cobalt smelters in the Kola peninsula, Norilsk and the Urals.

Table 3

FREE WORLD PRODUCTION OF COBALT, 1961-1962
(short tons)

	1961	1962
Republic of the Congo	9,178	10,615
Northern Rhodesia	1,701	948
Canada	1,591	1,741
Morocco	1,422	1,583
Other countries	908	813
Total*	14,800	15,700

Source: Dominion Bureau of Statistics; United States Bureau of Mines, Cobalt Preprint, 1962.
* United States production not available for publication but included in world total.

CONSUMPTION AND USES

The United States, by far the largest consumer of cobalt, used 11,268,000* pounds of cobalt in all forms in 1962, 1,672,000 pounds more than in 1961. According to the Cobalt Information Center**, Brussels, Belgium, there are indications that consumption in other parts of the world was less in 1962 than in 1960 or 1961, notably in Europe and Japan. Statistics on the consumption of cobalt in these areas are not readily available but indications are that Free World production capacity at some 18,000 tons a year exceeds requirements by about 2,500 tons. In 1958 productive capacity at 14,750 tons exceeded consumption by more than 6,000 tons; since then the increase in the rate of consumption has outpaced the increase in productive capacity.

* U.S. Bureau of Mines Cobalt Preprint, 1962.
** Cobalt - Number 18, March 1963.

Prior to 1954, United States consumption accounted for more than half of the world cobalt consumption. Since then, and particularly since 1958, there has been so large an increase in the use of cobalt in Europe that in 1960 the United States consumption was only 30 per cent of the total. However, this trend to smaller proportions for the U.S. was reversed in 1961 and 1962 or at least temporarily halted.

The table showing consumption of cobalt by uses in the United States illustrates that the general pattern of distribution among the various uses has not altered greatly from 1959. Notable is the decline in the proportion consumed by permanent-magnet alloys and the slight increase in the proportion being used in nonferrous alloys and other metallic products, and high-temperature high-strength materials.

Table 4

UNITED STATES CONSUMPTION OF COBALT, BY USES

(percentages of total consumption)

Use	1959	1960	1961	1962
Metallic (steel)				
High-speed steel...............	2.1	1.8	2.3	3.0
Other tool and alloy steel	6.3	7.0	6.1	5.4
Permanent-magnet alloys.......	30.2	26.9	25.6	25.5
Cutting and wear-resisting materials....................	1.4	2.9	2.7	2.8
High-temperature high-strength materials....................	24.5	22.5	24.5	26.8
Alloy hard-facing rods and materials....................	4.1	5.0	5.7	5.8
Cemented carbides.............	3.4	3.6	3.1	5.4
Nonferrous alloys and other metallic uses	6.6	6.8	8.4	6.3
Total, metallic	78.6	76.5	78.4	81.0
Nonmetallic (exclusive of salts and driers)				
Ground-coat frit...............	5.5	5.2	5.5	4.7
Pigments	2.0	2.1	2.0	1.5
Other materials	2.6	3.1	3.3	4.2
Total, nonmetallic	10.1	10.4	10.8	10.4

Table 4 (cont'd)

Uses	1959	1960	1961	1962
Salts and driers				
Lacquers, varnishes, paints, inks, pigments, enamels, feed, electroplating, etc. (estimated)...	11.3	13.1	10.8	8.6
Grand total....................	100.0	100.0	100.0	100.0

Sources: U.S. Bureau of Mines, Cobalt Preprint, 1962.

Table 5

COBALT CONSUMPTION IN CANADA, 1961-62

(pounds of contained cobalt)

	1961	1962
Cobalt metal..................	307,459	298,624
Cobalt oxide	47,715	48,669
Cobalt salts	34,917	36,149
Total	390,091	383,442

Source: Dominion Bureau of Statistics.

The most important application of cobalt is in high-temperature cobalt-base alloys used for such parts as nozzle guide vanes and turbine rotor blades in jet engines, gas-turbine engines and in guided missiles. The metal is an important constituent of permanent-magnet alloys, cemented carbides, hard-facing rods, and high-speed steel. A radioisotope, Cobalt 60, is widely used for radiographic examinations by industry and also in the 'cobalt bomb' treatment of cancer.

Cobalt oxide is used in ground-coat frit for bonding porcelain enamel to a metal base. It is also used as a coloring agent in making glass and ceramics.

Organic salts of cobalt are used as driers in paint, varnish, enamel, ink, etc. Inorganic salts such as cobalt sulphate and cobalt carbonate are used in animal feeds.

Canadian consumers of cobalt include: in Ontario - Deloro Smelting & Refining Company, Limited, Deloro and Belleville; Canadian General Electric Company Limited and Nuodex Products of Canada Limited, both of Toronto; Dussek Bros. (Canada) Limited, Belleville; The Indiana Steel Products Company of Canada Limited, Kitchener; Ferro Enamels (Canada) Limited, Oakville; Atlas Steels Limited, Welland; in Quebec - Dominion Glass Company, Limited, and Mallinckrodt Chemical Works, Limited, both of Montreal; Canadian General Electric Company Limited, Quebec City; in British Columbia - Macro Division of Kennametal Inc., Port Coquitlam.

St. Lawrence Chemical Company, Limited, Canadian Sales agent for The International Nickel Company (Mond) Limited, supplies the domestic market with cobalt salts in the form of acetate, carbonate, hydrate, and sulphate. Its sales in 1962 to manufacturers were in the following proportions: ceramics 26%, chemical 4%, animal feed 23%, drier 46% and miscellaneous 1%.

PRICES

Cobalt prices in the United States at the end of 1962, according to E & M J Metal and Mineral Markets, were as follows:

Cobalt metal per lb f. o. b. New York	
500-lb lots	$1.50
100-lb lots	$1.52
Less than 100 lb	$1.57
Fines	$1.50
Cobalt oxide (ceramic grade, 350-lb containers) per lb 72 1/2-73 1/2% cobalt	
East of Mississippi	$1.15
West of Mississippi	$1.18
70-71% cobalt	$1.12 to $1.15
Cobalt ore, per lb cobalt, free market	
10% cobalt content	$0.60 (nominal)
11% cobalt content	$0.70 (nominal)
12% cobalt content	$0.80 (nominal)

TARIFFS

	British Preferential	Most Favored Nation	General
Canada			
Ore	free	free	free
Cobalt metal	free	10%	25%
Cobalt oxide	free	10%	10%

Tariffs (cont'd)

United States

Ore	free
Metal	free
Cobalt oxide	2.7¢ lb
Cobalt sulphate	2 ¢ lb
Cobalt linoleate	5 ¢ lb
Other cobalt compounds and salts	13 1/2 %

Copper

A. F. Killin*

World production of copper increased in 1962 despite production cuts, labor strife and political unrest. Consumption of refined copper decreased from the 1961 total but stocks of refined and blister copper increased slightly. Curtailments by large companies, producer support of the London Metal Exchange price and the slight increase in consumption in Canada and the United States brought about a virtual balance in the supply-demand position on world copper markets.

Prices continued remarkably stable. The United States producers' and custom smelters' price remained at 31 cents (U.S.) a pound for the entire year thus extending the time this quotation has been in effect to twenty and a half months. The London Metal Exchange price, which started the year at 28.80 cents (U.S.) a pound, moved to 29.25 cents in January and was supported for the rest of the year. The Canadian producers' price was 30 cents (Can.), approximately 28.5 cents (U.S.), until the Canadian dollar was devalued in May at which time the price rose and remained at 31.5 cents (Can.), approximately 29.25 cents (U.S.).

Mine production of copper in Canada increased to 457,385 tons in 1962 - 4.2 per cent higher than the previous record set in 1961. The 1962 production was valued at $282,732,696 compared with $255,157,626 in 1961. The production of refined copper declined to 382,502 tons from 406,359 tons in 1961. Domestic consumption of refined copper rose in 1962 to 151,526 tons, 9,718 tons more than was consumed in 1961.

Exports of copper in ore and matte rose to 89,374 tons in 1962, an increase of 46,480 tons from 1961. The increase is attributable mainly to increased exports of copper in concentrates from British Columbia to Japan. Exports of copper in refinery shapes were 223,043 tons, a decrease of 43,204 tons from 1961. This decrease is due partly to decreased production of refined copper and partly to increased domestic consumption.

In 1962, eight new mines were brought into production, three mines were closed and seven were being developed. Exploration parties were active in all copper-producing provinces and in the territories. Production increased in British Columbia, Newfoundland, Manitoba and New Brunswick and decreased in Ontario, Saskatchewan, Quebec and the Northwest Territories. The decrease of production in Ontario resulted from a production cut at the mines of The International Nickel Company of Canada, Limited, in the Sudbury district.

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*Mineral Resources Division

Table 1

COPPER - PRODUCTION, TRADE, AND CONSUMPTION

	1961		1962	
	Short Tons	$	Short Tons	$
PRODUCTION(a)				
All forms				
Ontario	211,647	122,421,860	188,995	116,347,723
Quebec	149,007	86,990,202	147,431	91,407,164
British Columbia	15,845	9,205,938	54,490	33,766,394
Saskatchewan	33,479	19,545,019	32,017	19,850,465
Newfoundland	15,752	9,195,817	17,308	10,731,154
Manitoba	12,454	7,271,252	12,738	7,897,714
New Brunswick	-	-	3,674	2,277,864
Northwest Territories	463	270,440	314	194,928
Nova Scotia	-	-	204	126,300
Yukon	441	257,098	214	132,990
Total	439,088	255,157,626	457,385	282,732,696
Refined	406,359r		382,502	
EXPORTS				
In ore and matte				
Japan	2,237	971,323	43,627	20,388,990
United States	14,660	6,388,623	20,653	9,312,399
Norway	19,443	8,498,144	17,213	8,066,346
West Germany	612	138,687	1,368	564,881
Spain	2,854	1,314,393	2,350	1,080,932
Belgium and Luxembourg	862	145,931	1,892	572,174
Britain	2,218	1,172,882	1,818	950,723
Portugal	-	-	453	208,347
Other countries	8	6,000	-	-
Total	42,894	18,635,983	89,374	41,144,792

Table 1 (Cont'd)

	1961		1962	
	Short Tons	$	Short Tons	$
Refinery shapes				
Britain	115,859	66,292,15	93,693	56,999,248
United States	64,189	39,396,990	76,506	50,692,337
France	15,885	8,961,796	13,928	8,541,309
West Germany	13,355	7,485,155	11,907	7,005,832
Sweden	4,894	2,720,129	5,376	3,237,668
Belgium and Luxembourg	5,745	3,249,048	4,951	2,940,852
Poland	6,103	3,466,131	4,759	2,923,583
India	6,732	3,874,331	3,440	2,058,837
Japan	11,207	6,461,158	2,937	1,862,999
Italy	3,497	1,882,353	2,160	1,320,183
Australia	2,239	1,318,118	1,288	823,681
Other countries	16,542	9,302,14	2,098	1,294,598
Total	266,247	154,409,513	223,043	139,701,127
Scrap, slag, skimmings, sludge				
United States	1,919	612,638	2,294	877,577
Spain	855	476,241	2,005	1,086,718
Japan	2,647	1,366,126	1,593	871,126
Greece	-	-	677	364,939
Yugoslavia	27	13,460	466	245,381
Austria	11	5,230	379	186,002
West Germany	1,260	625,721	286	139,796
India	528	292,776	270	143,415
Other countries	837	495,602	298	151,494
Total	8,084	3,887,794	8,268	4,066,448
Bars, rods and shapes (sections) not elsewhere specified and plates, sheet, strip and flat products				
Norway	6,244	3,608,396	6,305	4,178,004
Switzerland	6,310	3,476,612	5,009	2,931,542
Denmark	896	525,409	2,863	1,781,531
Britain	3,213	2,027,479	2,667	1,804,485
United States	2,016	1,482,900	1,908	1,594,985
Pakistan	620	330,185	1,434	881,033

Table 1 (Cont'd)

	1961		1962	
	Short Tons	$	Short Tons	$
Bars, rods and shapes, etc. (continued)				
Venezuela	261	188,034	705	489,357
New Zealand	521	425,941	400	358,833
Other countries	1,063	699,606	571	467,065
Total	21,144	12,764,562	22,162	14,486,835
Pipe and tubing				
United States	2,221	2,255,535	1,577	1,552,681
New Zealand	913	813,678	1,213	1,227,207
Britain	263	284,938	498	538,587
Puerto Rico	446	429,926	383	375,973
Venezuela	205	212,430	291	286,708
Philippines	308	347,326	211	243,242
Colombia	425	401,737	183	168,372
Belgium and Luxembourg	103	112,404	159	175,143
Spain	22	25,879	95	103,616
Other countries	1,664	1,656,329	882	922,872
Total	6,570	6,540,182	5,492	5,594,401
Wire and cable, not insulated				
United States	151	98,016	317	219,148
Chile	-	-	38	29,956
Bermuda	35	27,819	24	18,306
Afghanistan	1	402	15	10,307
Panama	12	8,782	11	7,107
Colombia	3	3,180	8	7,392
Jamaica	-	205	8	4,470
Dominion Republic	45	33,325	7	5,515
Other countries	161	131,298	29	22,347
Total	408	303,027	457	324,548

Table 1 (Cont'd)

	1961		1962	
	Short Tons	$	Short Tons	$
Wire and cable insulated(b)				
United States	5,634	3,989,287	3,983	4,036,404
Venezuela	211	211,962	224	243,769
Peru	106	128,356	155	209,640
Dominican Republic	136	108,246	145	158,453
Panama	125	107,607	136	111,423
Bermuda	61	52,916	106	90,405
Other countries	721	663,424	686	685,785
Total	6,994	5,261,798	5,435	5,535,879
IMPORTS				
Copper in blocks, pigs, ingots	3	3,844	147	89,737
Copper scrap	3,958	2,220,336	454	262,599
Copper bars for electric wires	1,182	883,528	856	688,015
Copper in bars or rods, nop	64	54,663	139	103,391
Copper in strips, sheets, plates	130	168,416	173	241,202
Copper tubing	908	885,960	200	302,872
Copper rollers for wall-paper		104,345		197,301
Copper wire, nop	20	42,556	20	41,711
Copper wire cloth, woven wire		19,977		45,892
Copper manufactures, nop		1,714,358		1,244,833
Oxide of copper	99	78,783	143	123,469
Copper sulphate	387	113,183	437	158,513
Total		6,289,949		3,499,535
CONSUMPTION(c)				
Refined		141,807		151,525

Source: Dominion Bureau of Statistics.
(a)Blister copper plus recoverable copper in matte and concentrates exported.
(b)Includes also small quantities of non-copper wire and cable, insulated.
(c)Producers' domestic shipments.
Symbols: nop Not otherwise provided; r Revised from previously published figure.

The decrease in Manitoba and Saskatchewan was caused by the mining of lower-grade ore by Hudson Bay Mining and Smelting Co., Limited. Mining of lower-grade ore also resulted in decreased production at Sherritt Gordon Mines, Limited, in Manitoba.

PRODUCTION AND DEVELOPMENTS

Details of individual mine production and development are given in Table 3. The following résumé gives the production and significant developments by provinces.

Newfoundland

Copper production in Newfoundland increased to 17,308 tons, valued at $10,731,154 in 1962 from the 15,752 tons produced in 1961.

Atlantic Coast Copper Corporation Limited at Little Bay operated at its planned milling rate of 1,000 tons a day but copper production was reduced by excessive dilution. Mill capacity will be increased to 1,200 tons a day to maintain copper production. Maritimes Mining Corporation Limited and the Buchans Unit of American Smelting and Refining Company continued normal operations during the year. Copper properties were being explored and developed underground on the Burlington Peninsula at Whales Back Pond and Baie Verte. At Whales Back Pond, British Newfoundland Exploration Limited, a subsidiary of British Newfoundland Corporation Limited, collared a 3-compartment shaft and will start shaft sinking in 1963 to explore a copper deposit. Diamond drilling from the surface has indicated an orebody containing about 3 million tons averaging 1.8 per cent copper. At Baie Verte, Consolidated Rambler Mines Limited completed the sinking of a 3-compartment production shaft to a depth of 560 feet at its copper-gold property. Four levels were established and the results obtained from crosscutting, drifting and drilling on the 275- and 400-foot levels have indicated an orebody containing 1.2 million tons of ore averaging 1.03 per cent copper, 1.98 per cent zinc and 0.153 ounce of gold per ton. With assurance that the Newfoundland government will guarantee a $1.5-million bond issue, the company announced plans to build a 500-ton-a-day mill at the property.

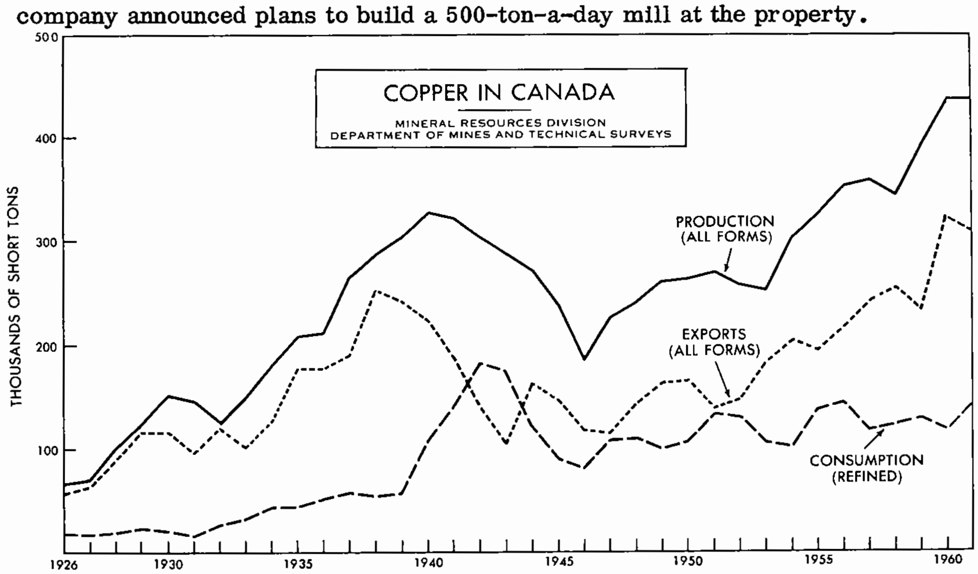


Table 2

COPPER - PRODUCTION, TRADE AND CONSUMPTION, 1952-62
(short tons)

	Production		Exports			Imports	Consumption(c)
	All Forms(a)	Refined	In ore and matte	Refined	Total	Refined	
1952	258,038	196,320	34,437	113,675b	148,112	12,973	130,347
1953	253,252	236,966	51,158	131,994b	183,152	5,515	105,482
1954	302,732	253,365	47,411	156,130b	203,541	1,703	102,432
1955	325,994	288,997	41,565	153,199	194,764	35	138,559
1956	354,860	328,458	40,993	174,844	215,837	2,541	145,286
1957	359,109	323,540	46,548	198,794	245,342	4,175	118,225
1958	345,114	329,239	30,316	224,638	254,954	1	122,893
1959	395,269	365,366	32,070	222,437	254,507	105	129,973
1960	439,262	417,029	47,633	278,066	325,699	25	117,636
1961	439,088	406,359r	42,894	266,247	309,141	3	141,807
1962	457,385	382,502	89,374	223,043	312,417	147	151,525

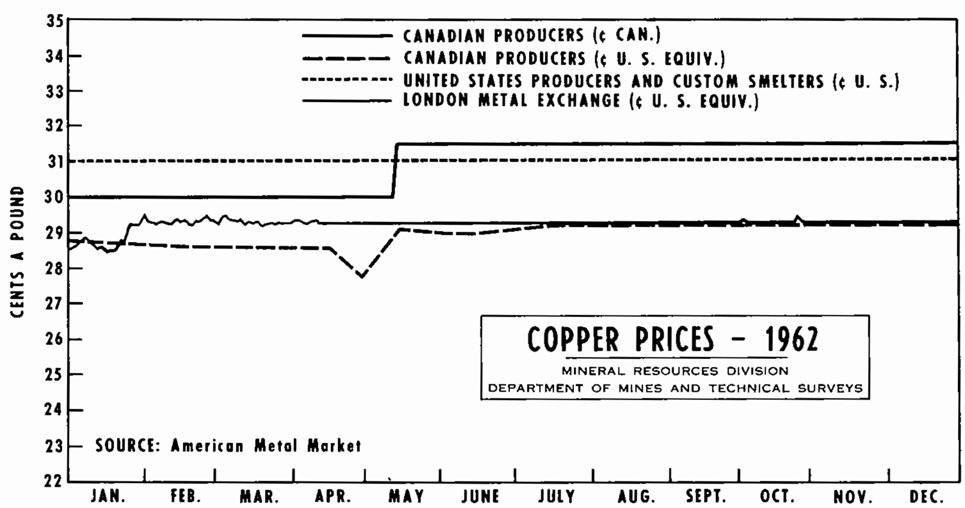
Source: Dominion Bureau of Statistics.
(a) Blister copper plus recoverable copper in matte and concentrate exported. (b) Includes blister and anode copper exported for refining as follows: 1952 - 27,974 short tons; 1953 - 3,527 short tons; 1954 - 4,712 short tons. (c) Producers' domestic shipments, refined copper.
Symbol: r Revised from previously published figure.

New Brunswick

With the start of production at the Wedge mine of The Consolidated Mining and Smelting Company of Canada Limited, New Brunswick rejoined the ranks of copper-producing provinces in Canada. The Wedge property is at the junction of the Nepisiguit River and Fortymile Brook, approximately 10 miles north of the Heath Steele mill of Heath Steele Mines Limited. Since the start of mining in January, 750 tons of ore a day have been trucked to the Heath Steele mill over a road built under the federal-provincial roads to resources program. Heath Steele continued exploration and development of its zinc-copper orebody about 35 miles northwest of Newcastle and reactivated its 1,500-ton-a-day mill to treat the Wedge ore. Production from the Heath Steele orebodies started in June and will be increased to 750 tons a day.

Brunswick Mining and Smelting Corporation Limited announced plans to start production from its No. 12 mine, about 10 miles southwest of Bathurst. Rehabilitation of the mine plant and construction of a 3,000-ton-a-day mill was started. A new production hoist will be installed and production from the zinc-lead-copper orebody is scheduled to start in 1964. Canadian National Railways has agreed to construct a 15-mile branch line from Nepisiguit Junction to the property and will transport concentrates from the mine to the port of Dalhousie. Ore reserves in the No. 12 orebody are reported to be 29.3 million tons averaging 6.6 per cent zinc, 2.4 per cent lead and 0.5 per cent copper. Brunswick has a contract to deliver concentrates to Société Génerale des Minerais, in Belgium, for a period of 12 years.

The announced production plans at Brunswick have stimulated activity on several properties in the immediate vicinity of the mine.



Quebec

Copper production in Quebec totalled 147,431 tons valued at $91,407,164 in 1962. Although one new mine joined the established producers during the year, production decreased 1,576 tons because of the continuation of production cuts at the mines of Noranda Mines, Limited (Horne mine), Waite Amulet Mines, Limited (closed in October) and Gaspé Copper Mines, Limited. The new producer, Solbec Copper Mines, Ltd., at Stratford Place in the Eastern Townships started production of copper and zinc concentrates in January at its 1,000-ton-a-day mill. Cupra Mines Ltd. continued development and exploration of its property 2 1/2 miles south of the Solbec mine. Results to date have indicated an orebody containing 859,940 tons averaging 3.64 per cent copper, 3.39 per cent zinc, 0.57 per cent lead, 0.022 ounce of gold and 1.324 ounces of silver per ton. A complete mining plant has been installed and a vertical shaft will be sunk to a depth of 2,250 feet below the collar. Production is scheduled for 1964 with the ore being trucked to the Solbec mill.

In the Noranda-Normetal area, Lake Dufault Mines, Limited, installed a mining plant, and a permanent headframe and hoist, and collared a 3-compartment shaft. Shaft-sinking to about 1,400 feet below the collar will start in 1963. About 60 miles northwest of Amos, Joutel Copper Mines Limited started sinking a 3-compartment shaft to 1,025 feet below the collar at its property in Joutel township. Lateral development from the shaft on two levels will be carried out in 1963. Rio Algom Mines Limited holds a group of claims in the same area and was preparing to sink a production shaft to 1,275 feet. At this property, results obtained from diamond drilling have indicated one million tons averaging 3 per cent copper.

At Matagami Lake, Mattagami Lake Mines Limited, New Hosco Mines Limited and Orchan Mines Limited were continuing mine plant construction and underground development of their respective mines. Production from these properties is scheduled to commence late in 1963.

Exploration parties were active in many parts of Quebec with most interest centred in the Belleterre, Noranda and Joutel areas in the northwest and in Ungava where the main activity was north of Schefferville between Romanet Lake and the Mercier River.

Ontario

Copper production in 1962 declined to 188,995 tons valued at $116,347,723 from the 1961 total of 211,647 tons. The reduction was caused by a production curtailment at the mines of The International Nickel Company of Canada, Limited.

In the Timmins area, Kam-Kotia Porcupine Mines, Limited, is preparing to sink a shaft to explore and develop two recently discovered mineralized zones near its open-pit producing mine. The discovery has sparked exploration activity in the area. McIntyre-Porcupine Mines, Limited modified a section of its gold mill to treat low-grade copper ore from an orebody adjacent to the company's gold mine.

Table 3

PRODUCING COMPANIES, 1962

Company and Location	Mill Capacity (tons ore/day)	Ore Produced 1962 (short tons)	Grade			Ore Produced 1961 (short tons)	Developments During Year
			Copper (%)	Zinc (%)	Nickel (%)		
Newfoundland							
American Smelting and Refining Company (Buchans Unit) Buchans	1,300	378,000	1.07	12.44	-	387,000	Routine development and exploration.
Atlantic Coast Copper Corporation Limited, Little Bay	1,000	367,748	1.31	-	-	226,536	Main shaft will be deepened to 1,650 feet below the collar in 1963. Surface diamond drilling and exploration.
Maritimes Mining Corporation Limited, Tilt Cove	2,000	831,835	1.53	-	-	814,748	Routine development and exploration.
New Brunswick							
The Consolidated Mining and Smelting Company of Canada Limited (Wedge Mine), Nepisiguit River, Bathurst-Newcastle	750 tons of ore a day shipped to Heath Steele Mill	223,920	na	-	-	-	Commenced production in January.
Heath Steele Mines Limited, Bathurst-Newcastle	1,500	na	na	na	-	-	Reactivated its mill. Commenced limited production from the B orebody in June.
Quebec							
Campbell Chibougamau Mines Ltd. (Main, Kokko Creek, Cedar Bay and Henderson mines) Dore Lake, Chibougamau	3,000	739,333	2.11	-	-	712,493	Main mine - lateral development and exploration of new ore zone on four levels. Cedar Bay mine - shaft sinking and lateral development of lower levels of the orebody. Henderson mine - routine development of the A ore zone. Lateral development and diamond drilling of B ore zone.
The Patino Mining Corporation, Copper Rand Division (Machin Point, Chibougamau Jaculet and Portage Island mines) Gouin Peninsula, Chibougamau	1,500	639,711	2.48	-	-	604,480	Development of lower levels at Machin Point mine. Shaft sinking and station development at Portage Island mine.

Gaspé Copper Mines, Limited, Murdochville	7,000	2,694,100	1.29	-	-	2,589,390	Extensive surface diamond-drilling program on Copper Mountain orebody. Molybdenum circuit added to concentrator.
Manitou-Barvue Mines Limited, Val d'Or	1,300	291,440 169,140	0.99 -	- 6.02	- -	298,385 162,860	Lateral development of zinc ore at depth from recently deepened shaft.
Merrill Island Mining Corporation, Ltd., Dore Lake, Chibougamau	650	159,910	2.30	-	-	154,301	Shaft sinking to 2,300 feet below the collar and crosscutting to the orebody on four new levels.
Noranda Mines, Limited, Noranda	3,300	901,500	0.87	-	-	1,340,881	Completed sinking of an internal shaft to the 8,000-foot level. Started drifting on the 7,000- and 8,000-foot levels.
Normetal Mining Corporation, Limited, Normetal	1,000	354,751	2.71	5.17	-	355,001	Routine exploration and development.
Opemiska Copper Mines (Quebec) Limited, Chapais	2,000	544,518	2.95	-	-	599,061	Surface and underground exploration by diamond drilling. Routine stope and level development.
Quemont Mining Corporation, Limited, Noranda	2,300	804,600	1.25	2.64	-	822,275	Routine development of the orebody at depth. Exploration by diamond drilling from the surface on other areas on the property.
Solbec Copper Mines, Ltd., Stratford Place	1,000	271,384	1.85	4.88	-	-	Production started in January.
Sullico Mines Limited, Val d'Or	3,000	991,868	0.76	0.60	-	1,028,201	Routine development of small orebodies.
Waite Amulet Mines, Limited, Noranda	2,000	171,306	3.86	4.08	-	248,000	Mine closed October 31, 1962.
Vauze Mines Limited, Noranda	350	109,242	4.64	4.29	-	22,300	A 400-foot inclined winze was sunk below the 750-foot level and exploration by crosscutting and diamond drilling carried out.
Ontario							
Falconbridge Nickel Mines, Limited (Falconbridge, East, Hardy, Onaping, Boundary and Fecunis mines) Sudbury	3,000 at Falconbridge 1,500 at Hardy 2,400 at Fecunis	2,407,520	na	-	na	2,531,933	Routine development and exploration. Strathcona orebody being readied for production.

Table 3 (cont'd)

PRODUCING COMPANIES, 1962

Company and Location	Mill Capacity (tons ore/day)	Ore Produced 1962 (short tons)	Grade			Ore Produced 1961 (short tons)	Developments During Year
			Copper (%)	Zinc (%)	Nickel (%)		
International Nickel Company of Canada, Limited, The (Frood-Stobie, Creighton, Garson, Levack, Murray, Frood, Clarabelle and Ellen open-pit mines) Sudbury	30,000 at Copper Cliff 12,000 at Creighton mine 6,000 at Levack mine		na	-	na	12,407,768	
Geco Mines Limited, Manitouwadge	3,300	1,282,414	1.81	4.68	-	1,276,778	Main shaft deepening completed, ore raises and pockets installed along with automatic ore-hoisting equipment. A new 4,000-foot shaft will be sunk for depth development of the orebodies.
Kam-Kotia Porcupine Mines, Limited, Timmins	1,000	376,533	1.95	0.85	-	235,136	Surface exploration and diamond drilling have indicated 1.5 million tons of ore in a new orebody on the property. A 4-compartment shaft was collared and will be sunk 1,100 feet in 1963. Mill capacity will be increased to 1,500 tons of ore a day and a circuit for the recovery of zinc concentrate will be added.
North Coldstream Mines Limited, Kashabowie	1,000	364,348	2.00	-	-	332,783	Routine exploration and development.
Rio Algom Mines Limited, Pronto Division, Pater mine, Spragge	750	256,325	1.69	-	-	238,600	Routine exploration and development. Shaft will be deepened to 3,000 feet below the collar in 1963.
Temagami Mining Co. Limited, Timagami	150	52,970	6.77	-	-	50,078	Shaft deepened 310 feet and three new levels established.
Willroy Mines Limited, Manitouwadge	1,300	495,028	1.69	5.56	-	421,772	Shaft deepening and routine exploration and development on lower levels of main ore zone.
Manitoba-Saskatchewan							
Hudson Bay Mining and Smelting Co., Limited (Flin Flon, Coronation, Schist Lake and Chisel Lake mines) Flin Flon, Man.	6,000 at Flin Flon	1,702,340	2.42	5.50	-	1,682,693	Routine exploration and development.

Sherritt Gordon Mines, Limited, Lynn Lake, Man.	3,150	1,262,502	na	-	na	1,219,157	Routine development of producing orebodies. Diamond drilling of two mineralized zones in the A intrusive plug.
British Columbia							
Bethlehem Copper Corporation Ltd., Highland Valley, Ashcroft	3,300	74,435	0.81	-	-	-	Open pit mining of the East Jersey orebody started in November and full mill capacity will be reached early in 1963.
Consolidated Woodgreen Mines Limited, Greenwood	1,000	62,584	0.47	-	-	201,123	Mine closed in April.
The Consolidated Mining and Smelting Company of Canada Limited, Benson Lake mine, Benson Lake, Vancouver I.	750	66,449	1.7	-	-	-	Production started in August 1962. Underground winze will be dewatered and lower levels developed.
Cowichan Copper Co. Ltd., Sunro mine, Jordan River, Vancouver I.	1,500	144,009	1.83	-	-	-	Production started in March 1962.
Craigmont Mines Limited, Merritt	5,000	1,797,000	2.10	-	-	484,073	Open pit mining. Jaw crusher installed underground on the 2,400-foot level. Underground shaft completed and hoisting equipment installed. Continued development for underground mining.
Giant Mascot Mines, Limited, Choate	1,000	311,443	0.32	-	0.85	260,583	Surface and underground exploration by diamond drilling. Development to production of new orebodies in the Brunswick zone.
Howe Sound Company, Britannia Division, Britannia Beach	4,000	501,078	1.47	0.88	-	458,429	Development to production of Lower Bluff orebody and routine exploration and development of known ore zones.
Phoenix Copper Company Limited, Greenwood	1,600	554,699	0.77	-	-	392,767	Mill and plant expansion completed. Mining rate increased to 1,500 tons a day.
Northwest Territories							
North Rankin Nickel Mines Limited, Rankin Inlet	250	48,677	0.74	-	2.50	79,411	Mine closed in October.

Source: Company reports. Symbols: na Not available; - Nil.

Table 4

PROSPECTIVE PRODUCING COMPANIES*, 1962

Company and Location	Type of Ore	Mill Capacity (tons ore/ day)	Production to Start	Destination of Concentrates
New Brunswick				
Brunswick Mining and Smelting Corporation Limited, Bathurst	Zn-Pb-Cu	3,000	1964	Belgium
Quebec				
Cupra Mines Ltd., Stratford Place	Cu-Zn	Ore will be trucked 2 miles to Solbec mill	1964	Overseas markets
Mattagami Lake Mines Limited, Matagami	Zn-Cu-Pb	2,000	1963	Valleyfield and Noranda, Quebec
New Hosco Mines Limited, Matagami	Cu	Will ship 900 tons of ore a day to Orchan mill	1963	Noranda, Quebec

Orchan Mines Limited, Matagami	Zn-Cu	1,900 (will treat 900 tons of ore a day from New Hosco)	1963	Valleyfield and Noranda, Quebec
<u>Ontario</u>				
McIntyre-Porcupine Mines, Limited, Timmins	Cu-Au	Not known	1963	Ore will be milled in modified portion of McIntyre gold mill
<u>Manitoba</u>				
Hudson Bay Mining and Smelting Co., Limited, Snow Lake	Cu	Not known. Ore will be milled at Flin Flon	1963	Flin Flon

Source: Company reports.
* Includes only companies with announced production plans.

Manitoba-Saskatchewan

Combined production from these provinces totalled 44,755 tons of copper, valued at $27,748,179 This was a decline of 1,178 tons from the 1961 production.

In the Snow Lake area of Manitoba, Stall Lake Mines Limited commenced shipments of copper-zinc ore to the mill of Hudson Bay Mining and Smelting Co., Limited (Hudbay), at Flin Flon. Production of 100 tons of ore a day is scheduled to start in 1963. Hudbay is preparing its Stall Lake mine, also in the Snow Lake area, for production in 1963 and intends to commence shaft sinking at the Osborne Lake mine north of Snow Lake.

Sherritt Gordon Mines, Limited, continued underground exploration from the Farley shaft workings at Lynn Lake and discovered two interesting mineral occurrences. Exploration at Sherritt's Fox Lake orebody was intermittent during the year.

British Columbia

Copper production in British Columbia at 54,490 tons with a value of $33,766,394 continued the spectacular rise which started in 1960. The 1962 production exceeded the previous record set in 1929 by 2,538 tons. In 1958 production totalled 6,010 tons from the only two copper producers in the province, one of which suspended operations in March of that year. In 1962 eight mines were in production and although one of these suspended operations in April, new production will amply replace that lost by the closure. The resurgence in copper mining since 1958 is attributable to the needs of Japanese smelters for foreign concentrates. Canadian exports to Japan of copper in concentrates increased from 2,237 tons in 1961 to 46,167 tons in 1962, whereas shipments of copper in concentrates to the United States increased only 5,993 tons in the same period.

In December Bethlehem Copper Corporation Ltd. started production at its open-pit mine in Highland Valley. Production will be at the rate of 3,300 tons of ore a day; concentrates are shipped to Japan from Vancouver. Craigmont Mines Limited near Merritt was carrying out an accelerated program of underground development at its copper mine. In the Boundary district, Consolidated Woodgreen Mines Limited suspended operations in April at its open-pit mine near Greenwood and dismantled the mining plant. In the same area, Phoenix Copper Company Limited increased its mill capacity to 1,500 tons of ore a day. On Vancouver Island, Cowichan Copper Co. Ltd. started production at its Sunro mine at River Jordan about 50 miles from Victoria. A 1,500-ton-a-day mill has been installed underground and concentrates are shipped to Japan from the company's wharf at Hatch Point on the east coast of Vancouver Island. The Consolidated Mining and Smelting Company of Canada Limited started production in September at the Benson Lake property of Coast Copper Company Limited. Concentrates produced at the 750-ton-a-day mill are shipped to Japan from Port McNeill on the northeast coast of the Island.

Exploration for copper was active in many parts of the province. On Vancouver Island the Buttle Lake and Duncan areas were being prospected. Western Mines Limited at the south end of Buttle Lake in central Vancouver Island had indicated more than a million tons of copper-zinc ore by the year end. Numerous prospects were being explored in the Highland Valley-Merritt area of south-central British Columbia and two prospects were under investigation in the Unuk River-Stikine River section in the northwestern part of the province.

Northwest Territories and Yukon Territory

North Rankin Nickel Mines Limited at Rankin Inlet on the west shore of Hudson Bay produced all of the copper shipped from the Northwest Territories in 1962. This property, which closed in October, shipped 314 tons of copper in concentrates valued at $194,928.

Dominion Explorers Limited at Kathleen Lake in the Yukon Territory produced 214 tons of copper in high-grade, direct-shipping ore which was sold to Japan. The value of the copper content was $132,990. Operations were suspended at this property late in 1962 but will be resumed in the summer of 1963.

DOMESTIC CONSUMPTION AND USES

Domestic consumption (producers' domestic shipments) of refined copper at 151,525 tons was the highest since the peak consumption period during World War II.

principal copper and brass fabricators in Canada are: British Columbia - Western Copper Mills Ltd., Vancouver; Ontario - Anaconda American Brass Limited, New Toronto; Canada Wire and Cable Company, Limited, Toronto; Phillips Electrical Company Limited, Brockville; Ratcliffs (Canada) Limited, Richmond Hill; Wolverine Tube Division of Calumet & Hecla of Canada Limited, London; Quebec - Noranda Copper and Brass Limited, Montreal East; Pirelli Cables, Conduits Limited, St. Johns; and Northern Electric Company, Limited, Montreal.

Table 5

CONSUMPTION OF PRIMARY COPPER IN MANUFACTURE OF SEMIFABRICATED PRODUCTS, 1960 and 1961
(short tons)

	1961	1962
Copper mill products - sheet, strip, bars, rolls, pipe, tube, etc.	44,754	46,058
Brass mill products - plate, sheet, strip, rods, bars, rolls, pipe, tube, etc.	9,328	12,674
Wire and rod mill products	87,297	95,703
Miscellaneous	1,543	1,384
Total	142,922*	155,819*

Source: Consumers' reports.
* No information is available on stocks on hand.

SMELTERS AND REFINERIES

Salient statistics on Canada's six copper smelters and two refineries are given in Tables 6 and 7. In 1962, the smelters operated close to capacity and treated about 85 per cent of the domestic ores and concentrates. All the blister and anode copper produced was refined in Canada. Nickel-copper matte from the Falconbridge smelter was shipped to Norway for treatment.

Table 6

CANADIAN COPPER AND COPPER-NICKEL SMELTERS

Operator and Location	Product	Rated Annual Capacity (short tons)	Remarks	Ore and Concentrate Treated, 1962 (short tons)	Blister or Anode Copper Produced, 1962 (short tons)
Falconbridge Nickel Mines, Limited, Falconbridge, Ont.	Copper-nickel matte	650,000 (ores and concentrates)	Copper-nickel ore and prepared concentrate smelted in four blast furnaces and six converters to produce matte for shipment to company's electrolytic refinery in Norway.	487,941	na
Gaspé Copper Mines, Limited, Murdochville, Que.	Copper anodes, metallic bismuth	300,000 (ores and concentrates)	One reverberatory furnace for green- or wet-charge concentrates, two Pierce-Smith converters, one anode furnace and one Walker casting wheel. Also smelts custom concentrates.	288,630	47,800
Hudson Bay Mining and Smelting Co., Limited, Flin Flon, Man.	Blister-copper cakes	575,000 (ores and concentrates)	Roasting furnaces, one reverberatory furnace and three converters for treating copper flotation concentrates and zinc-plant residues in conjunction with slag-fuming furnaces. Treats some concentrates on toll.	397,273	37,633

The International Nickel Company of Canada, Limited, Coniston, Ont.	Copper-nickel Bessemer matte	800,000 (ores and concentrates)	Sintering; blast-furnace smelting of nickel-copper ore and concentrate; converters for production of copper-nickel Bessemer matte.	na	na
Copper Cliff, Ont.	Blister copper, nickel sulphide and nickel sinter for company's refineries Nickel oxide sinter for market	4,000,000 (ores and concentrates)	Oxygen flash-smelting of copper-sulphide concentrate; converters for production of blister copper.	352,747	na
			Blast furnaces, roasters, reverberatory furnaces for smelting of copper-nickel ore and concentrate; converters for production of copper-nickel Bessemer matte. Production of matte followed by matte treatment, flotation, separation of copper and nickel sulphides, then by sintering to make sintered-nickel products for refining and marketing. Electric-furnace melting of copper sulphide and conversion to blister copper.	108,826	na
Noranda Mines, Limited, Noranda, Que.	Copper anodes	1,600,000 (ores, concentrates and scrap)	Roasting furnaces, two hot-charge reverberatory furnaces, one green-charge reverberatory furnace, and five converters. Also smelts custom material.	1,571,015 (of which 808,784 were custom material)	160,407

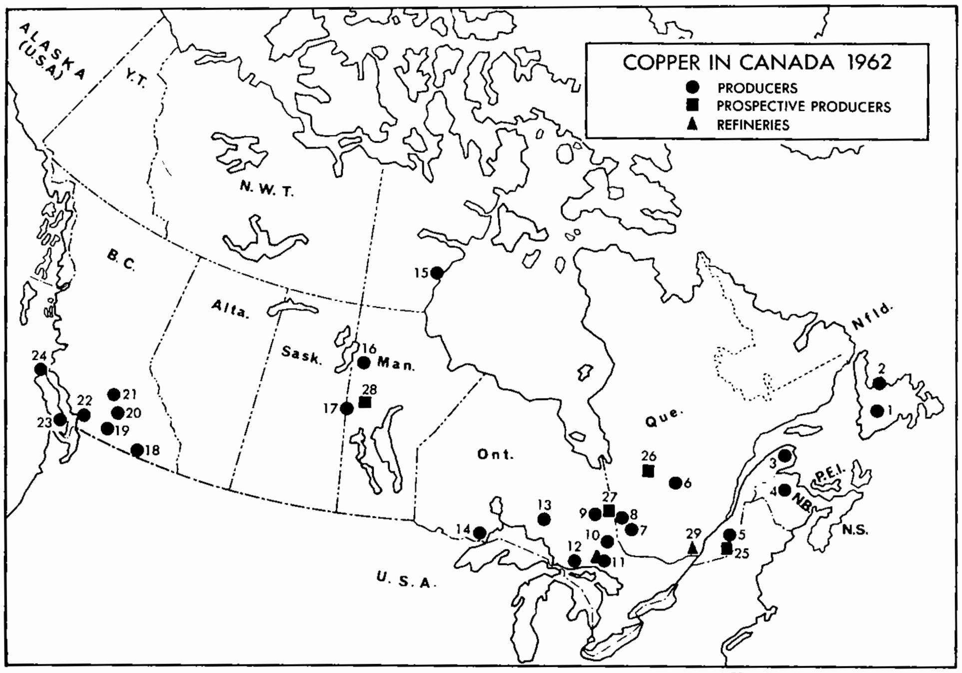
Source: Company reports.
na Not available.

Table 7

CANADIAN COPPER REFINERIES

		Rated Annual Capacity (tons)	
Canadian Copper Refiners Limited Montreal East, Que.	CCR brand electrolytic copper wire bars, ingot bars, ingots, cathodes, cakes and billets.	270,000	Controlled by Noranda Mines, Limited. Refines anode copper from Noranda and Gaspé smelters, blister copper from Flin Flon smelter and purchased scrap. Copper sulphate recovered by vacuum evaporation. Precious metals, selenium and tellurium recovered from anode slimes.
The International Nickel Company of Canada, Limited, Copper Refining Division, Copper Cliff, Ont.	ORC brank electrolytic copper, cathodes, wire bars, cakes, billets, ingots and ingot bars.	168,000	Refining of blister copper from Copper Cliff smelter, Also custom refining. Precious metals, selenium and tellurium are recovered from anode slimes.

Source: Company reports.



MINERAL RESOURCES DIVISION
DEPARTMENT OF MINES AND TECHNICAL SURVEYS

PRODUCERS

1. American Smelting and Refining Company (Buchans Unit)
2. Atlantic Coast Copper Corporation Limited
   Maritimes Mining Corporation Limited
3. Gaspé Copper Mines, Limited (smelter)
4. Consolidated Mining and Smelting Company of Canada Limited, The (Wedge mine)
   Heath Steele Mines Limited
5. Solbec Copper Mines, Ltd.
6. Campbell Chibougamau Mines Ltd. (4 mines)
   The Patino Mining Corporation, Copper Rand Mines Division (3 mines)
   Merrill Island Mining Corporation, Ltd.
   Opemiska Copper Mines (Quebec) Limited
7. Sullico Mines Limited
   Manitou-Barvue Mines Limited
   Noranda Mines, Limited (smelter)
   Quemont Mining Corporation, Limited
   Vauze Mines Limited
   Waite Amulet Mines, Limited
8. Normetal Mining Corporation, Limited
9. Kam-Kotia Porcupine Mines, Limited
10. Temagami Mining Co. Limited
11. Falconbridge Nickel Mines, Limited (6 mines, 1 smelter)
    International Nickel Company of Canada, Limited, The (7 mines, 2 smelters, 2 refineries)
12. Rio Algom Mines Limited, Pronto Division
13. Geco Mines Limited
    Willroy Mines Limited
14. North Coldstream Mines Limited
15. North Rankin Nickel Mines Limited
16. Sherritt Gordon Mines, Limited
17. Hudson Bay Mining and Smelting Co., Limited (4 mines, 1 smelter)
18. Consolidated Woodgreen Mines Limited
    Phoenix Copper Company Limited
19. Craigmont Mines Limited
20. Giant Mascot Mines Limited
21. Bethlehem Copper Corporation Ltd.
22. Howe Sound Company, Britannia Division
23. Cowichan Copper Co. Ltd. (Sunro mine)
24. Consolidated Mining and Smelting Company of Canada Limited, The (Benson Lake mine)

PROSPECTIVE PRODUCERS

25. Cupra Mines Ltd.
26. Mattagami Lake Mines Limited
    New Hosco Mines Limited
    Orchan Mines Limited
27. McIntyre Porcupine Gold Mines Limited
28. Hudson Bay Mining and Smelting Co., Limited (Stall Lake and Osborne Lake mines)

REFINERY

11. International Nickel Company of Canada, Limited, The (2 refineries)
29. Canadian Copper Refiners Limited

TARIFFS

Although Canada has no tariff on copper entering the country in ores and concentrates, various tariff rates are in effect for the copper content in bars, rods, wire, semifabricated forms and fully processed products. The following table summarizes the Canadian tariff rates on copper and its products. At the beginning of the year, tariffs were reduced on copper in pigs, blocks, ingots and cathodes and on copper in scrap. These changes are also summarized in the table.

The United States tariff on ores, concentrates and primary shapes is 1.7 cents a pound on copper content; on fabricated materials it goes as high as 4.5 cents a pound plus 1.7 cents a pound on copper content.

Table 8

CANADIAN TARIFFS

	British Preferential		Most Favored Nation		General	
	Change		Change		Change	
	from	to	from	to	from	to
Ores and concentrates ..	free	same	free	same	free	same
Pigs, blocks, ingots and cathodes..........	1¢ lb	3/4¢ lb	1.5¢ lb	3/4¢ lb	1.5¢ lb	3/4¢ lb
Scrap.................	1¢ lb	3/4¢ lb	1.5¢ lb	3/4¢ lb	1.5¢ lb	same
Anodes................	5%	same	7.5%	same	10%	same
Oxide.................	free	same	15%	same	15%	same
Bars or rods, tubing not less than 6 ft. in length, unmanufactured; copper in strips, sheets or plates, not polished, planished or coated ...	5%	same	10%	same	10%	same
Bars and rods for the manufacture of wire and cable	free	same	10%	same	10%	same
Tubing not more than 1/2 in. dia. and not less than 6 ft. long....	5%	same	10%	same	10%	same
Alloys of copper consisting 50% or more, by weight of copper in sheets, plates, bars, rods and tubes ..	7.5%	same	15%	same	25%	same

WORLD MINE PRODUCTION

Free World copper production in 1962, as reported by the American Bureau of Metal Statistics, totalled 3,600,375 tons*, a rise of only 72,058 tons from the comparable 1961 total. Production curtailments instituted by the large producers in the United States, South America, Northern Rhodesia, the Republic of the Congo, and Canada did not affect production until late in the fourth quarter. Some production was lost during the year by military action in the State of Katanga, Republic of the Congo, and by strikes at mines in South America, Northern Rhodesia and the United States.

* This total is the latest available but does not include production from Russia, Japan, Australia, Yugoslavia, Norway, Sweden, Finland, the Messina mine in the Transvaal and several small countries from which reports are not available.

Table 9

WORLD PRODUCTION OF COPPER, 1962
(short tons)

	Mine Production	Smelter Production
United States	1,223,978	1,400,978
Chile	646,064	614,941
Northern Rhodesia	619,856	608,341
Russia	550,000e	550,000e
Canada	457,385	373,650
West Germany		339,573
Republic of the Congo (State of Katanga)	322,974	322,974
Peru	182,875	164,925
Japan	113,645	298,095
Australia	108,696	97,608
Other countries	566,824	510,430
Total, world	4,792,297	5,281,515

Source: American Bureau of Metal Statistics.
e Estimate.

PRICES

The price of copper in Canada delivered at Toronto or Montreal was 30 cents a pound from January until the middle of May at which time the price rose to 31 1/2 cents a pound following devaluation of the Canadian dollar. The 31 1/2 cent price remained in effect to the end of the year.

Prices in leading world markets, as shown in the graph on page 228, were remarkably stable throughout the year.

Feldspar

J. E. Reeves

Canadian feldspar's declining importance as a raw material is the main characteristic of the industry. Nepheline syenite has replaced it extensively in many of its markets, and entirely in Canadian glass manufacturing.

In 1962, shipments were about five per cent lower than in 1961, and were less than 10,000 tons for the first time since 1932. A small increase in imports reflects a slightly increasing demand in western Canada, which cannot be met from the Canadian source. Exports, although appreciably greater than in 1961, are still small.

PRODUCER

All Canadian production emanates from the operations of International Minerals & Chemical Corporation (Canada) Limited at Buckingham, Quebec; it consists mainly of the finer-ground grades used in the manufacture of whitewares and porcelain enamels. The raw material is predominantly hand-cobbed potash feldspar from the company's Back Mine in nearby Derry township.

HISTORY

Canada has a continuous history of feldspar production of more than 70 years, and at one time was a renowned source of dental feldspar. Most of the feldspar has been mined from coarse-grained granitic pegmatites, which abound in southwestern Quebec and southeastern Ontario, a few of the largest deposits having provided most of this production. The development of nepheline syenite, particularly during the last decade, has resulted in a severe restriction of the markets for Canadian feldspar.

TECHNOLOGY

The feldspar group of minerals consists mainly of aluminum silicates of potassium, sodium and calcium. They commonly occur in small grains in various rock types; the potassium and sodium varieties also occur widely in natural concentrations in coarse-grained granitic pegmatites.

Such pegmatites have been the main commercial sources, much hand labor being used to clean the lumps of feldspar before they were milled. More

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*Mineral Processing Division, Mines Branch.

Table 1

PRODUCTION, TRADE AND CONSUMPTION

	1961		1962	
	Short Tons	$	Short Tons	$
PRODUCTION (shipments)				
Quebec	10,507	229,626	9,994	222,460
IMPORTS				
United States	1,721	36,235	1,901	43,846
EXPORTS				
United States	2,626	62,786	3,698	87,499
	1960	1961	1962	
CONSUMPTION (available data in short tons)				
Whiteware	5,808	6,451	5,662	
Porcelain enamel................	721	393	260	
Cleaning compounds	628	607	459	
Other	18	4	437	
Total	7,175	7,455	6,818	

Source: Dominion Bureau of Statistics.

recently, the depletion of many of these deposits and the need for high-tonnage operations have led to the bulk handling of mixtures composed of feldspar, quartz and small quantities of other minerals - from pegmatites or other highly feldspathic rocks in which rich zones of feldspar do not occur - and the mechanical concentration of the feldspar, usually by flotation. The flotation of feldspar has come into wide use in the United States.

The acceptance of feldspathic substitutes for traditional feldspar has adversely affected the growth of the feldspar industry. Nepheline syenite from Ontario has been substituted by glass manufacturers because of its comparatively high content of alumina (Al_2O_3); aplite, a feldspathic by-product of titanium mineral operations in Virginia, is also used in some types of glass as a relatively cheap source of alumina; and controlled feldspar-silica mixtures, from previously non-commercial feldspar deposits, have recently been introduced in the United States.

Feldspar is valued in the ceramic industry because it is a source of alumina and alkalis - potash (K_2O) and soda (Na_2O) - and has a relatively low firing temperature. It is of use to makers of cleaning compounds because of its moderate abrasive properties.

Table 2

PRODUCTION AND TRADE, 1952-62

(short tons)

	Production	Imports	Exports
1952	20,267	155	6,360
1953	21,246	336	6,848
1954	16,096	398	1,056
1955	18,152	137	1,426
1956	18,153	196	1,804
1957	20,450	241	4,047
1958	20,387	1,140	9,956
1959	17,953	1,161	7,552
1960	13,862	1,338	3,183
1961	10,507	1,721	2,626
1962	9,994	1,901	3,698

Source: Dominion Bureau of Statistics.

USES AND SPECIFICATIONS

Feldspar is sold mainly to the ceramics industries but small amounts are used in abrasive cleaning compounds and for decorative purposes.

Where it can compete economically with nepheline syenite it is still used extensively as a source of alumina and alkalis in the manufacture of glass. The size specification requires a relatively coarse particle, generally with an upper limit of 20 mesh. The iron content should be less than 0.1 per cent in terms of ferric oxide (Fe_2O_3).

Feldspar is important as a flux in the manufacture of whiteware bodies and glazes. It must be essentially minus 325 mesh, have a very low quartz and iron-mineral content, and, in many cases, contain a high potash-soda ratio. A low iron content (less than 0.1 per cent Fe_2O_3) will generally ensure a white fired product.

In the manufacture of porcelain enamels, feldspar is a source of alumina, potash and silica. It must be at least minus 120 mesh, have a very low iron content, and fire white.

Dental spar is a selected high-purity potash feldspar for use in the manufacture of artificial teeth. Freedom from iron-bearing minerals, which would cause specks in the final product, is important.

For cleaning compounds, feldspar should be white and free of quartz.

PRICES

According to E & M J Metal and Mineral Markets of December 31, 1962, prices in the United States, f.o.b. point of shipment, North Carolina, in bulk, per short ton, were as follows:

200 mesh	$17.00 to $21.00
325 mesh	$18.00 to $22.00
40 mesh, glass	$13.50
20 mesh, semigranular	$ 7.50

TARIFFS

Canadian and United States feldspar tariffs in effect at the time of writing were:

Canada	British Preferential	Most Favored Nation	General
Crude only	free	free	free
Ground but not further manufactured	"	15%	30%

United States

Crude	12 1/2¢ per long ton
Ground	7 1/2% ad valorem

Fluorspar

C.M. Bartley*

Canadian fluorspar production in 1962, entirely from Newfoundland, was somewhat lower in value at $1,870,184 than in 1961. Operations were maintained at about normal scale by one company. After many years of operation no production was reported from the fluorspar mines of the Madoc area of eastern Ontario during 1962.

Exploration for fluorspar was carried out at a property in Cardiff township, Ontario, and a small amount of diamond drilling and milling test work was done by a company on a fluorspar property in southern British Columbia.

PRODUCTION AND TRADE

Fluorspar mined and concentrated in Newfoundland by Newfoundland Fluorspar Limited, a subsidiary of the Aluminum Company of Canada, Limited, was used at Arvida, Quebec, in the production of aluminum. Production comes from the Director mine.

Exports of fluorspar from Canada were limited to a few tons of crystal fluorspar for optical purposes. This material had a relatively high value.

Imports of fluorspar, mostly from Mexico, were substantially higher at 67,847 tons than the 32,769 imported in 1961. Most of this material was metallurgical fluorspar for use in steel making. Fluorspar producers in Canada, as well as in the United States, have difficulty competing with fluorspar imported from Mexico and Europe.

PRODUCTION AND EXPLORATION

Occurrences of fluorspar which have been sources of production or are considered potential sources in the future, are known in Newfoundland, Nova Scotia, New Brunswick, Quebec, Ontario and British Columbia. Fluorspar has been found in the Yukon Territory but no production has been recorded and the extent of the occurrences is not known.

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* Mineral Processing Division, Mines Branch.

Table 1

FLUORSPAR -PRODUCTION, TRADE AND CONSUMPTION

	1961		1962	
	Short Tons	$	Short Tons	$
PRODUCTION (shipments)(a)				
Newfoundland		1,951,800		1,870,184
Ontario		38,400		
Total		1,990,200		1,870,184
EXPORTS				
Britain	-	-	4	10,366b
United States	2,048	53,326	-	-
Total	2,048	53,326	4	10,366
IMPORTS				
Mexico	31,927	871,468	52,906	1,609,564
Republic of South Africa	-	-	12,077	310,846
United States	700	36,041	2,236	98,979
Britain	142	6,712	628	32,667
Total	32,769	914,221	67,847	2,052,056
CONSUMPTION				
Metallurgical flux	28,586		40,396	
Glass	983		1,297	
Other (including aluminum production)	81,993		82,001	
Total	111,542		123,694	

Source: Dominion Bureau of Statistics. (a) Producers' shipments. Tonnages after 1957 are not available for publication. (b) Shipments of clear crystal for optical use. Symbol: - Nil.

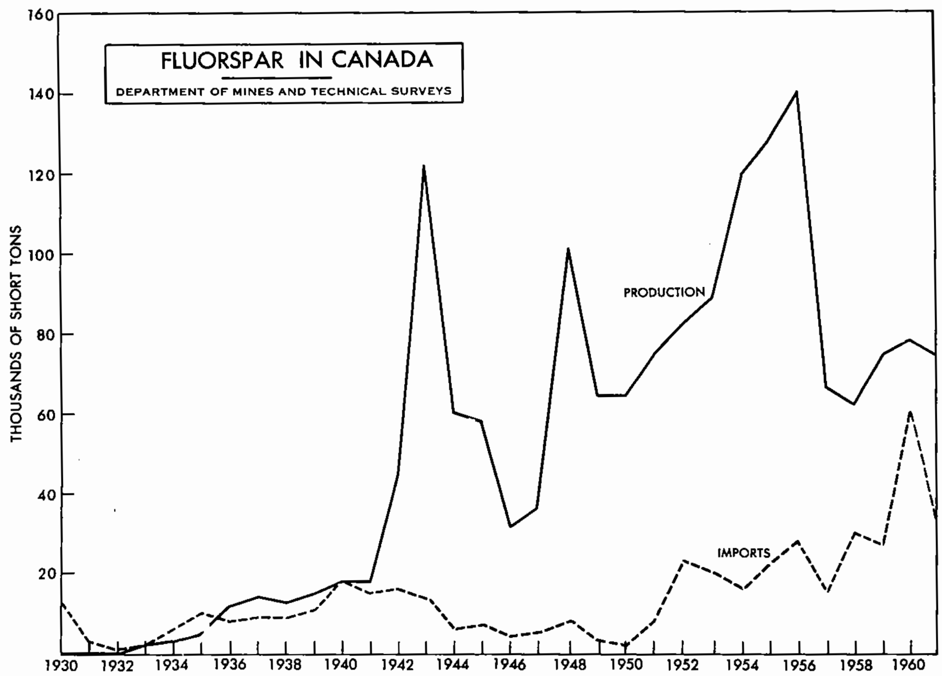
The most important deposits are located on the Burin Peninsula of southeastern Newfoundland. Large reserves in the form of veins and stringer zones in granitic rock have been found. Mines have been operated by Newfoundland Fluorspar Limited and by St. Lawrence Corporation of Newfoundland Limited. The former company mined ore and produced concentrate assaying more than 70 per cent calcium fluoride (CaF_2) using heavy media equipment.

Table 2

FLUORSPAR - PRODUCTION, TRADE AND CONSUMPTION, 1953-62
(short tons)

	Production(a)	Exports(b)	Imports	Consumption
1953	88,569	22,079	20,161	83,116
1954	118,969	34,756	16,240	80,610
1955	128,114	58,390	21,774	87,927
1956	140,071	78,380	28,148	96,126
1957	66,245	23,630	14,547	70,761
1958	62,000c	7	30,408	89,933
1959	74,000c	3,774	26,588	96,016
1960	78,000c	10,312	59,690	111,835
1961	76,200c	2,048	32,769	111,542
1962	70,000c	4	67,847	123,694

Source: Dominion Bureau of Statistics except where otherwise indicated.
(a) Producers' shipments. Tonnage statistics after 1957 are not available for publication. (b) Exports to the United States for 1953 and 1954 inclusive as reported in the United States import statistics. Exports after 1954 are as recorded in <u>Trade of Canada (DBS)</u>. (c) Estimates reported by the U.S. Bureau of Mines.



This concentrate was shipped to Arvida, Quebec, where, after further concentration by flotation, it was used in making aluminum. Plant capacity is about 100,000 tons of end-product per year. In 1962 the shaft-deepening program to open levels at 750 and 950 feet was completed. Stope backfilling by hydraulic and solid fill methods was continued. A normal scale of operation is planned for 1963.

St. Lawrence Corporation of Newfoundland Limited holds an adjoining property and has a plant equipped to produce both metallurgical- and acid-grade fluorspar concentrates, but did not produce during 1962.

As previously mentioned no fluorspar was produced in the Madoc area of eastern Ontario during 1962 but the former operator of several mines in this area is constructing a plant to briquet imported fluorspar for use as metallurgical flux.

During the summer of 1962 the Ball Prospecting Syndicate carried out some underground exploration work on a fluorspar occurrence near Harcourt in Cardiff township, Ontario.

Rexspar Minerals & Chemicals Limited holds a property at Birch Island, British Columbia, containing a large body of fine-grained fluorspar. The fine mineralization and some undesirable associated minerals make processing of the ore difficult. Late in the year, diamond drilling was undertaken to test areas of interest, and milling investigations currently in progress show encouraging results.

ESTIMATED WORLD PRODUCTION OF FLUORSPAR
(short tons)

	1961	1962
Mexico	439,286	553,642
China	275,000	220,000
U.S.S.R.	230,000	230,000
France	210,000	220,000
United States	197,354	206,026
Italy	165,814	171,474
Spain	161,954	158,667
West Germany	133,490	108,572
Britain	99,868	78,153
Union of South Africa	95,862	111,683
Canada	80,000	75,000
Other countries	256,372	271,783
Total, world	2,345,000	2,405,000

WORLD REVIEW

Although Canadian fluorspar production and exploration was smaller during 1962, rising interest is indicated by increasing world-wide production, consumption and trade. Demands for steel, aluminum and chemicals are increasing and in some areas of high consumption traditional sources of supply of fluorspar do not appear to be sufficient for continued expansion. For this reason world trade in fluorspar has increased considerably and production has been expanded in those countries with deposits which can be mined, processed and marketed competitively. The ability to compete is usually the result of a combination of: low cost of production and low transportation charges. This is well illustrated by the rapid increase in Mexican fluorspar production in recent years while production in the United States was falling and consumption rising.

The increasing consumption of acid-grade fluorspar in the industrialized countries is shown in United States statistics. This grade is the source of hydrofluoric acid which has many uses; for example for cryolite used in the manufacture of aluminum. Refrigerants, aerosol propellants and inert plastics are the main and most rapidly expanding uses for fluorocarbons.

In Mexico, the world's largest producer, production at 553,642 tons and exports at 480,000 tons, reached new peaks. The United States was the main purchaser but shipments were made to many other countries including Canada. Changes in Mexican mining laws to promote and encourage control of mining operations by Mexican companies, mainly by means of tax-saving incentives, appear to have been accepted by foreign-based companies with little or no change in operations. Controlling interest in many companies has been sold to Mexican nationals.

In January 1962, Minera Frisco S.A., which operates a large lead-zinc mine near Parral, Chihuahua, started a plant to recover fluorspar from mill tails. About 2,000 tons per day averaging about 15 per cent CaF_2 were treated by flotation to produce 300 tons of concentrate grading more than 98 per cent CaF_2. This operation is of interest because it indicates a new and possibly important source of acid-grade fluorspar.

New facilities for the production of hydrofluoric acid and fluorocarbons have been constructed in the United States, in several European countries, and in Japan, Australia and Mexico.

USES AND SPECIFICATIONS

Fluorspar is consumed in two general ways - as a metallurgical and ceramic flux and as the source material for hydrofluoric acid, fluorine gas and the fluorine chemical compounds made from them. For metallurgical purposes, the mineral is used in its natural state, after concentration. When it is a source material for chemicals, preparation of the raw material is more detailed and specifications more strict.

In the steel industry, fluorspar is used as a flux to assist in the melting of the ore charge and to improve the separation of metal and slag. Other materials have been used but few are comparable to fluorspar in efficiency. Fluorspar for metallurgical purposes must be in coarse sizes (2 inches to 3/8 inch), since fine material would float on the surface of the melt or be carried up the stack by draft.

For ceramic purposes, a finer-grained and purer concentrate is used, for example, as a flux in glass and in enamel melts.

Large amounts of fluorspar are consumed in aluminum production and no adequate substitute is known. As previously mentioned, fluorspar is processed to acid-grade purity and made into hydrofluoric acid which is then used to make cryolite. Aluminum metal is produced by the Hall electrolytic process from a molten solution of alumina and cryolite.

Fluosilicic acid and sodium fluoride are used to fluoridate public water supplies and thus reduce the incidence of dental cavities in children. Recently, natural calcium fluoride (fluorspar) has also been used for this purpose.

The amount of fluorspar used by the fluorine-chemical industry is increasing each year. The materials consumed are of two general classes - fluorine materials for industrial processes such as uranium-processing, the alkylation of gasoline, ore treatment and production of high-energy missile fuels; and fluorine and hydrofluoric acid for the manufacture of refrigerants, aerosol propellant gases, chemicals and the numerous fluorocarbon-plastic intermediates and fluorocarbon-plastic consumer articles. It has been estimated that fluorspar requirements for chemical purposes will continue to increase. For these various uses, the following three grades of fluorspar are marketed.

Standard-fluxing-gravel or lump grade is used for metallurgical purposes, and is usually sold on a specification of a mininum of 85 per cent CaF_2 and maximum of 5 per cent silica (SiO_2) and 0.3 per cent sulphur. Fines should not exceed 15 per cent.

In ceramic, glass or enamel grade the requirement is for not less than 94 per cent CaF_2 with maximum of 3.5 per cent calcium carbonate ($CaCO_3$), 3 per cent SiO_2, and 0.1 per cent ferric oxide (Fe_2O_3). The material must be in mesh sizes ranging from coarse to extra-fine.

Acid grade has the most rigid specifications. It must contain more than 97 per cent CaF_2 and not more than 1 per cent SiO_2. Like the ceramic grade, it is used in powdered form.

PRICES

Canada	
Ceramic grade, 94% CaF_2, coarse, Aluminum Company, Limited, per net ton f.o.b. Arvida, Quebec	$61.50
United States (per short ton as reported in E & M J Metal and Mineral Markets of Dec. 31, 1962)	
Metallurgical grade, f.o.b. Kentucky and Illinois	
Effective CaF_2 content 72 1/2%	$38.50 - $39.50
" CaF_2 " 70%	$37.00 - $37.50
" CaF_2 " 60%	$34.00 - $34.50

United States (cont'd)

Acid-grade concentrates, dry basis, f.o.b. Illinois	
Bulk, carloads	\$45.00 - \$49.00
Bulk, less than carloads	\$50.00 - \$51.00
Bags, extra	\$ 3.00
Pellets, bulk, carloads	\$55.00
Pellets, bulk, less than carloads	\$60.00
Ceramic grade	
95% CaF_2	\$45.00 - \$47.00
93-94% CaF_2, calcite and silica variable, Fe_2O_3 0.14% bulk, f.o.b. Kentucky and Illinois	\$43.00 - \$45.00
In 100-lb paper bags	\$ 3.00 extra
European, c.i.f. U.S. ports, duty paid, metallurgical, effective CaF_2 72 1/2%	
Spot	\$30.00 - \$33.00
Contracts	\$30.00 - \$33.00
Acid grade, 0.3% moisture maximum, large discount for high moisture	
Spot	\$57.00
Contracts	\$56.00
Mexican, f.o.b. border, effective CaF_2 72 1/2%	
All rail, duty paid	\$26.50 - \$28.00
Barge, Brownsville, Tex. duty paid	\$30.50 - \$32.50
Tampico, Mexico, vessel, cargo lots	\$21.00 - \$23.00
U.S. Atlantic ports, cars, duty paid	\$34.00 - \$36.50
Lake Erie, cars, duty paid	\$37.00 - \$39.50

TARIFFS

Canada	
Fluorspar	free
United States	
Fluorspar containing not more than 97% CaF_2, per long ton	\$8.40
Fluorspar containing more than 97% CaF_2, per long	\$2.10

Gold

T.W. Verity*

In 1962 the average Royal Canadian Mint value for a fine troy ounce of gold increased to $37.41 from $35.46. Notwithstanding the higher price, there was a 6.6 per cent drop in gold production, to 4,178,396 fine troy ounces valued at $156,313,794 from 4,473,699 ounces valued at $158,637,366 the previous year. Ontario remained the principal producer with 58 per cent of the total; followed by Quebec with 24 per cent; Northwest Territories, 9 1/2 per cent; and British Columbia, 4 per cent.

Gold was sixth in value of output in Canada following crude petroleum, nickel, copper, iron ore and uranium. Among Free World producers of gold, Canada was second to the Republic of South Africa. The United States Bureau of Mines, estimated total world gold production in 1962 at 50 million troy ounces of which the Republic of South Africa produced 25,491,993 ounces, Canada 4,178,396, United States 1,556,000, Australia 1,068,724 and Ghana 888,038. Production in the U.S.S.R. was estimated at 12,200,000 fine ounces. In 1962, world output increased due almost entirely to an increase of over two million ounces from the Republic of South Africa.

A number of factors caused the 1962 decline in Canadian gold production. Kerr-Addison Gold Mines Limited, the largest producer, had disappointing results in development below the 3,850-foot level and gold recovery declined nearly 22 per cent. Two of the older lode gold mines in Ontario - Carium Mines Limited (formerly Coniaurum) and Sylvanite Gold Mines, Limited - exhausted known ore reserves and ceased operating late in 1961. During 1961-62 many large gold mines were forced to carry out extensive exploration and development programs, including deepening of existing shafts, to open up ore reserves for mining. Results were disappointing in some cases as the amount of ore developed was less and gold content was lower than on upper levels. As a result many mines not only reduced mill tonngage but mined and milled lower grades of ore. In some cases it also became necessary, because of increased wall pressures at depth, to use cut-and-fill methods of mining rather than the more economical shrinkage method used on upper levels.

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*Mineral Resources Division

Table 1

PRODUCTION OF GOLD
(troy ounces)

	1961	1962
Newfoundland		
Base-metal mines	14,429	13,966
New Brunswick		
Base-metal mines	-	553
Nova Scotia		
Auriferous-quartz mines	-	-
Quebec		
Auriferous-quartz mines		
Bourlamaque-Louvicourt	307,409	293,481
Cadillac-Malartic	289,710	261,013
Noranda-Belleterre	34,640	26,137
Total	631,759	580,631
Placer operations	478	117
Base-metal mines	421,792	412,812
Total, Quebec	1,054,029	993,560
Ontario		
Auriferous-quartz mines		
Porcupine	1,075,161	1,006,700
Red Lake and Patricia	523,465	507,791
Larder Lake	520,868	422,263
Kirkland Lake	301,806	249,852
Thunder Bay (Port Arthur)	110,081	132,728
Sudbury	37,934	35,735
Miscellaneous	133	27
Total	2,569,448	2,355,096
Base-metal mines	68,272	66,153
Total, Ontario	2,637,720	2,421,249

Table 1 (cont'd).

	1961	1962
Manitoba		
Auriferous-quartz mines	31,025	37,194
Base-metal mines	26,722	31,065
Total	57,747	68,259
Saskatchewan		
Base-metal mines	70,784	66,034
Alberta		
Placer operations	171	186
British Columbia		
Auriferous-quartz mines	134,816	121,608
Base-metal mines	27,167	35,232
Placer operations	2,484	2,652
Total	164,467	159,492
Northwest Territories		
Auriferous-quartz mines	407,474	400,292
Yukon Territory		
Placer operations	66,107	54,805
Base-metal operations	771	-
Total	66,878	54,805
Canada, total		
Auriferous quartz mines	3,774,522	3,494,821
Base-metal mines	629,937	625,815
Placer operations	69,240	57,760
Total	4,473,699	4,178,396
Total value	$158,637,366	$156,313,794
Average value per ounce	$35.46	$37.41

Source: Dominion Bureau of Statistics.
Symbol: - Nil.

Operating difficulties such as: increased depth of mining, lower grade of ore available for mining, increased exploration and development expenditures, and increased labor and material costs resulted in lower ore production and increased operating costs during 1961 and 1962. Many gold mines, however, were able to continue operating because of the cost assistance received under the terms of the Emergency Gold Mining Assistance Act and a higher Mint price for gold.

The Emergency Gold Mining Assistance Act came into force by proclamation on June 15, 1948, to assist marginal gold mines. The Act has been extended with some amendments several times. The last amendment extended the Act to the end of the calendar year 1963. To qualify for assistance, Canadian gold mines must have an average cost of production exceeding $26.50 a troy ounce of gold. They are eligible for this assistance only to the extent that they sell their gold to the Royal Canadian Mint. During 1962, there were 52 producing lode gold mines of which 42 received cost assistance under the Act. Most of the remaining gold was available for sale in the open market.

OPERATIONS AT PRODUCING MINES

Atlantic Provinces

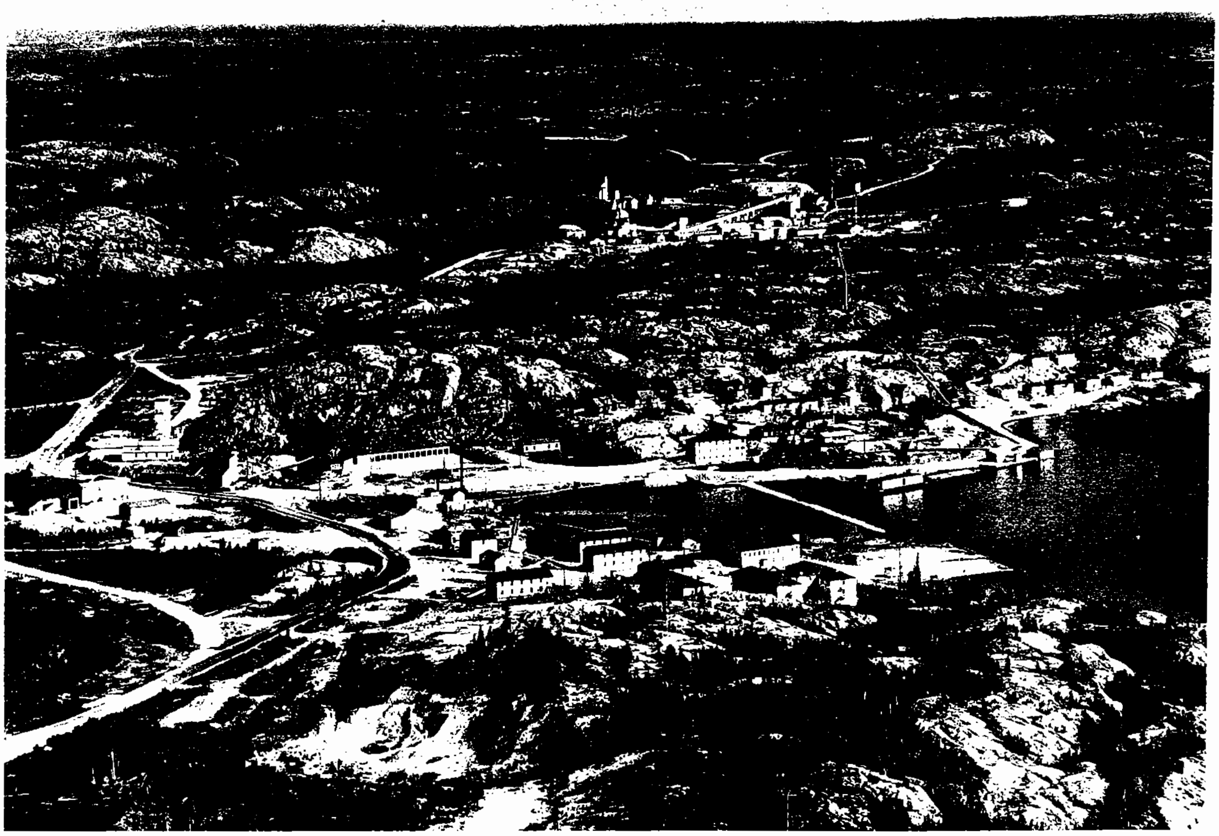
Gold output came as a byproduct from the lead-zinc ores of the Buchans Unit, American Smelting and Refining Company, in the central part of Newfoundland; from copper ores of the Tilt Cove operation of Maritimes Mining Corporation Limited and the Little Bay operation of Atlantic Coast Copper Corporation Limited, both on Newfoundland's northeast coast. No gold production was reported from Nova Scotia or Prince Edward Island but a small amount of gold was recovered from base-metal mining in New Brunswick.

Quebec

In Quebec, total gold production was lower by 5.7 per cent. Gold recovery from base-metal mines decreased by 2.1 per cent. A small amount of gold was recovered from placer operations.

Auriferous-quartz Mines

Bourlamaque-Louvicourt District - Each of the five producers reported lower gold recovery. Mill production increased but only lower grades of ore were available. Lamaque Mining Company Limited, Quebec's largest lode gold mine, conducted an extensive exploration and development program, especially in the new No. 3 mine area. Sigma Mines (Quebec) Limited was developing new levels and converting to cut-and-fill methods of mining on the lower levels. Akasaba Gold Mines Limited, Bevcon Mines Limited and Sullivan Consolidated Mines, Limited, increased mill production but mined a lower grade of ore resulting in lower gold output.



Giant Yellowknife Mines Limited at Yellowknife, Northwest Territories. The main shaft and mill is shown in the mid-background. Another mine shaft is located on the left and mine-site living quarters and general office buildings are in the foreground.

Contwoyto Lake, Northwest Territories with base camp of the International Nickel Company of Canada, Limited, in the background. The site, Canada's newest gold discovery, is 250 miles northwest of Yellowknife.

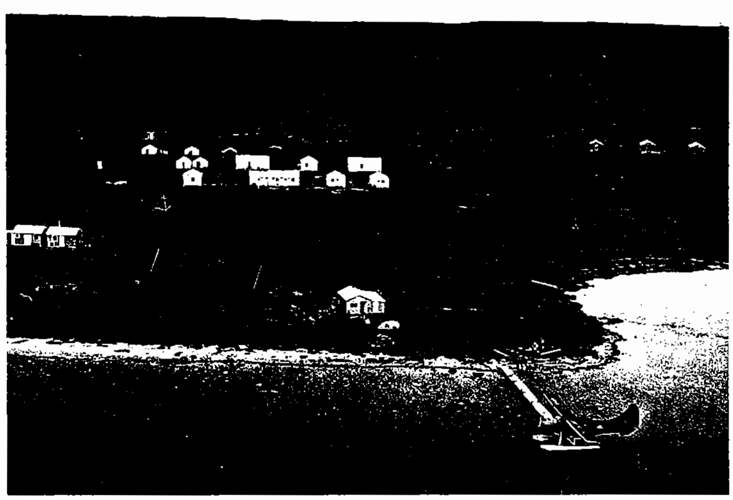


Table 2

PRODUCTION OF GOLD, 1952-62

Year	Auriferous-Quartz Mines troy ounces	%	Placer Operations troy ounces	%	From Base-metal Ores troy ounces	%	Total Gold Production troy ounces	Total Value in Canadian Dollars	Average Value per Ounce in Canadian Funds	Gold % of all Mineral Production Value
1952	3,823,747	85.5	92,843	2.1	555,135	12.4	4,471,725	153,246,016	34.27	11.9
1953	3,509,527	86.6	77,505	1.9	468,691	11.5	4,055,723	139,597,985	34.42	10.4
1954	3,738,955	85.7	89,571	2.1	537,914	12.2	4,366,440	148,764,611	34.07	10.0
1955	3,866,124	85.2	78,621	1.7	597,217	13.1	4,541,962	156,788,528	34.52	8.7
1956	3,704,870	84.5	74,919	1.7	604,074	13.8	4,383,863	151,024,080	34.45	7.2
1957	3,766,285	85.0	76,303	1.7	591,306	13.3	4,433,894	148,757,143	33.55	6.8
1958	3,928,187	85.9	71,955	1.6	571,205	12.5	4,571,347	155,334,370	33.98	7.4
1959	3,852,074	85.9	72,974	1.6	558,368	12.5	4,483,416	150,508,275	33.57	6.2
1960	3,930,366	84.9	80,804	1.7	617,741	13.4	4,628,911	157,151,527	33.95	6.3
1961	3,774,522	84.4	69,240	1.5	629,937	14.1	4,473,699	158,637,366	35.46	6.1
1962	3,494,821	83.6	57,760	1.4	625,815	15.0	4,178,396	156,313,794	37.41	5.5

Source: Dominion Bureau of Statistics.

Cadillac-Malartic District - In 1962, production from the seven mines was lower than in the previous year. In March, one new mine, Malartic Hygrade Gold Mines Limited, commenced trucking ore to Malartic Gold Fields Limited's custom mill. East Malartic Mines, Limited, the largest mine in the district, completed sinking its No. 5 internal shaft the previous year and in 1962 was developing seven new levels and exploring potential ore zones to the east on the upper levels; gold production was much lower. Barnat Mines Ltd. increased mill production and gold production but mined lower-grade ore. Malartic Gold Fields Limited treated more custom ore in its mill but recovered much less gold from its own mine. In March, Canadian Malartic Gold Mines Limited reduced its gold ore-milling capacity by 400 tons a day and added a section to its mill to treat nickel ore from Marbridge Mines Limited. Marban Gold Mines Limited and Norlartic Mines Limited increased ore shipments to a custom mill and gold output.

Noranda-Belleterre District - Lode gold production was lower from the two mines shipping silica flux ore to the Noranda smelter. Elder Mines and Developments Limited was reorganized under the name of Elder-Peel Limited and announced that its main shaft would be deepened 800 feet in 1963 to establish four new levels. Eldrich Mines Limited ceased operating in December 1962.

Base-Metal Mines

Nearly all the copper concentrates from base-metal mines in Quebec and from some Ontario mines are smelted by Noranda Mines, Limited, at Noranda. Anode copper from Noranda and blister copper from Flin Flon, Manitoba, are refined at Montreal East by Canadian Copper Refiners Limited, a subsidiary of Noranda Mines, Limited. About 500,000 troy ounces of gold are recovered annually with about 400,000 ounces of this coming from the base-metal operations of northwestern Quebec. Gold is also recovered at Montreal East from copper anodes produced at the Murdochville smelter of Gaspé Copper Mines, Limited.

Placer Operations

Beauce Placer Mining Co. Ltd. operated its electric dredge on the Gilbert River near Beauceville East and recovered a small amount of gold.

Ontario

In Ontario, twenty-nine lode gold mines operated during the year, one less than in 1961. Two long-producing mines closed in 1961 and one new mine commenced operating in 1962. Total gold recovery was 8 per cent lower. By-product gold from base-metal mines was also lower. Only the Port Arthur mining division increased gold output.

Auriferous-quartz Mines

Porcupine Mining Division - With the closing of Carium Mines Limited (formerly Coniaurum) in July 1961 there were only 12 mines operating; gold production decreased 6 per cent. The three principal producers were Hollinger Consolidated Gold Mines, Limited, McIntyre-Porcupine Mines, Limited, and Dome Mines Limited. Only McIntyre, Delnite Mines, Limited, and Pamour Porcupine Mines, Limited, increased gold output. Dome Mines Limited commenced sinking No. 7 internal shaft from the 4,000-foot level to provide six new levels. Hallnor Mines, Limited, was also sinking an internal shaft from the 21st level (3,209 feet) to provide for seven new levels. In February 1962, the Hollinger Ross mine, Holtyre, completed deepening its shaft to 2,646 feet below the collar to provide seven new levels. Paymaster Consolidated Mines, Limited, commenced deepening No. 6 winze to 6,100 feet below surface in September 1962 to open 11 new levels. McIntyre-Porcupine Mines, Limited was developing its new copper ore zone with copper production to commence late in 1963. Aunor Gold Mines Limited was developing lower levels through headings driven from No. 3 winze in the adjoining property of Delnite Mines, Limited.

Red Lake and Patricia Mining Division - Six lode-gold mines were operating in the Red Lake mining division and one in the Patricia mining division. Gold production declined 3 per cent. Only the leading producers - Campbell Red Lake Mines Limited and Dickenson Mines Limited - had higher gold output. These and Madsen Red Lake Gold Mines Limited were developing new lower levels. McKenzie Red Lake Gold Mines Limited was deepening its No. 5 production shaft to provide two new levels and was exploring the west end of the mine. H.G. Young Mines Limited, after having difficulty in finding new ore, closed early in 1963. Pickle Crow Gold Mines, Limited, in the Patricia mining division was deepening No. 4 shaft from the 2,900-foot level to 3,800 feet.

Larder Lake Mining Division - Kerr-Addison Gold Mines Limited, Canada's leading gold producer, reduced mill production and had a large drop in gold production.

Kirkland Lake District - With the closing of Sylvanite Gold Mines, Limited, in August 1961, only five lode gold mines remained operating. Gold production was 17 per cent lower with only Upper Canada Mines, Limited, recording increased gold output. Macassa Gold Mines Limited completed sinking No. 2 winze to 6,350 feet below surface in February. Wright-Hargreaves Mines, Limited, Lake Shore Mines, Limited, and The Teck-Hughes Gold Mines, Limited, all produced less gold.

Port Arthur Mining Division - Consolidated Mosher Mines Limited commenced production on January 1, 1962; its ore was treated in the nearby mill of MacLeod-Cockshutt Gold Mines Limited. Mill feed from MacLeod was reduced to 650 tons a day; from Mosher it was increased to 1,250 tons a day. Leitch Gold Mines Limited had the highest gold production in its history but results of exploration for new ore were disappointing.

Sudbury Mining Division - Gold production at Renabie Mines Limited was 6 per cent lower than in 1961.

Base-metal Mines

Byproduct gold from base-metal mines came mainly from nickel-copper mines in the Sudbury area and zinc-copper mines in the Manitouwadge area. Gold recovered from base-metal mines amounted to less than 3 per cent of the provincial total.

Manitoba-Saskatchewan

San Antonio Gold Mines Limited and its subsidiary Forty-Four Mines, Limited, continued operating at Bissett in the Rice Lake area of Manitoba, but output was lower. There was a 18-per-cent increase in the total recovery of byproduct gold from the copper-zinc ores of Hudson Bay Mining and Smelting Co., Limited, at Flin Flon and from the nickel-copper ores of Sherritt Gordon Mines, Limited, at Lynn Lake.

There was a 7-per-cent decline in gold recovered from the Saskatchewan operations of Hudson Bay Mining and Smelting Co., Limited.

Alberta

A small amount of placer gold was recovered from gravels of the North Saskatchewan River near Edmonton.

British Columbia

Only 2 lode-gold mines were operating by the year-end. French Mines Ltd., near Hedley, ceased operating in May 1961 and gold ore shipments by McKinney Gold Mines Limited with property at Rock Creek to the Trail smelter of The Condolidated Mining and Smelting Company of Canada Limited ceased in May 1962. Gold production from auriferous-quartz mining declined 10 per cent while production from base-metal mines increased 30 per cent. There was a small increase in placer gold recovery.

The two operating lode-gold mines were: Bralorne Pioneer Mines Limited, Bridge River area, and The Cariboo Gold Quartz Mining Company, Limited, in the Wells area. Production was lower from each of these mines. Small amounts of placer gold were recovered in the Barkerville, Atlin and Manson Creek areas. Gold recovered from base-metal mines came mainly from Phoenix Copper Company Limited, Silbak Premier Mines, Limited, Consolidated Woodgreen Mines Limited and Howe Sound Company (Britannia mine).

Northwest Territories

In 1962, all gold from the Northwest Territories came from lode-gold mines. Four mines continued to operate but production declined 2 per cent. Giant Yellowknife Mines Limited, Canada's third-ranking gold producer, had an increase in output; production from the Con and Rycon mines of The Consolidated Mining and Smelting Company of Canada Limited was close to that of 1961. Production from Consolidated Discovery Yellowknife Mines Limited was much lower than in the previous year. Consolidated Discovery also carried out underground stoping operations at the mine of Camlaren Mines, Limited, at Gordon Lake. Ore from Camlaren was trucked to the Discovery mill during the winter of 1962-63.

Yukon Territory

Gold production from placer operations in Yukon Territory was much lower than in 1961. A small amount of gold was recovered from the silver-lead-zinc ores of United Keno Hill Mines Limited. The Yukon Consolidated Gold Corporation, Limited, continued to operate five electric dredges and a combined hydraulic and mechanical benching operation near Dawson City. There were about 30 small placer operations in the Yukon Territory.

DEVELOPMENTS AT OTHER PROPERTIES

Quebec

Sturgeon River Mines Limited was shaft sinking in the Bachelor Lake area. Kiena Gold Mines Limited diamond drilled, from surface, a gold property at Lake Dubuisson, near Val d'Or, and planned to sink an exploration shaft to 1,200 feet in 1963. Some 18 companies were working in the Lake Dubuisson area in February 1963 and several possible gold deposits were being explored. Francoeur Mines Limited, a former producer, was drilling on its property west of Noranda.

Ontario

In the Red Lake area, Cochenour Willans Gold Mines, Limited, was driving underground exploration headings into the adjoining properties of both Consolidated Marcus Gold Mines Limited and Wilmar Mines Limited. Dickenson Mines Limited developed the adjoining property of Robin Red Lake Mines Limited and milled some development ore from this property. The mine of Kenilworth Mines Limited, formerly owned by Naybob (1945) Gold Mines Limited, in the Timmins area was being dewatered and surface buildings were rehabilitated. Lake Beaverhouse Mines Limited partially dewatered its mine and carried out some underground development work. Small amounts of gold were recovered from clean-up operations at several former operating mines in the province.

Manitoba

In Manitoba, Falconbridge Nickel Mines, Limited, conducted tests to determine the feasibility of recovering gold from arsenic concentrate stockpiled during the operating period of Nor-Acme Gold Mines, Limited, at Snow Lake; the mine was operated by other interests under lease until 1958.

British Columbia

In British Columbia a small amount of gold was recovered from the leased property of Tofino Mines Limited on Vancouver Island. Some gold was also recovered from clean-up operations of former gold producers in the Hedley area.

Northwest Territories

Diamond drilling on gold prospects in the Contwoyto Lake area of Northwest Territories indicated several potential high-grade gold ore zones. Taurcanis Mines Limited continued underground development of its Matthew Lake property and announced that it intended to go into production in 1964.

Yukon Territory

In Yukon Territory Ormsby Mines Limited continued driving an adit at the former La Forma property on the slopes of Mount Freegold in the Carmacks area. Klondike Lode Gold Mines Ltd. was churn drilling at the junction of Eldorado and Bonanza Creeks near Dawson City.

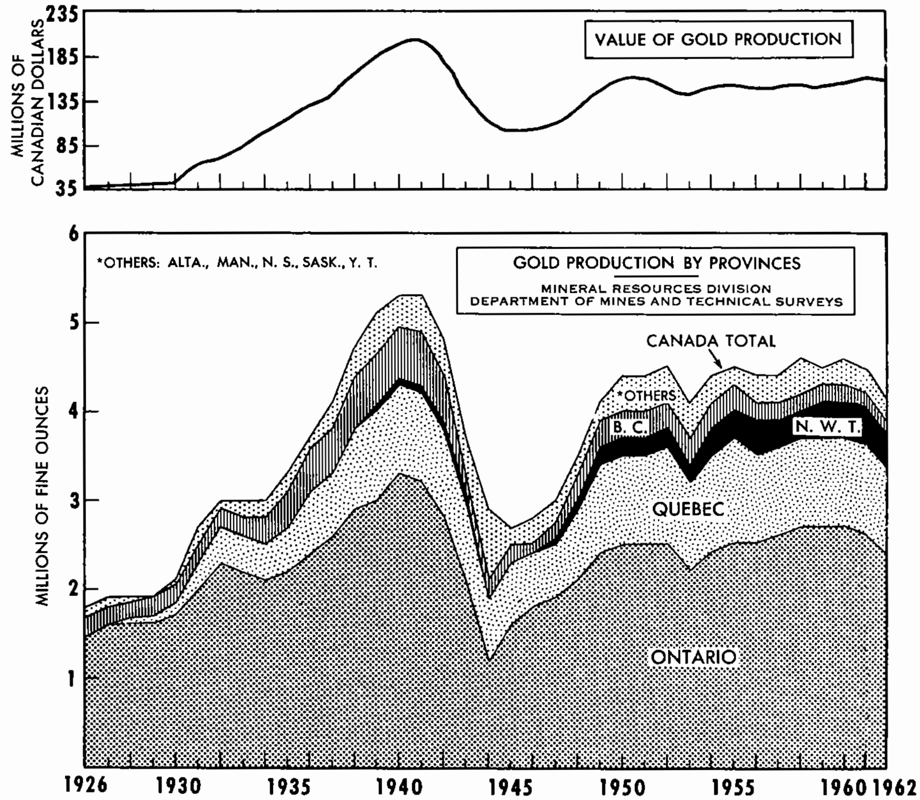
WORLD GOLD PRODUCTION

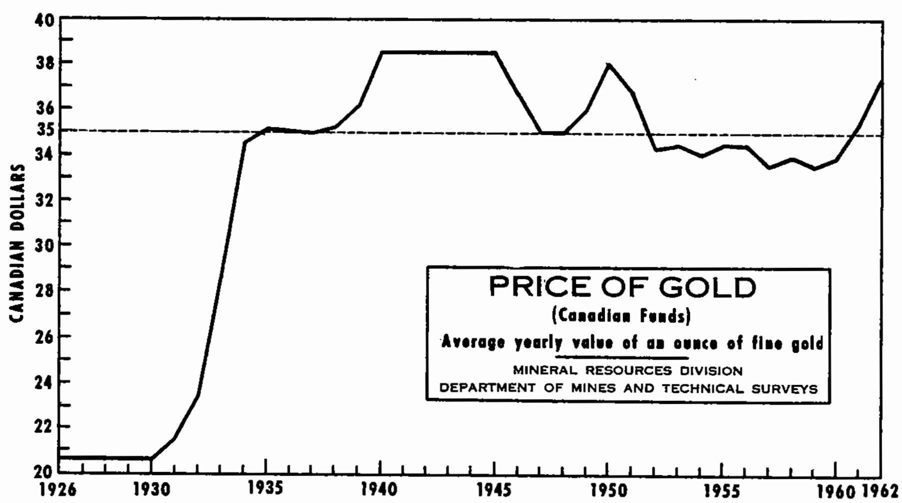
The statistics in Table 3 showing world gold estimates for 1961 and 1962 are summarized from tables compiled by the U.S. Bureau of Mines. The 1962 world total is 5.5 per cent higher. This was due to an 11.1 per cent increase in gold production from the Republic of South Africa and a 3.4 per cent increase from the U.S.S.R. Because the Soviet Bloc does not report its gold production the U.S.S.R. totals are only estimates. The Republic of South Africa produced 67.4 per cent of the Free World total in 1962.

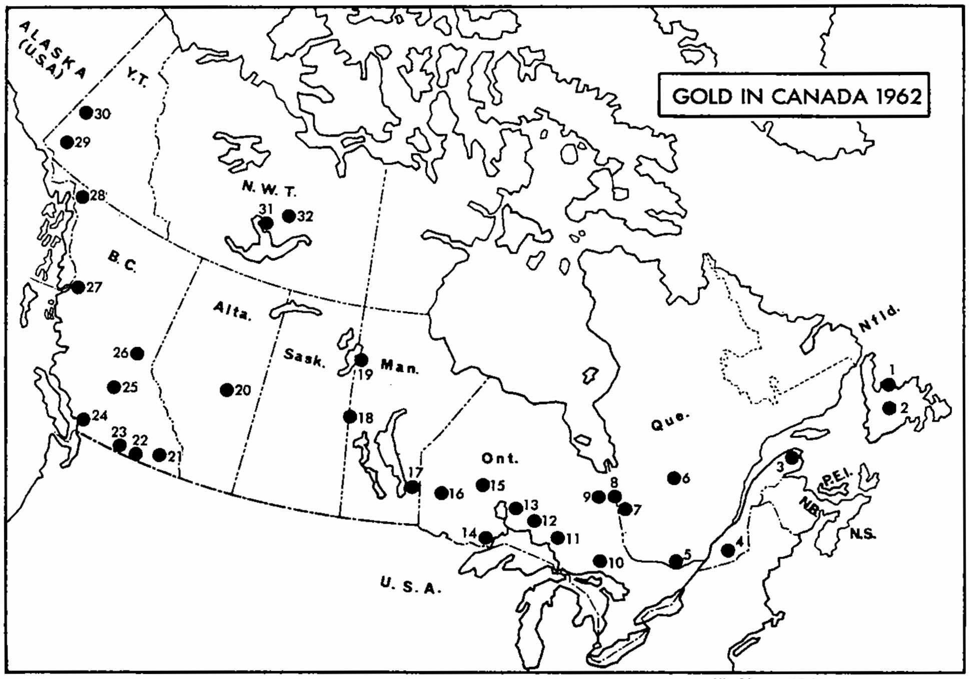
USES

Gold has always been prized for its rarity, beauty, lustre, its ability to resist corrosion and because it could be easily worked into objects of value. Today however it is used principally as a monetary reserve of governments and central banks to give stability to paper currencies and to balance international trade.

The resistance of gold to corrosion led to its early use for jewelry and decoration. This resistance in recent times has made it useful for electrical contacts and other devices that must operate reliably in corrosive atmospheres.


VALUE OF GOLD PRODUCTION
MILLIONS OF CANADIAN DOLLARS
235
185
135
85
35
GOLD PRODUCTION BY PROVINCES
MINERAL RESOURCES DIVISION
DEPARTMENT OF MINES AND TECHNICAL SURVEYS
*OTHERS: ALTA., MAN., N. S., SASK., Y. T.
MILLIONS OF FINE OUNCES
6
5
4
3
2
1
CANADA TOTAL
*OTHERS
B. C.
N. W. T.
QUEBEC
ONTARIO
1926
1930
1935
1940
1945
1950
1955
1960
1962


PRICE OF GOLD
(Canadian Funds)
Average yearly value of an ounce of fine gold
MINERAL RESOURCES DIVISION
DEPARTMENT OF MINES AND TECHNICAL SURVEYS
CANADIAN DOLLARS
40
38
36
35
34
32
30
28
26
24
22
20
1926
1930
1935
1940
1945
1950
1955
1960
1962



MINERAL RESOURCES DIVISION
DEPARTMENT OF MINES AND TECHNICAL SURVEYS

PRODUCERS AND PROSPECTIVE PRODUCERS

Newfoundland

1. Maritimes Mining Corporation Limited (Tilt Cove)(a)
   Atlantic Coast Copper Corporation Limited (Little Bay)(a)
2. American Smelting and Refining Company (Buchans Unit)(a)

Quebec

3. Gaspé Copper Mines, Limited(a)
4. Beauce Placer Mining Co. Ltd.(c)
5. New Calumet Mines Limited(a)
6. Chibougamau District
   Campbell Chibougamau Mines Ltd. (a)
   The Patino Mining Corporation(a)
   Merrill Island Mining Corporation, Ltd. (a)
   Opemiska Copper Mines (Quebec) Limited(a)
7. Rouyn-District
   Elder-Peel Limited(b)
   Eldrich Mines Limited(b)
   Noranda Mines, Limited(a)
   Quemont Mining Corporation, Limited(a)
   Waite Amulet Mines, Limited(a)

   Cadillac-Malartic District
   Barnat Mines Ltd.(b)
   Canadian Malartic Gold Mines Limited(b)
   East Malartic Mines, Limited(b)
   Malartic Gold Fields Limited(b)
   Malartic Hygrade Gold Mines Limited(b)
   Marban Gold Mines Limited(b)
   Norlartic Mines Limited(b)

Quebec (cont'd)

Bourlamaque-Louvicourt District
Akasaba Gold Mines Limited(b)
Bevcon Mines Limited(b)
Lamaque Mining Company Limited(b)
Sigma Mines (Quebec) Limited(b)
Sullivan Consolidated Mines, Limited(b)
Sullico Mines Limited (East Sullivan mine)(a)
Manitou-Barvue Mines Limited(a)

Duparquet District
Normetal Mining Corporation, Limited(a)

Ontario

8. Larder Lake District
Kerr-Addison Gold Mines Limited(b)

Kirkland Lake District
Lake Shore Mines, Limited(b)
Macassa Gold Mines Limited(b)
The Teck-Hughes Gold Mines, Limited(b)
Upper Canada Mines, Limited(b)
Wright-Hargreaves Mines, Limited(b)

9. Porcupine District
Aunor Gold Mines Limited(b)
Broulan Reef Mines Limited(b)
Delnite Mines, Limited(b)
Dome Mines Limited(b)
Hallnor Mines, Limited(b)
Hollinger Consolidated Gold Mines, Limited(b)
Hollinger Ross mine(b)
Hugh-Pam Porcupine Mines Limited(b)
McIntyre-Porcupine Mines, Limited(b)
Pamour Porcupine Mines, Limited(b)
Paymaster Consolidated Mines, Limited(b)
Preston Mines Limited(b)

10. Sudbury Mining Division
The International Nickel Company of Canada, Limited(a)
Falconbridge Nickel Mines Limited(a)

11. Renabie Mines Limited(b)

12. Port Arthur Mining Division
Geco Mines Limited(a)
Willroy Mines Limited(a)

13. Leitch Gold Mines Limited(b)
MacLeod-Cockshutt Gold Mines Limited(b)
Consolidated Mosher Mines Limited(b)

14. North Coldstream Mines Limited(a)

15. Patricia Mining Division
Pickle Crow Gold Mines, Limited(b)

16. Red Lake Mining Division
Campbell Red Lake Mines Limited(b)
Cochenour Willans Gold Mines Limited(b)
Dickenson Mines Limited(b)
Madsen Red Lake Gold Mines Limited(b)
McKenzie Red Lake Gold Mines Limited(b)
H.G. Young Mines Limited(b)

Manitoba

17. Forty-Four Mines, Limited(b)
San Antonio Gold Mines Limited(b)

18. Hudson Bay Mining and Smelting Co., Limited(a)

19. Sherritt Gordon Mines, Limited(a)

Alberta

20. Small Placer Operations on North Saskatchewan River(c)

British Columbia

21. The Consolidated Mining and Smelting Company of Canada Limited (Sullivan and Bluebell mines)(a)
22. McKinney Gold Mines Limited(b)
    Phoenix Copper Company Limited(a)
    Consolidated Woodgreen Mines Limited(a)
23. Craigmont Mines Limited(a)
24. Howe Sound Company (Britannia Division)(a)
    Texada Mines Ltd.(a)
25. Bralorne Pioneer Mines Limited (Bralorne Division)(b)
26. The Cariboo Gold Quartz Mining Company Limited(b)
    Small placer operations(c)
27. Silbak Premier Mines, Limited(a)
28. Small placer operations(c)

Yukon Territory

29. Action Mining Co. Limited(c)
    The Burwash Mining Company, Limited(c)
    and smaller operations(c)
30. The Yukon Consolidated Gold Corporation, Limited(c)
    Ballarat Mines Limited(c)
    and smaller operations(c)

Northwest Territories

31. The Consolidated Mining and Smelting Company of Canada Limited (Con and Rycon mines)(b)
    Giant Yellowknife Mines Limited(b)
32. Consolidated Discovery Yellowknife Mines Limited(b)
    Taurcanis Mines Limited(b)(d)
    and other small gold mines(d)

(a) Base Metals. (b) Auriferous quartz. (c) Placer. (d) Prospective producer.

In jewelry, gold is alloyed with silver, copper, nickel, zinc or palladium to improve its hardness and wearing qualities. It is used in many forms such as plating, goldware, foil, leaf, lace, thread, gilding, gold solutions, inserts, inlays and lettering. The color may vary from natural yellow through various shades of green and even white depending on the alloying elements present.

Gold is extremely ductile, highly conductive, has a high reflectivity, high density and low specific heat and vapor pressure. It is used in the chemical industry, in dentistry and in glass-making. Gold in solution is applied like lacquer to decorate pottery. Uses in electronics include radio tubes, gold-plated printed circuits, gold-film thermometers, x-ray tubes, bolometers, transparent windows and semiconductors. The electrical industry employs it in electrical-contact alloys, resistance alloys, heating elements, condenser plates and thermal fuses. The textile industry uses it in connection with spinnerets and gold thread. It has provided lining for liquid fuel reactors, and, because of its optical qualities, has found increasing use in modern aircraft missiles, earth satellites and space vehicles, including Telstar, the first privately owned television satellite.

Table 3

WORLD GOLD PRODUCTION

(troy ounces)

	1961	1962
North America		
Canada	4,473,699	4,178,396
United States (including Alaska)	1,566,800	1,556,000
Mexico	268,684	236,758
Nicaragua	226,250	221,984
Other countries	1,567	1,862
Total	6,537,000	6,195,000
South America		
Colombia	401,060	396,825
Peru	137,418	126,223
Brazil	120,000	120,000
Chile	100,000	100,000
Other countries	140,522	93,952
Total	899,000	837,000
Europe		
U.S.S.R.	11,800,000	12,200,000
Sweden	83,174	90,000
Yugoslavia	67,195	80,000
Other countries	549,631	530,000
Total	12,500,000	12,900,000
Asia		
Philippines	423,983	423,394
Japan	294,534	286,200
Korea (including North Korea)	214,105	237,880
India	156,510	163,326
Other countries	345,868	344,200
Total	1,435,000	1,455,000
Africa		
Republic of South Africa	22,941,561	25,491,993
Ghana	852,619	888,038
Southern Rhodesia	570,095	554,647
Republic of the Congo	232,611	200,000
Other countries	213,114	235,322
Total	24,810,000	27,370,000

Table 3 (cont'd)

	1961	1962
Oceania		
Australia	1,068,690	1,068,724
Fiji	83,417	87,354
New Guinea	41,820	39,002
Other countries	28,325	21,792
Total	1,222,252	1,216,872
World total (estimate)	47,400,000	50,000,000

Source: U.S. Bureau of Mines, Gold Preprint 1962.

PRICES

The average Royal Canadian Mint value for a troy ounce of fine gold in Canadian dollars increased to $37.41 from the 1961 average of $35.46.

For reasons associated with an imbalance in international trade, the Government of Canada encouraged a reduction in the value of the Canadian dollar in terms of United States funds during 1961. As the Canadian dollar declined from a premium to a discount position, the price paid by the Royal Canadian Mint in Canadian funds rose. During the week of December 16, 1961, the price reached $36.51 per troy ounce, the highest since November 1951. On May 2, 1962, Order in Council P.C. 1962-656 fixed the value of the Canadian dollar at $0.925 United States dollars. The Canadian dollar may be permitted to fluctuate by one per cent either side of the fixed value. The Mint buying price in Canadian funds may vary, therefore, between $37.46 and $38.22 a troy ounce.

An accompanying graph shows the Royal Canadian Mint price for a fine troy ounce of gold in Canadian funds from 1926 to 1962. The Mint price for gold has been pegged at $35 a fine ounce in United States funds since 1934 and the Mint buying price varies because of the relationship between the Canadian and the United States dollars. Gold production by province and the value of gold production from 1926 to 1962 are shown in a second graph. There has been little change in the total annual value of gold production since 1954.

The price for gold at the international gold market in London, England, fluctuated between narrow limits in 1962 with a low of $35.07 (U.S.) an ounce in April and a high of $35.19 during the Cuban crisis in October. Bank of Nova Scotia gold quotations in Toronto were close to the London price. Toronto Stock Exchange quotations were within a few cents of the Royal Canadian Mint price.

United States gold reserves continued to decline in 1962 to under $16 billion. However, both International Monetary Fund officials and United States monetary authorities made firm statements that no increase in the U.S. price of gold was contemplated.

Graphite

J.E. Reeves*

There was no production of graphite in Canada in 1962. The minute production that began at Labelle, Quebec, in 1961 was not sustained.

Canada imports natural graphite in many forms from several countries. Amorphous graphite is obtained from Mexico, directly and via the United States; small-flake graphite is shipped from Norway; and coarsely crystalline graphite comes from Ceylon. The United States is the principal source of natural graphite that has been ground or otherwise processed to some manufactured form.

Artificial graphite is produced at Welland, Ontario, by the Electro Metallurgical Company, division of Union Carbide Canada Limited, by the electric-furnace treatment of petroleum coke.

CANADIAN OCCURRENCES

Graphite is relatively common, although generally not in very high content, in the Precambrian rocks - particularly the limestones and gneisses - of southeastern Ontario and southwestern Quebec. It occurs mainly as a disseminated fine- to medium-grained flake. Most of the graphite produced in Canada from 1846 to 1954 originated in such deposits. One deposit, located a few miles southeast of Perth near the community of Portland, has recently received considerable attention. A concentrating plant is under construction at the deposit.

WORLD PRODUCTION

Mainly because of a very large increase reported by the Republic of (South) Korea, world production of graphite increased considerably over the 440,000 short tons of 1961. Korea (North and South), Austria and Mexico are the prominent sources of amorphous graphite - the dominant variety. The Malagasy Republic is the traditional source of large, tough flake graphite for use in crucibles; Ceylon produces a coarse, massive graphite, frequently with a naturally high carbon content; and West Germany and Norway are suppliers of small flake graphite. The demands for the different varieties of commercial graphite and the imbalance in available resources between many producing and consuming countries result in considerable world trade.

TECHNOLOGY

Graphite is the common form of natural crystalline carbon. It occurs as flakes disseminated through various rock types, as coarsely crystalline masses in veins, and in cryptocrystalline, usually bedded, deposits. In general, industry recognizes two kinds of natural graphite: 'crystalline', which comprises

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* Mineral Processing Division, Mines Branch.

Table 1

GRAPHITE - PRODUCTION AND IMPORTS

	1961		1962	
	Short Tons	$	Short Tons	$
PRODUCTION (shipments)	1	146	-	-
IMPORTS				
Unmanufactured				
United States		18,482		28,706
Mexico		19,290		21,550
Norway		4,510		4,622
Ceylon		4,415		2,777
France		355		465
Britain		398		231
Total		47,450		58,351
Ground and manufactured				
United States		833,893		998,089
Japan		6,409		253,410
Britain		75,332		68,095
West Germany		27,692		42,427
Austria		-		363
France		395		108
Other countries		1,537		-
Total		945,258		1,362,492
Crucibles and covers				
United States		139,231		156,380
Britain		76,557		98,067
Total		215,788		254,447
Foundry facings				
United States		199,505		273,864
Britain		1,977		249
West Germany		701		-
Switzerland		62		-
Total		202,245		274,113

Source: Dominion Bureau of Statistics.
Symbol: - Nil.

Table 2

GRAPHITE - PRODUCTION AND TRADE, 1953-62

	Production*	Exports	Imports		
	Natural Graphite	Natural Graphite	Unmanu-factured	Manufactured	Crucibles
	(short tons)	(short tons)	($)	($)	($)
1953	3,466	3,253	125,740	481,982	217,066
1954	2,463	2,156	54,385	548,824	156,516
1955	-	-	64,798	561,394	202,864
1956	-	-	87,926	815,384	260,000
1957	-	-	74,089	748,732	237,333
1958	-	-	53,219	909,226	166,056
1959	-	-	64,014	976,250	224,204
1960	-	-	75,714	905,756	236,148
1961	1	-	47,450	945,258	215,788
1962	-	-	58,351	1,362,492	254,447

Source: Dominion Bureau of Statistics.
*Producers' shipments.
Symbol: - Nil.

the high-grade products from the first and second types of occurrences and 'amorphous', which comprises products from the last type of occurrence and some of the low-grade products from the first two.

Graphite is of industrial importance because of its chemical composition and its varied physical properties. It is soft and greasy, is a good conductor of heat and electricity and is highly resistant to the action of heat and chemicals.

Table 3

WORLD PRODUCTION OF GRAPHITE, 1962
(short tons)

Republic of Korea	204,032
Austria	98,416
U.S.S.R.	60,000e
North Korea	55,000e
China	45,000e
Mexico	31,993
Malagasy Republic	16,500e
West Germany	13,500e
Ceylon	9,665
Norway	6,300e
Other countries	29,594
Total	570,000

Source: U.S. Bureau of Mines, Graphite Preprint 1962.
e Estimate.

USES AND SPECIFICATIONS

Much graphite is used in foundry facings and steelmaking. Foundry facings are mixtures of ground and blended grades of graphite (mostly amorphous), clay and other materials. These mixtures provide a smooth surface on sand moulds. In the steel industry, low-cost amorphous graphite is used for recarburizing. Graphite crucibles, covers, stoppers and nozzles are used in the melting of metals. Graphite is also used as a conducting material in dry-cell batteries; as a lubricant, in dry form and in greases and oils; as a pigment in some polishes and anticorrosion paints; in lead pencils; in the manufacture of close-tolerance, mechanical and electrical products such as electric brushes, and special pistons, rings and bearings; and, in minor amounts, in certain rubber products, such as seals and gaskets, and in packings.

Artificial graphite is employed chiefly in the form of electrodes used in some types of metallurgical and chemical plants. It is also employed in lubricants and in the manufacture of electric brushes, refractory brick, nuclear-reactor components and numerous special shapes. In powdered form it is of high purity but is granular rather than flaky and competes with natural graphite only in a few industries.

Specifications for natural graphite are many and varied and change periodically. They are mainly a matter of negotiation between supplier and consumer. The carbon content, particle size and type of graphite are the principal factors involved.

PRICES

Graphite prices in the United States, according to _E & M J Metal and Mineral Markets_ of December 31, 1962, were:

Crystalline, f.o.b. source, in bags per metric ton (2,205 pounds)	
Malagasy Republic	$ 90 - $200
Norway	80 - 140
West Germany	114 - 672
Per long ton (2,240 pounds)	
Ceylon	95 - 250
Amorphous	
In bulk, per metric ton	
Mexico	17 - 20
Korea	15
In bags, per long ton	
Hong Kong	21

TARIFFS

Partial information on tariffs in effect at this date is as follows:

	British Preferential	Most Favored Nation	General
Canada			
Graphite, not ground or otherwise manufactured	free	5%	10%
Graphite, ground and manufactures thereof, not otherwise provided for	15%	20%	25%
Graphite flakes	5%	5%	25%
Foundry facings	15%	22 1/2%	25%

United States	
Amorphous*	
Artificial	5%
Other	1 1/2%
Crystalline chip, dust or lump	6 1/2%
Crystalline flake, valued per lb	
At less than 2 3/4¢	0.4125¢ per lb
From 2 3/4¢ to 5 1/2¢	15%
At more than 5 1/2¢	0.825¢ per lb

* Amorphous graphite, crude or refined, valued at not more than $50 a long ton is currently duty free.

Gypsum and Anhydrite

R. K. Collings*

GYPSUM

Gypsum, a hydrous calcium sulphate, is one of the more important non-metallic minerals, primarily because of its use in the manufacture of plaster and plaster products for the building-construction industry. In Canada it is produced in Nova Scotia, Ontario, British Columbia, Manitoba, New Brunswick and Newfoundland. Most of the production is from quarries in Nova Scotia and is exported to plants along the eastern coast of the United States.

Production totalled 5,183,911 tons in 1962, an increase of 5 per cent. Value of production increased over 16 per cent to $9,033,148. Exports of crude gypsum increased 9 per cent, to 4,162,997 tons, which was over 80 per cent of the total production for the year. Imports of crude, mainly from Mexico for use in British Columbia, amounted to 69,947 tons.

In 1962, the apparent consumption of crude gypsum was 1,090,861 tons. Most of this was used in gypsum products however, a substantial part (25 per cent in 1961) was consumed in cement manufacture.

OCCURRENCES

Large surface and near-surface gypsum deposits occur in three of the Atlantic Provinces - in Nova Scotia, throughout the central and northern parts of the mainland and on Cape Breton Island; in the St. George's Bay area in southwestern Newfoundland; and in southeastern New Brunswick near Hillsborough.

No natural gypsum has ever been discovered on the mainland of Quebec but extensive deposits outcrop over large areas of the Magdalen Islands in the Gulf of St. Lawrence.

In Ontario, gypsum occurs in the Moose River area in the northeast, and in the Grand River area, south and west of Hamilton. The Moose River gypsum is 15 to 20 feet thick and is usually under 10 to 30 feet of cover; the Grand River deposits occur at depths up to 200 feet and are generally thin.

Manitoba and Alberta each have large gypsum deposits. The main occurrences in Manitoba are at Amaranth where 40 feet of gypsum is found 100 feet below the surface, and at Gypsumville where beds 30 feet or more in thickness are exposed. An underground deposit in the vicinity of Silver Plains, 30 miles south of Winnipeg, is currently under investigation. Gypsum occurs in Alberta in Wood Buffalo Park and is exposed along the banks of the Peace River

*Mineral Processing Division, Mines Branch.

Table 1

GYPSUM-PRODUCTION AND TRADE

	1961		1962p	
	Short Tons	$	Short Tons	$
PRODUCTION (shipments)				
Crude gypsum				
Nova Scotia	4,113,188	5,693,653	4,302,568	6,668,719
Ontario	425,287	991,944	450,000	1,223,300
British Columbia	153,300	459,900	151,688	455,064
Manitoba	122,233	366,699	139,355	418,065
New Brunswick	85,330	136,856	89,100	140,000
Newfoundland	40,699	101,696	51,200	128,000
Total	4,940,037	7,750,748	5,183,911	9,033,148
IMPORTS				
Crude gypsum				
Mexico	63,600	181,260	68,000	266,392
United States	2,448	35,740	1,935	34,128
Britain	27	888	12	456
Total	66,075	217,888	69,947	300,976
Plaster of paris, wall plaster				
United States	9,256	344,908	7,011	307,959
Britain	301	5,350	31	630
France	9	1,781	6	1,245
West Germany	4	205	3	129
Total	9,570	352,244	7,051	309,963
Wallboard and lath				
United States	311	18,490	71	17,211
Total imports	75,956	588,622	77,069	628,150
EXPORTS				
Crude gypsum				
United States	3,819,345	5,553,551	4,162,997	5,630,206

Source: Dominion Bureau of Statistics.
p Preliminary.

Table 2

GYPSUM-PRODUCTION, TRADE AND CONSUMPTION, 1952-62
(short tons)

	Production(a)	Imports(b)	Exports(b)	Apparent Consumption(c)
1952	3,590,783	649	2,763,492	827,940
1953	3,841,457	547	2,769,990	1,072,014
1954	3,950,422	4,958	2,830,945	1,124,435
1955	4,667,901	16,104	3,039,192	1,644,813
1956	4,895,811	70,436	3,840,721	1,125,526
1957	4,577,492	92,139	3,410,684	1,258,947
1958	3,964,129	108,038	2,898,230	1,173,937
1959	5,878,630	117,830	4,848,576	1,147,884
1960	5,205,731	60,011	4,273,668	992,074
1961	4,940,037	66,075	3,819,345	1,186,767
1962p	5,183,911	69,947	4,162,997	1,090,861

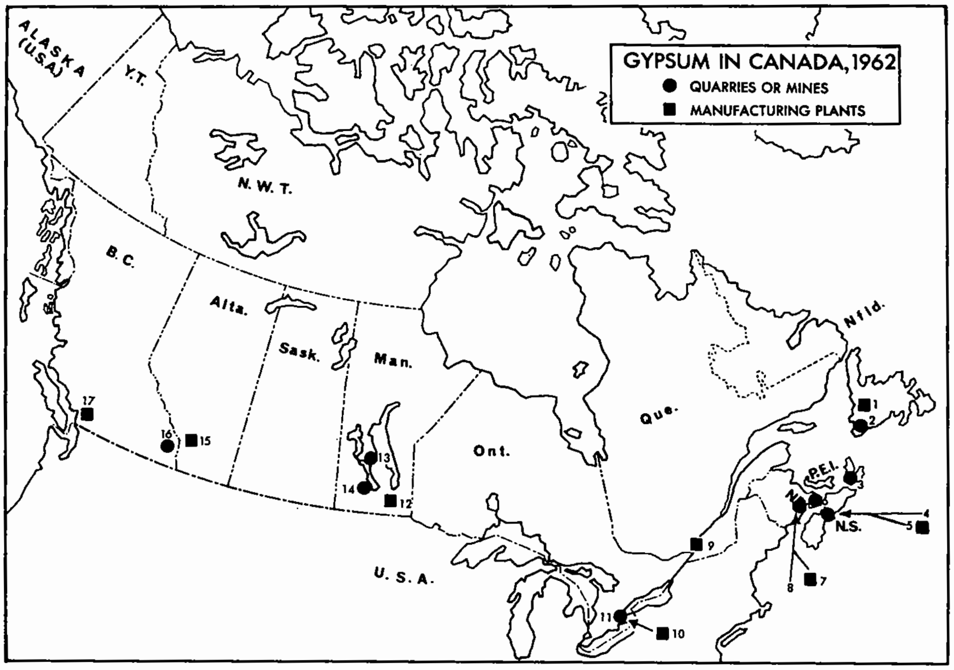
Source: Dominion Bureau of Statistics.
(a) Producers' shipments, crude gypsum.
(b) Include crude and ground but not calcined.
(c) Production plus imports minus exports.
p Preliminary.

Table 3

WORLD PRODUCTION OF GYPSUM, 1961
('000 short tons)

United States	9,500
U.S.S.R.	5,000
Canada	4,940
France	4,245
Britain	4,102
Spain	2,360
Italy	2,205
West Germany	1,213
Other Countries	9,395
Total	42,960

Source: Canada-Dominion Bureau of Statistics; all other countries-U.S. Bureau of Mines, Minerals Yearbook 1961.



DEPARTMENT OF MINES AND TECHNICAL SURVEYS

QUARRIES OR MINES

2. The Flintkote Company of Canada Limited, Flat Bay Station
3. Little Narrows Gypsum Company Limited, Little Narrows
   The Bestwall Gypsum Company (Canada) Ltd., River Denys
4. Fundy Gypsum Company Limited, Wentworth and Miller Creek
   National Gypsum (Canada) Ltd., Milford, Walton, and Cheverie
   Domtar Construction Materials Ltd., McKay Settlement
6. Domtar Construction Materials Ltd., Nappan
8. Canadian Gypsum Company Limited, Hillsborough
11. Canadian Gypsum Company Limited, Hagersville
   Domtar Construction Materials Ltd., Caledonia
13. Domtar Construction Materials Ltd., Gypsumville
14. Western Gypsum Products Limited, Amaranth
16. Western Gypsum Products Limited, Windermere

MANUFACTURING PLANTS

1. Atlantic Gypsum Limited, Humbermouth
5. Domtar Construction Materials Ltd., Windsor
7. Canadian Gypsum Company Limited, Hillsborough
9. Canadian Gypsum Company Limited, Montreal
   Domtar Construction Materials Ltd., Montreal
10. Canadian Gypsum Company Limited, Hagersville
   Domtar Construction Materials Ltd., Caledonia
   Western Gypsum Products Limited, Clarkson
12. Domtar Construction Materials Ltd., Winnipeg
   Western Gypsum Products Limited, Winnipeg
15. Domtar Construction Materials Ltd., Calgary
   Western Gypsum Products Limited, Calgary
17. Domtar Construction Materials Ltd., Port Mann
   Western Gypsum Products Limited, Vancouver

between Peace Point and Little Rapids. It also occurs along the banks of the Slave and Salt rivers north and west of Fort Fitzgerald and as narrow seams interbedded with anhydrite at a depth of 500 feet at McMurray in the northeastern section of the province. In addition, outcrops of gypsum have been found near Mowitch Creek, within the northern boundary of Jasper Park, and at the headwaters of Fetherstonhaugh Creek, near the Alberta-British Columbia border.

In British Columbia the main deposits are at Windermere, Mayook, and Canal Flats, in the southeast, and at Falkland near Kamloops. Another deposit, recently discovered near Loos in east-central British Columbia, is currently under investigation.

Gypsum deposits have been found in the southern part of Yukon Territory and, in the Northwest Territories, along the north shore of Great Slave Lake, along the banks of the Mackenzie, Great Bear, and Slave rivers, and on several of the Arctic Islands.

CURRENT OPERATIONS

Nova Scotia

There are five companies actively producing gypsum in Nova Scotia. Production from their operations made up 83 per cent of the Canadian total in 1962.

Fundy Gypsum Company Limited, a subsidiary of United States Gypsum Company of Chicago, operates quarries for the export of crude gypsum at Wentworth and Miller Creek near Windsor.

National Gypsum (Canada) Ltd., a subsidiary of National Gypsum Company of Buffalo, New York, operates a quarry near Milford, 30 miles north of Halifax. Most of the gypsum from this quarry is for export to company plants in the United States, however, a small amount is shipped to Quebec. Gypsum for export is also obtained from quarries at Walton and Cheverie, Hants county.

Little Narrows Gypsum Company Limited, also a subsidiary of United States Gypsum Company, quarries gypsum at Little Narrows on Cape Breton Island, shipping crude rock to the United States and to Montreal.

Domtar Construction Materials Ltd., formerly Gypsum, Lime & Alabastine Limited, with head offices in Montreal, obtains gypsum from near Nappan for use in a company-owned gypsum-products plant in Montreal. This company operates a calcining plant at Windsor, for the production of plaster of paris. Gypsum for this plant is obtained from deposits at McKay Settlement near Windsor.

The Bestwall Gypsum Company (Canada) Ltd., during the year completed construction of storage and shipping facilities at Point Tupper on the Strait of Canso, and shipped its first gypsum from the newly opened quarry at River Denys. Most of this gypsum will be exported to company plants in the United States.

Ontario

Gypsum is mined at Caledonia, near Hamilton, by Domtar Construction Materials Ltd., and at Hagersville, southwest of Caledonia, by Canadian Gypsum Company Limited. This gypsum is used in the manufacture of plaster and wallboard at company plants located near each of the mines.

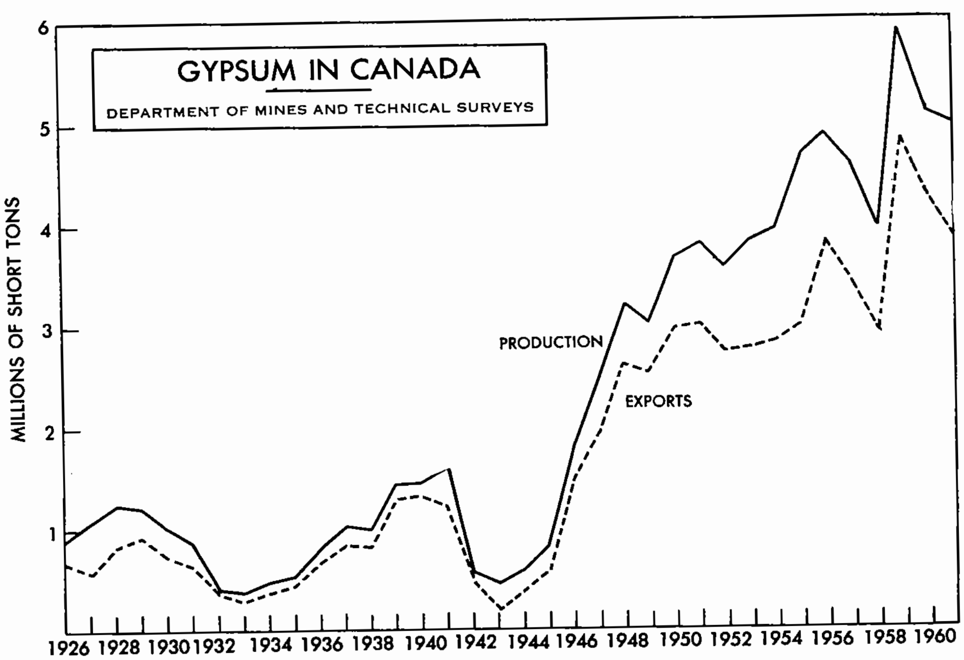
British Columbia

Western Gypsum Products Limited operates a gypsum quarry near Windermere in the southeastern part of the province. Gypsum from this quarry is shipped to company plants in Calgary and Vancouver and to Domtar Construction Materials Ltd. for use in its Calgary plant. Windermere gypsum is also used by cement plants in Alberta and British Columbia.

Manitoba

Gypsum is quarried at Gypsumville, 150 miles northwest of Winnipeg by Domtar Construction Materials Ltd. This gypsum is used at Winnipeg for plaster and wallboard manufacture at a company-owned plant.

Western Gypsum Products Limited obtains gypsum from an underground deposit at Amaranth, 90 miles northwest of Winnipeg, for use in a company-owned gypsum-products plant in Winnipeg. This company is investigating an underground gypsum occurrence near Silver Plains, 30 miles south of Winnipeg, with a view to developing it as a source of crude for the Winnipeg plant.



New Brunswick

Gypsum is quarried near Hillsborough by Canadian Gypsum Company Limited for plaster and wallboard manufacture at a company-owned plant at Hillsborough.

Canada Cement Company, Limited, obtains gypsum from Havelock, west of Moncton, for cement manufacture at Havelock.

Newfoundland

Atlantic Gypsum Limited produces gypsum plaster and wallboard at Humbermouth, on the west coast of the island. This plant, owned by the Government of Newfoundland, is operated by The Flintkote Company of Canada Limited, Toronto, a subsidiary of Flintkote Company of New York. Crude gypsum for its operation is obtained from Flintkote's quarries at Flat Bay Station, 62 miles by rail southwest of Humbermouth. A 6-mile aerial conveyor from the quarry area to St. George's, and water shipping facilities at St. George's were completed during the year, and initial bulk shipments of crude were made to gypsum-product plants on the eastern coast of the United States and to a plant at Clarkson, Ontario.

OTHER PROCESSING PLANTS

Quebec

Domtar Construction Materials Ltd. and Canadian Gypsum Company Limited operate gypsum-products plants in Montreal East. Crude gypsum is obtained from quarries in Nova Scotia.

Ontario

Construction of Western Gypsum Products Limited's gypsum-products plant at Clarkson, southwest of Toronto, was completed during the year. This plant will use Newfoundland gypsum for plaster products and gypsum from southern Ontario for board manufacture.

Alberta

Domtar Construction Materials Ltd. and Western Gypsum Products Limited each produce plaster and wallboard in Calgary. Gypsum for these plants is obtained from quarries in British Columbia and Manitoba.

British Columbia

Domtar Construction Materials Ltd. and Western Gypsum Products Limited also have plants in Vancouver for the production of gypsum plaster and wallboard. The former obtains its crude gypsum from Mexico, the latter is supplied from its Windermere quarry.

USES

Calcined gypsum, or plaster of paris, is the main constituent of gypsum board and lath, gypsum tile and roof slabs, and all types of industrial plasters. Gypsum plaster is mixed with water and aggregate (sand, vermiculite or expanded perlite) and applied over wood, metal or gypsum lath to form an interior wall finish. Gypsum board, lath and sheathing are formed by introducing a slurry consisting of plaster of paris, water, foam, accelerator, etc. between two sheets of absorbent paper, where it sets, producing a firm, strong wallboard. Gypsum board and sheathing are used in the building-construction industry.

Crude uncalcined gypsum is used in the manufacture of portland cement. The gypsum, acting as a retarder, controls the set of the cement. Crude gypsum, reduced to 40 mesh or finer, is used as a filler in paint and paper. Ground gypsum is used to a small extent as a substitute for salt cake in glass manufacture. Powdered gypsum is used as a soil conditioner to offset the effect of black alkali, as a means of restoring impervious, dispersed soil and as a fertilizer for peanuts and other leguminous crops.

TARIFFS

	British Preferential	Most Favored Nation	General
Canada			
Gypsum, crude	free	free	free
Gypsum, ground, not calcined	10%	12 1/2%	15%
Plaster of paris and prepared wall plaster, per 100 lb	free	11¢	12 1/2¢
Gypsum wallboard and lath	15%	20%	35%

United States	
Gypsum, crude	free
Gypsum, ground or calcined, per long ton	$1.19
Gypsum wallboard and lath	6 to 12 1/2%

ANHYDRITE*

Anhydrite, or anhydrous calcium sulphate, is commonly associated with gypsum. It is produced in Nova Scotia by Fundy Gypsum Company Limited at Wentworth; by Little Narrows Gypsum Company Limited at Little Narrows; and for National Gypsum (Canada) Ltd. by B.A. Parsons at Walton. Production in 1962 was about 245,000 tons. Most of this was shipped to the United States for use in the manufacture of portland cement and as a fertilizer for peanut crops. Anhydrite also has a small application as a soil conditioner.

Gypsum and anhydrite are potential sources of sulphur compounds but are not utilized as such in Canada. In Europe, gypsum or anhydrite is calcined at a high temperature with coke, silica and clay to produce sulphur dioxide, sulphur trioxide and byproduct cement. The gases are then converted into sulphuric acid.

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*Production and trade statistics for anhydrite are not reported separately by the Dominion Bureau of Statistics but are included with gypsum in the gypsum section of this review.

Indium

D.B. Fraser*

Indium occurs in minute quantities in certain ores of zinc, lead, tin, tungsten and iron. It has a widespread association with sphalerite, the common zinc mineral, and becomes concentrated in residues and slags derived from zinc and lead smelting operations. It is recovered commercially from the residues and slags at only a few of the world's lead and zinc smelters.

Information on world output is vague since the few companies that recover indium do not publish production data. Indium is produced regularly in Canada and the United States and is reported to have also been recovered in Peru, Belgium, West Germany, Japan and Russia. The single Canadian producer of indium, The Consolidated Mining and Smelting Company of Canada Limited (COMINCO), which has zinc and lead smelters and refineries at Trail, British Columbia, is one of the world's largest.

PRODUCTION

The first extraction of indium at Trail was made in 1941, though the presence of indium in the lead-zinc-silver ores of COMINCO's Sullivan mine at Kimberley, British Columbia, had been known for many years. In the following year 437 ounces were produced by laboratory methods. There followed several years of intensive research and development, and in 1952, production began on a commercial scale. At present, the potential annual production at Trail is one million troy ounces, or about 35 tons.

Indium enters the Trail metallurgical plants with the zinc concentrates. In the electrolytic zinc process, indium remains in the zinc calcine during roasting and in the insoluble residue during leaching. The residue is then delivered to the lead smelter for the recovery of contained lead and residual zinc. In the lead blast furnaces, the indium enters the lead bullion and the blast-furnace slag in about equal proportions. From the slag, it is recovered along with zinc and lead during slag-fuming. The fume is leached for the recovery of zinc, and indium again remains in the residue, which is re-treated in the lead smelter. From the lead bullion, indium is removed in the bullion dross. The dross is re-treated for recovery of copper matte and lead, and in this process a slag is recovered which contains lead, tin and copper as the major constituents, together with 2.5 to 3.0 per cent indium.

*Mineral Resources Division.

The dross re-treatment slag is reduced electrothermally to produce a bullion containing lead, tin, indium and antimony, which is treated electrolytically to yield a high (20 - 25 per cent) indium anode slime. The anode slime is then treated chemically to give a crude (99 per cent) indium metal, which is refined electrolytically to produce a standard grade (99.97 per cent) or a high-purity grade (approximately 99.999 per cent) of indium. The metal is cast in ingots varying in size from 10 ounces to 10 kilograms. Also produced are various alloys and chemical compounds of indium, and a variety of fabricated forms such as disks, wire, ribbon, foil and sheet, powder, and spherical pellets.

PROPERTIES AND USES

Indium is silvery-white, very much like tin or platinum in appearance; chemically and physically, it resembles tin more than it does any other metal. Its chief characteristics are its extreme softness, its resistance to corrosion and its low coefficient of sliding friction. It is easily scratched with the finger nail and can be made to adhere to other metals merely by hand-rubbing. It has a melting point of 156°C, which is relatively low, and a high boiling point of 2,000°C. Like tin, a rod of indium will emit a high-pitched sound if bent quickly. The metal has an atomic weight of 114.8; its specific gravity at room temperature is 7.31, which is about the same as that of iron.

Indium forms alloys with silver, gold, platinum and many of the base metals, improving their performance in certain special applications. Its first major use, still an important outlet, was in high-speed silver-lead bearing alloys, in which the addition of indium increases the strength, wettability and corrosion-resistance of the bearing surface. Such bearings are used in aircraft engines, diesel engines and several types of automobile engines; the standard-grade (99.97 per cent) is satisfactory for this purpose. Indium is used also in low-melting-point alloys containing bismuth, lead, tin and cadmium, in glass-sealing alloys containing about equal amounts of tin and indium, in certain solder alloys in which resistance to alkaline corrosion is required and in gold dental alloys.

A newer use of indium, probably the most extensive now, is found in various semiconductor devices. In these, high-purity indium alloyed in the form of disks or spheres into each side of a germanium wafer modifies the properties of the germanium. Indium is especially suitable not only because it has electronic properties but also because it alloys readily with germanium at low temperatures and, being a soft metal, does not cause strains on contracting after alloying.

Discovered in 1863 but in commercial use for only the last 25 years, indium and its compounds are relatively new materials whose potential applications are still being explored. Uses have been found in intermetallic semiconductors, electrical contacts, resistors, thermistors and photoconductors. Indium can be used as an indicator in atomic reactors since artificial radioactivity is easily induced in indium by neutrons of low energy. Indium compounds added to lubricants have been found to have a beneficial anti-corrosive effect. Indium anodes have been used in lightweight storage-battery cells.

TRADE AND CONSUMPTION

No statistics are available on the export, import or domestic consumption of indium. Much of Canada's output is exported to the United States and Britain, and smaller amounts go to a number of countries in Europe.

PRICES

Prices of indium, 99.97 per cent, quoted per troy ounce for the whole of 1962, in E & M J Metal and Mineral Markets were as follows:

25-ounce lots	$2.25
Ingot, 100 to 10,000 ounces	$1.50 - $1.80

Iron Ore

R. B. Elver*

The decreasing level of iron ore shipments, evident since 1959, was sharply reversed in 1962 when total shipments reached an all-time high of 24,428,282 tons**, up 34 per cent from 1961; output of all producing provinces was higher. Although over-all shipments surpassed previous records, lower shipments and softer prices continued for some companies. This reflected increased competition and a generally stagnant, increasingly captive, international market. Most companies intensified their ore-research programs during the year and continued producing a beneficiated product for marketing rather than 'direct-shipping' ore.

During 1962, three new operations in British Columbia and one in Labrador commenced production. Another company announced plans to commence production by 1964 from a new operation in Ontario while another continued to develop a project in Labrador for production by 1965. As a result, Canadian iron ore productive capacity increased during 1962 from 26 million to nearly 30 million tons. By 1965, the productive capacity is expected to approach 45 million tons. The designed capacity of Canadian iron ore mines and mills in existence at the end of 1962 was approximately 38 million tons. Since two large mills were still in the process of tuneup there was a considerable difference between productive capacity and designed capacity.

In Quebec, a new producer of high-grade concentrates in 1961 shipped approximately 4.5 million tons in 1962 compared with 1.2 million tons the previous year. A substantial increase in shipments by a traditional producer of medium-grade ore in the Schefferville area also contributed to the total increase. This company increased shipments from mines on the Labrador side of the provincial boundary near Schefferville, Quebec, and commenced shipments of high-grade concentrate from new facilities near Labrador City, Labrador. Although production increased from the Labrador area of Newfoundland, the long-established producer of medium-grade ore in Newfoundland experienced a relatively poor year because of increased competition in its main market, western Europe.

In Ontario, most producers of medium- and high-grade ores had a satisfactory year; one producer in the Steep Rock Lake area increased its shipments by about one million tons as it approached its designed capacity. The traditional

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*Mineral Resources Division.

**The long or gross ton of 2,240 pounds is used throughout unless otherwise noted.

Table 1

IRON ORE - PRODUCTION AND TRADE

	1962		1961	
	Long Tons	$	Long Tons	$
PRODUCTION (shipments)				
Quebec	9,967,841	112,444,643	5,035,653	53,627,608
Newfoundland	7,131,170	67,753,153	6,795,839	59,889,125
Ontario............	5,727,621	64,479,510	5,154,164	62,350,773
British Columbia ...	1,601,650	18,326,911	1,192,025	12,082,541
Total	24,428,282	263,004,217	18,177,681	187,950,047
Byproduct iron ore in above	312,767	-	277,086	-
Byproduct iron ore(a).	343,428	-	329,263	-
Ilmenite ore(b)	665,851	-	1,032,122	-
IMPORTS				
United States	4,449,348	54,665,032	3,959,192	45,579,195
Brazil.............	155,471	1,659,310	172,713	1,851,460
Italy	-	-	300	1,213
Netherlands........	-	-	75	1,185
Total	4,604,819	56,324,342	4,132,280	47,433,053
EXPORTS				
Iron ore, direct shipping(c)				
United States.......	9,513,573	90,063,625		
Britain	1,520,818	13,916,270		
Netherlands........	447,053	4,021,174		
West Germany	243,276	2,210,783		
Total............	11,724,720	110,211,852		
Iron ore, concentrate(c)				
United States.......	6,028,240	70,065,698		
Japan	1,544,523	14,610,173		
West Germany	275,090	1,788,182		
Belgium and Luxembourg	261,520	2,455,808		
Britain	147,979	975,414		
Netherlands	121,113	904,755		
Italy	89,146	579,449		
France	23,190	221,465		
Total	8,490,801	91,600,944		

Table 1 (Cont'd.)

	1962		1961	
	Long Tons	$	Long Tons	$
EXPORTS (Cont'd)				
Iron ore, agglomerate (c)				
United States	1,212,033	15,308,527		
Iron ore, not elsewhere specified including byproduct iron ore (c)				
United States	190,573	3,248,701		
West Germany......	27,631	151,971		
Total.............	218,204	3,400,672		
Total Exports Iron ore, all classes				
United States	16,944,419	178,686,551	9,380,832	96,709,353
Britain	1,668,797	14,891,684	2,314,562	20,227,324
Japan	1,544,523	14,610,173	1,159,361	10,152,146
Netherlands	568,166	4,925,929	725,925	6,335,673
West Germany......	545,997	4,150,936	821,820	5,556,920
Belgium and Luxembourg	261,520	2,455,808	348,175	2,729,519
Italy	89,146	579,449	104,036	754,815
France	23,190	221,465	11,955	90,857
Trinidad	-	-	1,500	9,375
Total	21,645,758	220,521,995	14,868,166	142,565,982

Sources: Dominion Bureau of Statistics and supplementary data from individual companies.

(a) Total of shipments of byproduct iron ore compiled from data supplied by individual companies to the Mineral Resources Division. Difference with DBS data is due to variations in industry classifications.

(b) Ilmenite ore used to produce titania slag and pig iron.

(c) Not available as a separate class prior to 1962.

Symbol: - Nil.

Table 2

IRON ORE - PRODUCTION, TRADE AND CONSUMPTION, 1952-62
(long tons)

	Production (shipments)	Imports	Exports	Consumption (indicated)
1952	4,707,008	3,810,409	3,434,820	5,082,597
1953	5,812,337	3,721,046	4,303,549	5,229,834
1954	6,572,855	2,709,991	5,470,480	3,812,366
1955	14,538,551	4,052,490	13,008,000	5,583,041
1956	19,953,820	4,525,768	18,094,080	6,385,508
1957	19,885,870	4,052,704	17,972,769	5,965,805
1958	14,041,360	3,047,301	12,391,314	4,697,347
1959	21,864,576	2,500,894	18,552,488	5,812,982
1960	19,241,813	4,514,596	16,942,140	6,814,269
1961	18,177,681	4,132,280	14,868,166	7,441,795
1962	24,428,282	4,604,819	21,645,758	7,387,343

Source: Dominion Bureau of Statistics.
*Shipments plus imports less exports with no account taken of changes in stocks at consuming plants.

producer of medium-grade ore in the Steep Rock Lake area experienced its lowest output year since the late 1940's because of increased competition that was due, primarily, to a weakening of the non-captive merchant ore market in the United States.

In British Columbia, the number of high-grade concentrate producers doubled to six. Reserves of one of the older producers were almost depleted by the end of 1962.

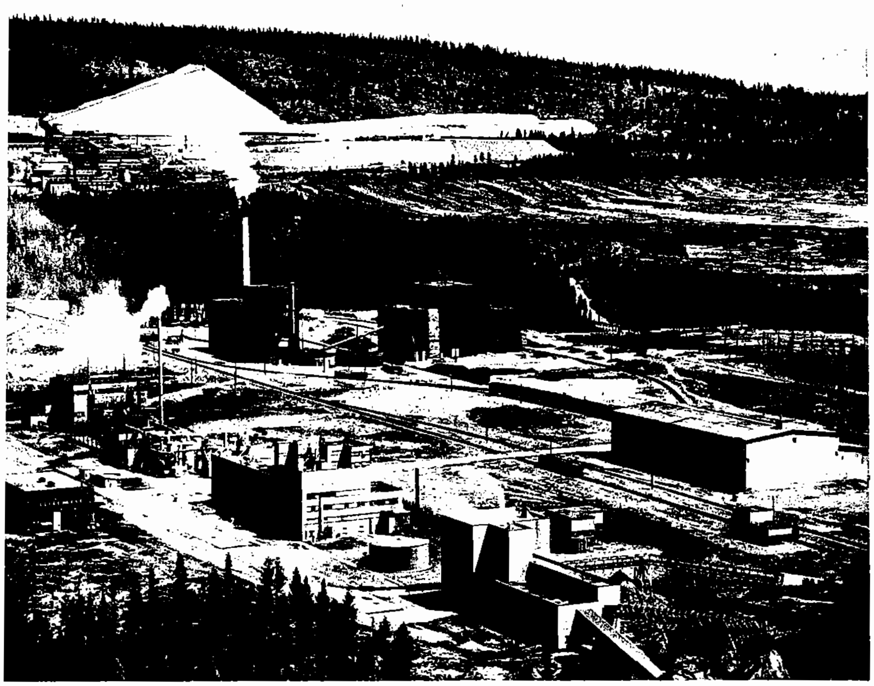
MARKETS AND TRADE

There are five main market areas for Canadian iron ore - the United States, Britain, western Europe, Japan and Canada. The United States is the principal market, the level of ore consumption there improving slightly during 1962 from the two previous years. The consumption of non-Canadian ore in the United States increased only slightly compared with the great increase in imports and consumption of Canadian ore. The main reason for this was a high level of production by Canada's three largest iron-ore producers that are integrated with United States steel companies. Non-captive ore sales by these and other Canadian producers, except those in British Columbia, tended to weaken.

In western Europe, steel production by most countries tended to level off or decline slightly after a decade of continuous growth. An upturn was expected before the end of 1962 although no positive trend was evident.

Caland Ore Company Limited, Mink Point open-pit iron mine at Steep Rock Lake, Ontario. The railway loading facilities, shops and office buildings can be seen in the left background.

The Consolidated Mining and Smelting Company of Canada Limited, by-product pig iron plant at Kimberley, British Columbia. The two dark buildings in the centre, house sintering and electric furnace equipment used in making pig iron. The foreground buildings comprise the ammonium phosphate fertilizer plant. Smoke at the left results from the roasting of iron sulphide concentrates in the production of sulphuric acid, a basic material in making fertilizer and iron oxide for the pig-iron plant.



Exports from Canada in 1962 to all customers in Europe decreased except for a relatively small increase to France. A large part of the net decrease in exports was experienced by one company whose ore is particularly subject to rigorous competition from new, higher-grade sources in Africa and South America.

In Japan, the high and rapidly increasing ore-consumption rate levelled off unexpectedly early in 1962 to the extent that planned imports for the year were reduced by about 20 per cent. Canadian producers were affected by this reduction. Despite the cutbacks, there was a substantial increase in exports from British Columbia, the sole Canadian supplier to Japan, because of deliveries on previously negotiated contracts.

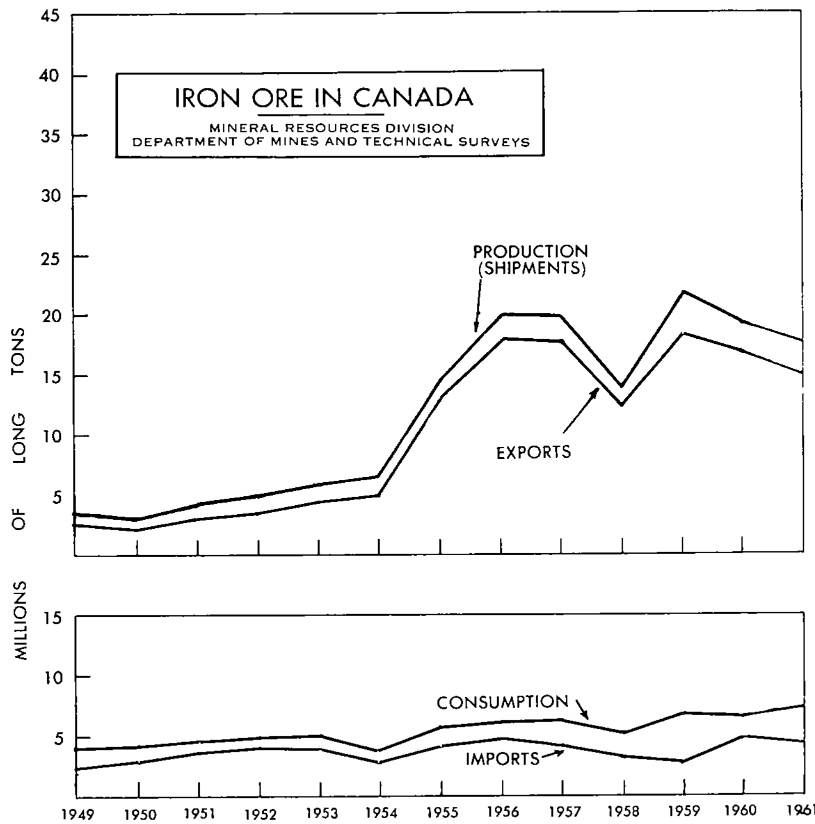
In recent years, developments in Canada have permitted the Canadian steel industry to obtain an increasing part of their ore requirements from domestic sources. This general upward trend can be expected to continue, particularly after 1965, by which time a new project will come into production in Labrador that will provide nearly two million tons of captive ore to the Canadian steel industry. However, domestic consumption of Canadian iron ore decreased slightly in 1962 although Canadian steel production reached a record level—approximately 10 per cent above that of 1961. Imports from the United States and other foreign sources increased. The reason for these opposing trends is that during the period before Canadian iron ore became abundantly available in the 1950's, Canadian steel producers obtained most of their ore requirements from United States iron-ore mining firms in which they had, and still have, a financial interest or traditional commercial links.

The decrease and stabilization of the value of the Canadian dollar in relation to United States funds on May 2, 1962, was of net benefit to Canadian iron-ore exporters. Increased revenue from export sales more than offset the additional capital charges that several operators were required to repay in foreign currency. The net benefit to several producers, however, was largely dissipated by the lower base price for sales of direct-shipping ore in North America. In addition, competition in the European markets from other exporting countries increased the pressure on prices received for Canadian direct-shipping and high-grade beneficiated ore.

WORLD PRODUCTION

The countries listed in Table 3 accounted for approximately 80 per cent of the world's 1961 iron-ore output. Estimates of 1962 production indicate that USSR production continued to increase while that of the United States and France remained about the same as in 1961. Canada displaced Sweden as the fifth leading producer. Production in Britain, Venezuela and West Germany decreased.

The decline in production in West Germany was a result of several planned mine closures as greater quantities of high-grade imports are used. The decline in production in Venezuela which began after 1960 following a decade of continuous growth, is of particular significance.



DOMESTIC CONSUMPTION

Iron ore is used primarily as a raw material in the making of iron and steel. Small tonnages, not primarily referred to as iron ore, are used in the manufacture of paint, as heavy aggregate in concrete, as heavy media in some beneficiation plants, and for agricultural purposes. Most of the iron ore is made into pig iron, some of which is used by iron foundries. Most pig iron, however, along with steel scrap goes into the production of crude steel. Some iron ore is also used in steelmaking furnaces. Table 4 summarizes statistics on the consumption of iron ore in Canadian iron and steel plants.

Table 3

PRODUCTION OF IRON ORE, BY COUNTRY
('000 long tons)

	1959	1960	1961	1962
USSR	92,531	104,343	116,137	126,569
United States	60,276	88,784	71,329	72,305
France	59,976	65,907	65,525	65,852
China	44,300	54,100	44,300	62,005
Canada	21,865	19,242	18,178	24,428
Sweden	18,061	20,975	22,771	21,751
West Germany.....	17,778	18,571	18,568	16,643
Britain	14,870	17,088	16,512	15,278
Venezuala.........	16,929	19,182	14,425	13,641
Subtotal	346,586	408,192	387,745	418,472
Other countries....	84,774	104,137	109,865	104,610
World total	431,360	512,329	497,610	523,082

Source: American Iron and Steel Institute, Annual Statistical Report for 1962.

Table 4

CONSUMPTION OF IRON ORE IN CANADIAN IRON AND STEEL PLANTS
(long tons)

	1962	1961
In blast furnaces, direct	5,952,476	5,388,755
In steel furnaces, direct	322,083	353,875
In sintering plants before ore is charged to blast or steel furnaces	1,442,582	1,400,259
Miscellaneous	6,180	59
Total..................................	7,723,321	7,142,948

Source: American Iron Ore Association, Cleveland, Ohio.

Table 5

CANADIAN CONSUMPTION OF IRON ORE AND PRODUCTION OF PIG IRON AND CRUDE STEEL
(long tons)

	1962	1961
Total receipts at iron and steel plants(a)	7,390,362	7,159,660
Receipts imported(a)	4,684,012	4,173,955
Receipts from domestic sources(a)	2,706,350	2,985,705
Consumption of iron ore (a.b).	7,723,321	7,142,948
	(net tons)	(net tons)
Pig-iron production(c)	5,288,933	4,925,395
Capacity at Dec. 31(c)	5,390,900	5,240,900
Steel-ingot and castings production(c)	7,173,475	6,466,324
Capacity at Dec. 31(c)	8,614,000	8,313,400
Stocks at iron and steel plants	Change from Previous Year	
Dec. 31, 1961 3,487,587	+ 24,147	
Dec. 31, 1962 3,211,404	-287,183	

(a) American Iron Ore Association, Cleveland, Ohio.
(b) Consumption figures are compiled from company submissions and cannot be calculated from the statistics shown in this table.
(c) Dominion Bureau of Statistics.

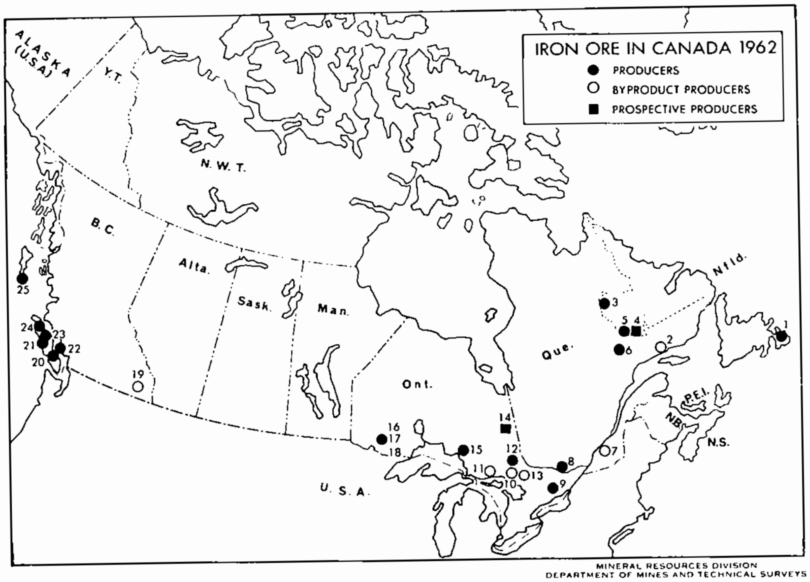
CANADIAN DEVELOPMENTS

Newfoundland

Wabana Mines Division of Dominion Steel and Coal Corporation, Limited experienced increased difficulty in the western European market despite a more intensive sales program and continuing efforts to increase mine efficiency.

Labrador (Newfoundland)

Iron Ore Company of Canada's (IOCC) Carol Lake project brought into production in July 1962, was the highlight of mine developments during the year. The operation is near the new town of Labrador City on the west side of Wabush Lake. It was designed to mine and process annually approximately 18 million tons of crude ore, grading 37.5 per cent iron, to produce seven million tons of concentrate, grading about 64.5 per cent iron. The Smallwood deposit, which is being mined on ground subleased from Labrador Mining and Exploration Company Limited, is one of several the company holds in the area. The deposits held by the company are conservatively estimated to contain more than



PRODUCERS

Algoma Steel Corporation, Limited, The (Algoma Ore Properties Division)	15
Brynnor Mines Limited	20
Caland Ore Company Limited	16
Canadian Charleson, Limited	17
Dominion Steel and Coal Corporation, Limited (Wabana Mines Division)	1
Empire Development Company, Limited	24
Hilton Mines, Ltd.	8
Iron Ore Company of Canada (Schefferville)	3
Iron Ore Company of Canada (Labrador City)	5
Jedway Iron Ore Limited	25
Lowphos Ore, Limited	12
Marmoraton Mining Company, Ltd.	9
Nimpkish Iron Mines Ltd.	23
Quebec Cartier Mining Company	6
Steep Rock Iron Mines Limited	18
Texada Mines Ltd.	22
Zeballos Iron Mines Limited (1962)	21

BYPRODUCT PRODUCERS

Consolidated Mining and Smelting Company of Canada Limited, The (mines and plant)	19
Cutler Acid Limited (plant)	11
International Nickel Company of Canada, Limited, The (mines and plant)	10
Falconbridge Nickel Mines, Limited (mines and plant)	13
Quebec Iron and Titanium Corporation (mine)	2
Quebec Iron and Titanium Corporation (plant)	7

PROSPECTIVE PRODUCERS (by 1965)

Jones & Laughlin Steel Corporation (1964)	14
Wabush Mines Project (1964-65)	4

1,500 million tons of material grading 36 - 38 per cent iron. The deposits are largely composed of specular hematite and quartz. The project, which required a capital expenditure of over $125 million, is about 38 rail-miles west of Mile 224 on the Quebec North Shore and Labrador Railway that connects Sept Iles with Schefferville. Additional stockpile and boat-loading facilities will be constructed in 1963 at Sept Îles, Quebec, to handle IOCC's concentrate and high-grade pellets from Carol Pellet Company.

Carol Pellet Company was formed in 1961 by the United States principals of Iron Ore Company of Canada to construct a pellet plant adjacent to IOCC's Carol Lake concentrator. Construction of the $65-million plant is to be completed by mid-1963; it will be operated by IOCC and is designed to pelletize annually 5.5 million of the 7.0 million tons of concentrate produced from the adjoining concentrator.

Wabush Mines and participating companies completed financing arrangements and continued development of the $235-million iron-ore project on the southeast side of Wabush Lake. Initial production of concentrates, and probably pellets, grading about 66 per cent iron, is expected by 1965. The deposit contains over 1,000 million tons of material grading about 36 per cent iron. The concentrator will have an annual capacity of about 6.0 million tons. The harbor and boat handling facilities at Pointe Noire, across the bay from Sept Iles, became operational during 1962. The 25-mile railway from Pointe Noire to Mile 8 on the Quebec North Shore and Labrador Railway was also completed to establish rail service to the mine area. Wabush Mines had participated with Iron Ore Company of Canada in the construction of the 38-mile line from the Wabush area to Mile 224. Both companies participated with British Newfoundland Corporation Limited, in financing the construction of hydro-electric facilities at Twin Falls, Labrador. At Wabush Lake, mine development, plant construction and townsite building continued.

Jubilee Iron Corporation indicated tentative plans to mine and possibly smelt ore from one of its concentrating-grade deposits in the Wabush Lake area if markets and financing could be arranged.

Quebec-Labrador (Newfoundland)

Iron Ore Company of Canada's mining operations in the Schefferville Quebec area astride the Quebec-Labrador border, operated at a favorable level compared with 1961. The company continued its extensive ore-research program and a decision may be made in 1963 to beneficiate part of the Schefferville production. Since 1960, the company has operated an ore-drying plant at Sept Iles to treat about 1.2 million tons of ore a year. At Sept Iles the company commenced a $3-million expansion to include an additional stockpile and loading and harbor facilities for the movement of concentrate and pellets.

Quebec

Quebec Cartier Mining Company operated at a markedly improved rate, particularly during the second half of 1962. Initial production from the company's $350-million project commenced in July 1961. The project includes development of a mine to produce 20 million tons of crude ore annually, a concentrator to produce 8 million tons annually, a 193-mile railway, a stockpile and boat-loading facilities, and two new towns - Port Cartier and Gagnon. The deposit being mined is one of several held by the company from Lac Jeannine northward to Mount Reed and then to Mount Wright.

Hilton Mines, Ltd. operated close to the record established in 1961. The company has taken a greater interest in outside exploration during recent years to augment its limited ore reserves.

Quebec Iron and Titanium Corporation operated its Lac Tio mine and Sorel Smelter at approximately 25 per cent under the record level set in 1961. The workers at Sorel went on strike on August 28 and by year-end no settlement had been reached.

Ontario

Algoma Ore Properties Division of The Algoma Steel Corporation, Limited, shipped about the same tonnage of sinter as in 1961. A trend to declining merchant ore sales in recent years has resulted in a greater amount of production being shipped to the company's blast furnaces at Sault Ste. Marie. Since the new underground MacLeod mine was brought into production in 1960, the company's main crude ore source has shifted from the Helen and Victoria underground mines, which have been closed, and the Sir James open pit. To improve blast-furnace operations the company installed a $2-million screening plant at Wawa to produce a sinter product 3/8-inch in size or over. Research on various methods of beneficiating crude ore continued.

In the Steep Rock Lake area, 140 miles west of Port Arthur, shipments by Steep Rock Iron Mines Limited declined to the annual production rates in effect prior to 1949. The Hogarth open pit was depleted early in 1962 and the Roberts open pit ('G' Orebody) became the prime source of ore, after seven years of dredging and other development work. The company commenced construction and installation of a $4.5-million crushing, screening, stockpile and conveyor-belt system to transport Roberts ore from the pit to either a new railway loading pocket or to the North concentrator. The Errington underground mine continued to produce from experimental stopes. The company continued its extensive ore-research program which could result in a decision to instal additional beneficiation facilities.

Caland Ore Company Limited, with initial production in 1959, became the largest ore producer in the Steep Rock area. The operation ran smoothly in 1962 with no abnormal operating problems.

Canadian Charleson, Limited, two miles south of Steep Rock Lake, resumed mine production after being idle in 1961 when only small shipments were made from stockpile.

Lowphos Ore, Limited, commenced construction of a pelletizing plant, scheduled for completion in September 1963, to process 600,000 tons of concentrate annually. Since 1959, concentrates have been shipped elsewhere for treatment.

Because of smaller requirements by the parent company, Marmoraton Mining Company, Ltd., shipped a smaller amount of pellets than in 1961.

The International Nickel Company of Canada, Limited, continued with plans to triple its present plant capacity by 1963 to about 750,000 tons of high-grade pellets a year. The plant would then treat 1.2 million short tons of nickeliferous pyrrhotite concentrate a year. Ore shipments were about the same as in 1961.

Noranda Mines, Limited operated its Cutler plant at a low rate in 1962. Sale of the Cutler plant to Canadian Industries Limited was completed in October. A new company, Cutler Acid Limited, was formed by CIL to operate the plant.

Jones & Laughlin Steel Corporation proceeded with mine development and plant construction to produce one million tons of pellets annually at its \$30-million project near Kirkland Lake, Ontario. The project is scheduled for production in 1964.

Prairie Provinces

Because of the possible need for additional raw materials for steel-making the tempo of iron-ore exploration in the Prairie Provinces increased in 1962. Peace River Mining & Smelting Ltd. continued to evaluate various means of beneficiating and transporting ore from the Peace River area of Alberta. The deposits were previously controlled by Premier Steel Mills Ltd., a company which The Steel Company of Canada, Limited, acquired early in 1962; the iron deposits were not included in the acquisition.

British Columbia

During the year, three companies commenced production - Brynnor Mines Limited, in May, Zeballos Iron Mines Limited, in June, and Jedway Iron Ore Limited, in September. Of the three previous producers Texada Ltd. and Nimpkish Iron Mines Ltd. produced at a high rate whereas Empire Development Company, Limited's deposits approached depletion. For the five companies, contracts call for total shipments to Japan of nearly two million tons a year.

The Consolidated Mining and Smelting Company of Canada Limited operated its sinter plant and electric pig-iron furnace at near-capacity. The company also proceeded with a \$4-million program to add a second pig-iron furnace that will increase production from 36,000 to 100,000 tons a year. Construction will be completed in 1964.

Texada Mines Ltd. commenced development of underground reserves in March 1962, for production in the latter part of 1963. By that time open-pit mining will have almost ceased.

Yukon

Crest Exploration Limited, a subsidiary of The California Standard Company, announced the discovery of a multi-billion ton iron occurrence in the Snake River area near the Northwest Territories border at about 65°N. The company is undertaking a preliminary but comprehensive study of the potential of the deposit.

PRICES AND TARIFFS

Traditionally, prices received by most Canadian iron-ore producers in Ontario and Quebec for shipments made to Canadian and United States consumers reflect the Lake Erie price, that is, the price paid per long ton of iron ore delivered at the rail vessel at Lake Erie ports. The Canadian mine price can be approximated by deducting the appropriate handling charges and transportation charges. The Lake Erie price is based on a natural iron content of 51.5

Table 6

LAKE ERIE BASE PRICES, 1950-62
(Mesabi Non-Bessemer Grade)

Year	Per Long Ton ($ US)	Per Long Ton Unit ($ US)
1950	7.70	0.1495
1951	8.30	0.1612
1952 (to July)	8.30	0.1612
1952	9.05	0.1757
1953 (to July)	9.70	0.1884
1953-54	9.90	0.1922
1955	10.10	0.1961
1956	10.85	0.2107
1957-61	11.45	0.2223
1962	10.65	0.2068

per cent and various other specifications regarding physical and chemical properties. Despite increasing production costs, which in many cases have not been offset by increased productivity, the Lake Erie price remained stable from 1957 to early 1962. In April 1962, the price for traditional medium-grade ores declined by about seven per cent. This price decrease reflects increased supplies from Canada and overseas countries and the trend toward lower ore prices in international markets particularly in western Europe. Late in 1962, it was announced that prices for Swedish ores in Europe in 1963 would be about seven per cent less than in 1962; this is a decline similar to that announced toward the end of 1961. These decreases are reflected in most ore sales contracts with suppliers in other countries and could have a further depressing effect on the Lake Erie price.

There are no tariffs on iron ore in any country with which Canada trades. In January 1959, the United States Tariff Commission held public hearings on competition and the effects of iron-ore imports on the United States iron-mining industry. At the time, no opposition to imports was voiced but in October 1960 the Commission held further public hearings to determine whether, owing to the customs treatment accorded under the General Agreement on Tariffs and Trade, iron-ore imports had seriously injured the domestic iron-mining industry. If the Commission had found evidence of serious injury it would have been bound to recommend restrictive measures against imports. Early in 1961, however, it ruled that iron-ore imports had not injured the domestic industry. Since that time, various senate committees have been requested to initiate some form of protection against imports. This situation, although not critical, warrants recognition by Canadian exporters.

Table 7

CANADIAN PRODUCERS OF IRON ORE DURING 1962

Company and Property Location	Participating Companies	Product Mined (average natural grade)	Product Shipped (average natural grade)	Shipments (a) ('000 long tons) 1962	1961
The Algoma Steel Corp., Ltd. Algoma Ore Properties Division; mines and sinter plant near Wawa, Ont.	Wholly owned	Siderite from open pit and underground mines (34.3% Fe)	Ore beneficiated by sink-float and sintered (50.64% Fe, 2.84% Mn)	1,561	1,634
Brynnor Mines Ltd., near Kennedy Lake, Vancouver Island, B.C.	Noranda Mines, Ltd.	Magnetite from open pit mine (54.5% Fe)	Magnetite concentrate (61.4% Fe)	410	-
Caland Ore Co. Ltd.; E. arm of Steep Rock Lake, N. of Atikokan, Ont.	Inland Steel Co.	Hematite and goethite from open pit mines (53.76% Fe)	Direct-shipping ore (53.74% Fe)	2,005	1,009
Canadian Charleson, Ltd.; S. of Steep Rock Lake, near Atikokan, Ont.	Oglebay Norton Co.	Hematite-bearing gravels (12-20% Fe)	Jig and spiral concentrate (55.13% Fe)	119	18
Empire Development Co., Ltd.; Benson R., 25 miles SW of Port McNeill, Vancouver, B.C.	Loram Ltd.; Quatsino Copper-Gold Mines, Ltd.	Magnetite from open pit mine (32.7% Fe)	Magnetite concentrate (56.49% Fe)	22	265
Hilton Mines, Ltd.; near Bristol, Que., 40 miles NW of Ottawa	The Steel Co. of Canada, Ltd.; Jones & Laughlin Steel Corp.; Pickands Mather & Co.	Magnetite from open pit mine (approximately 20% Fe)	Iron oxide pellets (66.28% Fe)	780	800

Iron Ore Company of Canada; near Schefferville, Que.	The M.A. Hanna Co.; The Hanna Mining Co.; Hollinger Cons. Gold Mines, Ltd.; Armco Steel Corp.; Bethlehem Steel Corp.; National Steel Corp.; Republic Steel Corp.; Wheeling Steel Corp.; Youngstown Sheet and Tube Co.	Hematite-goethite from open pit mines (53.08% Fe)	Direct-shipping ore (54.75% Fe)	9,797d	7,444d
Iron Ore Company of Canada; near Labrador City, Nfld.	Same as above	Specular hematite from open pit mine (36.1% Fe)	Specular hematite concentrate (approx. 63.69% Fe)	740	-
Jedway Iron Ore Ltd.; Moresby Island, Queen Charlotte Is., B.C.	The Granby Mining Co. Ltd.	Magnetite from open pit mine (42.2% Fe)	Magnetite concentrate (58.47% Fe)	48	-
Lowphos Ore, Ltd.; Sudbury area, 20 miles N. of Capreol, Ont.	National Steel Corp.; The Hanna Mining Co.	Magnetite from open pit mine (31.54% Fe)	Magnetite concentrate (60.04% Fe)	401	578
Marmoraton Mining Co., Ltd.; near Marmora, in southern Ont.	Bethlehem Steel Corp.	Magnetite from open pit mine (35-37% Fe)	Iron oxide pellets (64.4% Fe)	408	529
Nimpkish Iron Mines Ltd.; 26 miles W. of Beaver Cove, Vancouver Is., B.C.	International Iron Mines Ltd.; Standard Slag Co.	Magnetite from open pit mine (41.6% Fe)	Magnetite concentrate (58.6% Fe)	324	378
Quebec Cartier Mining Co.; Gagnon, Que.	United States Steel Corp.	Specular hematite from open pit mine (31.0% Fe)	Specular hematite concentrate (64.5% Fe)	4,620	1,240

Table 7 (Cont'd.)

Company and Property Location	Participating Companies	Product Mined (average natural grade)	Product Shipped (average natural grade)	Shipments (a) ('000 long tons) 1962	1961
Steep Rock Iron Mines Ltd.; Steep Rock Lake N. of Atikokan, Ont.	Premium Iron Ores Ltd.; The Cleveland-Cliffs Iron Co., and others	Hematite-goethite from open pit and underground mines (50.93% Fe)	Direct-shipping ores and gravity concentrate (54.07% Fe)	963	1,214
Texada Mines Ltd.; Texada Island, B.C.	Private company	Magnetite from open pit mine (42.03% Fe)	Magnetite concentrate (61.81% Fe)	537	446
Dominion Steel and Coal Corp., Ltd., Wabana Mines Division; Bell Island, Conception Bay, E., coast of Nfld.	Wholly owned	Hematite-chamosite from underground and open pit mines (48.55% Fe)	Heavy-media concentrate (50.60% Fe)	1,275	2,292
Zeballos Iron Mines Ltd.; near Zeballos, Vancouver I., B.C.	International Iron Mines Ltd.	Magnetite from open pit mine (48% Fe)[e]	Magnetite concentrate (plus 60% Fe)[e]	200[e]	-
Byproduct Producers					
The Consolidated Mining and Smelting Co. of Canada Ltd., Kimberley, B.C.	Wholly owned	Pyrrhotite flotation concentrates are roasted for acid production. Calcine is pelletized and sintered (65.4% Fe)	Iron oxide pellets (65.0% Fe) are further processed into pig iron at the plant	43	41

Falconbridge Nickel Mines, Ltd.; Sudbury area, Ont.	Wholly owned	Pyrrhotite flotation concentrates	Iron oxide calcine (67-68% Fe)[e]	na	-
The Internation Nickel Co. of Canada, Ltd.; mines and plant in Sudbury area, Ont.	Wholly owned	Pyrrhotite flotation concentrates treated	Iron oxide pellets (68% Fe)	257	231
Noranda Mines, Ltd.; mines near Noranda, Que.; plant at Cutler, Ont.	As of Nov. 1, 1962, owned by Cutler Acid Limited, a new subsidiary of Canadian Industries Limited.	Pyrrhotite and pyrite flotation concentrates treated	Iron oxide calcine (64-66% Fe)	37b	57b
Quebec Iron and Titanium Corp.; mine in Allard Lake area, Que., electric smelter at Sorel, Que.	Kennecott Copper Corp., New Jersey Zinc Co.	Ilmenite-hematite from open pit mine (40% Fe, 35% TiO_2)	TiO_2 slag and various grades of desulphurized iron or 'remelt iron'	660c	1,032c

Source: Company reports, personal communications and other sources.
(a) Statistics supplied by the companies to the Mineral Resources Division.
(b) Production.
(c) Ilmenite consumed.
(d) Under the lease agreement with Hollinger North Shore Exploration Company Limited and Labrador Mining and Exploration Company Limited, Iron Ore Company of Canada mines ore, included in the total figures, for the account of the two concession companies. Shipments in 1962 were 761,278 tons and 738,721 tons, respectively.
Symbols: na Not available; e Estimate; - Nil.

Table 8

COMPANIES UNDER DEVELOPMENT WITH ANNOUNCED PLANS FOR PRODUCTION

Company and Expected Production Date	Property Location	Participating Companies	Product to be Mined	Product to be Shipped	Expected Annual Production
Carol Pellet Company (mid-1963)	Adjacent to Iron Ore Co. of Canada's concentrator, Labrador City, Labrador.	United States participants of Iron Ore Co. of Canada (See Table 7)	Company's plant to be operated by IOCC to process concentrate into pellets.	Pellets (64-65% Fe)	5.5 million long tons
Jones & Laughlin Steel Corp. (1964)	Boston twp., near Kirkland Lake, Ont.	Wholly owned	Magnetite iron formation from open pit mine (25% Fe)	Pellets (65-66% Fe)	1,000,000 long tons
Lowphos Ore, Limited (1963)	20 miles north of Capreol, Ont.	The National Steel Corp.; The M.A. Hanna Co.	Magnetite concentrate to be used	Pellets (65-66% Fe)	Pellet plant being added to concentrator.
Wabush Mines, Pickands Mather & Co., Managing agent (1964-65)	Wabush Lake, near Labrador City, Lab., 190 miles N. of Sept Iles	As of Nov. 1, 1961: The Steel Co. of Canada Ltd, Dom. Foundries and Steel, Ltd., Mannesmann Canadian Iron Ores Ltd., Hoesch Iron Ores Ltd. and Wabush Iron Co. Ltd. (Youngstown Sheet and Tube Co., Inland Steel Co., Interlake Iron Corp., Pittsburgh Steel Co., Finsider of Italy and Pickands Mather & Co.)	Specular-hematite iron formation from open pit mine (37% Fe)	Concentrate and possibly pellets (64-65% Fe)	5,500,000 long tons. Test shipments of concentrate: 1960, 42,000 tons; 1961, 55,000 tons.

Byproduct Producers					
The Consolidated Mining and Smelting Co. of Canada Ltd. (1964)	Kimberley, B.C.	Wholly owned	nil	nil	Electric furnace pig iron capacity being increased to 100,000 short tons.
The International Nickel Co. of Canada, Ltd. (1963)	Mines and plant in Sudbury area, Ont.	Wholly owned	Pyrrhotite flotation concentrates to be used.	Iron oxide pellets (68% Fe)	Capacity being increased to 750,000 long tons.

Sources: Company reports, personal communications, and other.

Lead

J. W. Patterson*

On the basis of lead bullion produced from domestic ores and the recoverable lead content of ores and concentrates exported, Canada's output of 215,329 tons in 1962 was substantially lower than that of 1961. A large part of this reduction was due to lower metal production in British Columbia at the Trail smelter and refinery operated by The Consolidated Mining and Smelting Company of Canada Limited (COMINCO). The Trail output in 1962 was 152,217 tons compared with 171,833 tons in 1961. All other lead-producing provinces recorded increases; Yukon Territory recorded a decrease.

Total production for Canada based on the lead content of ore and concentrates produced, rather than on exports and bullion production as above, was 211,321 tons. In 1961 and 1960, it was 182,557 and 212,229 tons.

COMINCO treated most of the lead concentrates from British Columbia and Yukon Territory at its Trail plant; the remainder were treated in the United States at plants in Idaho and Montana by The Bunker Hill Company and American Smelting and Refining Company. Producers in other parts of Canada shipped all but a small part of their lead concentrates to smelters in Europe and the United States.

Canada's export pattern in 1962 remained essentially unchanged from that of recent years. Chief customers continued to be Britain and the United States which together received 77 per cent of the exports of all forms of primary lead. Belgium, Luxembourg and West Germany continued to purchase substantial quantities of lead concentrates but their share of Canada's lead-concentrate exports declined 7 per cent to about 44 per cent in 1962.

Consumption of lead in Canada increased 3,868 tons (5 per cent) from 1961. A large part of the increase was the result of greater amounts of secondary lead being used in the production of antimonial lead, one of the principal materials used in storage-battery manufacture. Also, substantially more secondary lead was consumed in the manufacture of semifinished products used by the plumbing and pipe-fitting trades.

In the United States, where most of Canada's lead is used, the increase in lead consumption, amounting to 82,419 tons (8 per cent), was largely attributable to a marked increase in battery manufacture. The use of lead in solders also increased substantially. There were no substantial declines in any of the principal uses of lead.

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*Mineral Resources Division

TABLE 1

LEAD - PRODUCTION, TRADE AND CONSUMPTION

	1961		1962	
	Short Tons	$	Short Tons	$
PRODUCTION				
All forms(a)				
British Columbia	192,800	39,369,815	167,641	33,260,028
Newfoundland	21,969	4,485,938	25,330	5,025,529
Yukon Territory	8,385	1,712,198	8,145	1,615,980
Quebec	3,392	692,694	4,716	935,656
Manitoba	3,054	623,558	3,792	752,357
Nova Scotia	-	-	2,682	532,047
Ontario	835	170,562	1,144	226,879
New Brunswick	-	-	1,879	372,865
Total	230,435	47,054,765	215,329	42,721,341
Mine output(b)	182,557		211,321	
Refined(c)	171,833		152,217	
EXPORTS				
In ores and concentrates				
United States	34,525	4,713,789	29,230	3,991,965
Belgium and Luxembourg	24,001	2,911,276	16,018	1,872,296
West Germany	12,177	1,464,902	10,020	1,482,333
Britain	21	4,864	4,227	508,651
Japan	210	32,613	-	-
Taiwan	33	4,543	-	-
Total	70,967	9,131,987	59,495	7,855,245
In pigs, blocks and shot				
United States	55,947	9,635,247	60,194	9,522,669
Britain	42,538	5,817,023	48,082	5,974,322
India	5,749	800,637	7,361	932,225
Japan	6,676	1,000,029	6,014	773,214
Netherlands	4,508	618,426	1,764	219,317
Czechoslovakia	-	90	896	109,192
Other countries	2,219	318,501	1,491	195,785
Total	117,637	18,189,953	125,802	17,726,724

Table 1 (Cont'd.)

	1961		1962	
	Short Tons	$	Short Tons	$
EXPORTS (Cont'd.)				
Lead and lead-alloy scrap				
United States	2,381	249,282	1,645	192,736
West Germany	10	1,000	81	12,405
Britain	72	16,151	54	9,984
Jamaica	30	2,485	-	-
Other countries	13	3,473	-	-
Total	2,506	272,391	1,780	215,125
Lead fabricated materials not elsewhere specified				
United States	411	125,382	2,381	536,654
Venezuela	7	2,646	6	2,702
Britain....................	-	817	4	745
British Guiana	1	182	2	633
Other countries	27	10,875	3	1,926
Total	446	139,902	2,396	542,660
IMPORTS				
Lead in pigs and blocks	1,121	238,064	578	83,308
Lead in bars and sheets	63	17,848	68	23,348
Litharge....................	511	155,184	772	204,418
Lead manufactures...........	na	335,826	na	290,597
Miscellaneous lead products(d)	na	279,571	na	418,772
Total		1,026,493		1,020,443
CONSUMPTION				
Primary lead				
Antimonial lead	1,072		575	
Batteries and battery oxides.	16,427		15,568	
Cable covering	4,204		4,026	
Chemical uses (white lead, red lead, litharge, tetra-ethyl lead, etc.	13,442		14,215	
Copper alloys (brass, bronze, etc.)	245		214	

Table 1 (Cont'd.)

	1961		1962	
	Short Tons	$	Short Tons	$
CONSUMPTION (Cont'd.)				
Primary lead (cont'd.)				
Lead alloys				
Solders	1,637		1,575	
Other (including babbitts type metal, etc.)	566		329	
Semifinished products (pipe, sheet, traps, bends, block for caulking, ammunition, foil, collapsible tubes, etc.)	9,155		8,503	
Other	2,017		972	
Total..................	48,765		45,977	
Secondary lead				
Antimonial lead	14,422		16,760	
Batteries and battery oxides	339		456	
Cable covering............	1,868		2,578	
Chemical uses (white lead, red lead, litharge, tetraethyl lead, etc.).....	1,649		1,631	
Copper alloys (brass, bronze, etc.)	91		116	
Lead alloys				
Solders	1,339		2,384	
Others (incl. babbitts, type metal, etc.)	1,957		2,557	
Semifinished products (pipe, sheet, traps, bends, block for caulking, ammunition, foil, collapsible tubes, etc.)...	1,730		3,485	
Other	1,258		1,342	
Total	24,653g		31,309g	

Table 1 (Cont'd.)

	1961		1962	
	Short Tons	$	Short Tons	$
CONSUMPTION SUMMARY				
Primary lead	48,765		45,977	
Secondary lead	24,653g		31,309g	
Total	73,418		77,286	

Source: Dominion Bureau of Statistics.

(a) Lead content of base bullion produced from domestic primary materials (concentrates, slags, residues, etc.) plus the estimated recoverable lead in domestic ores and concentrates exported.

(b) Lead content of domestic ores and concentrates produced.

(c) Primary refined lead from all sources.

(d) Includes scrap lead, lead capsules for bottles, orange mineral, red lead, and dry white lead, acetate and nitrate of lead (not ground), arsenate of lead and paste paints, including white lead.

(g) Includes all remelt scrap lead and scrap lead used to make antimonial lead.

UNITED STATES QUOTAS

On October 1, 1958, the United States government placed annual quotas on imports of unmanufactured lead and zinc for consumption. Under these quotas, Canada's quarterly allotments are 7,960 tons of lead metal and 6,720 tons of lead contained in concentrates. In 1962, as in previous years, all allotments for lead were filled.

After its third periodic review of trade in unmanufactured lead and zinc since the imposition of quotas, the United States Tariff Commission on October 1 stated that conditions of competition between imported and domestic unmanufactured lead and zinc had not changed sufficiently to warrant a formal inquiry as to whether the import quotas could be relaxed without serious injury to the domestic lead-zinc industry.

INTERNATIONAL LEAD AND ZINC STUDY GROUP

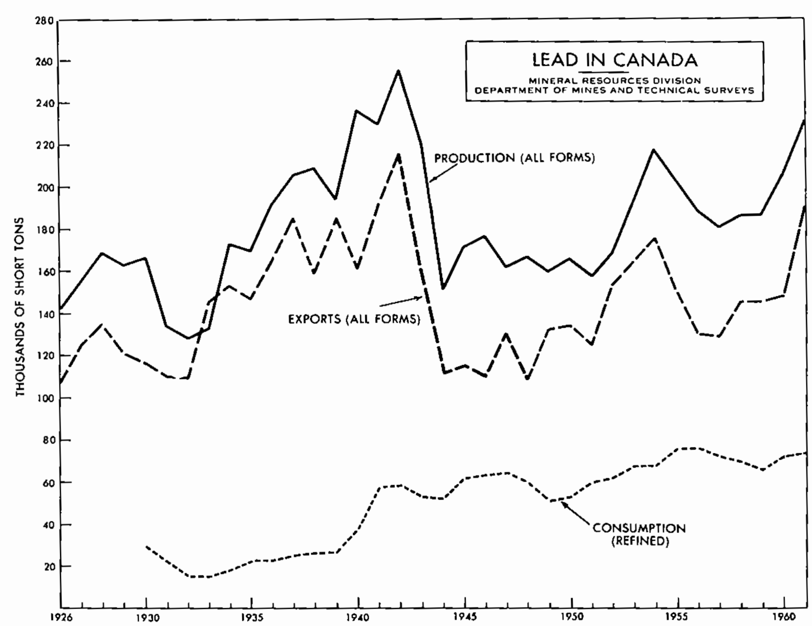
The International Lead and Zinc Study Group held two meetings in Geneva, Switzerland, in 1962. The first meeting, consisting of two sessions, was held in March and May; the second was held in October. At the March session a number of delegates indicated that before any definite commitments could be made they would need to consult their industries for further guidance.

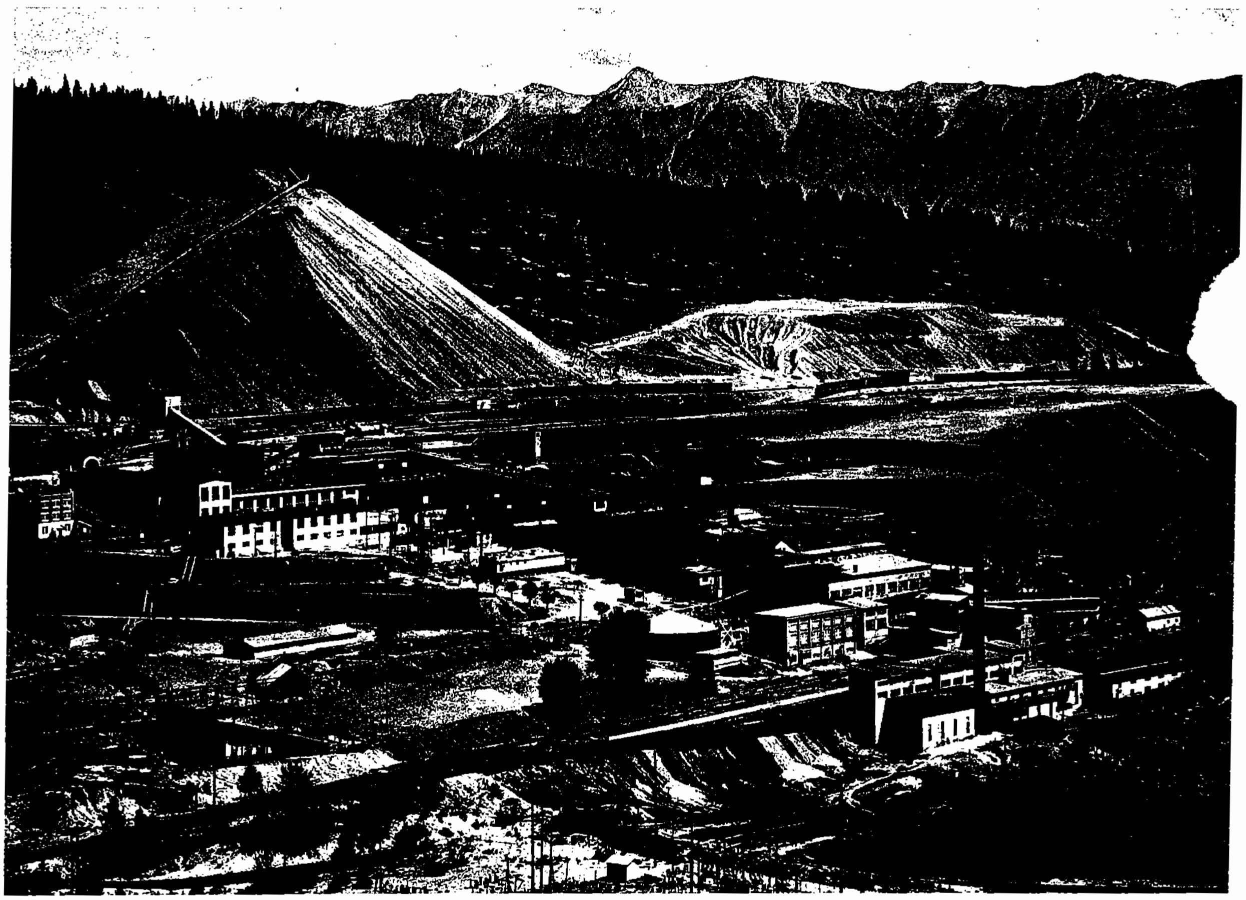
TABLE 2

SUMMARY - LEAD PRODUCTION, TRADE AND CONSUMPTION, 1952-62
(short tons)

	Production		Exports			Imports	Consumption(d)
	All forms(a)	Refined(b)	In Ore and Concentrates	Refined	Total	Refined(c)	
1952	168,842	182,943	23,967	129,740	153,707	355	62,466
1953	193,706	165,752	61,683	102,879	164,562	255	67,718
1954	218,495	166,005	59,755	116,409	176,164	148	67,947
1955	202,763	148,811	58,164	92,704	150,868	98	76,351
1956	188,854	147,865	49,974	79,633	129,607	105	75,882
1957	181,484	142,935	44,167	84,541	128,708	1,507	71,583
1958	186,680	132,987	54,081	92,351	146,432	1,668	69,769
1959	186,696	135,296	53,726	92,252	145,978	1,810	65,935
1960	205,650	158,510	51,336	96,449	147,785	620	72,087
1961	230,435	171,833	70,967	117,637	188,604	1,121	73,418
1962	215,329	152,217	59,495	125,802	185,297	578	77,286

Source: Dominion Bureau of Statistics. (a) Lead content in base bullion produced from domestic primary materials (concentrates, slags, residues, etc.) plus estimated recoverable lead in domestic ores and concentrates exported. (b) Primary refined lead from all sources. (c) Lead in pigs and blocks. (d) Consumption of lead, both primary and secondary in origin. Prior to 1960, consumption of lead derived from secondary sources was not reported completely.





The Sullivan mill at Kimberley, British Columbia, operated by The Consolidated Mining and Smelting Company of Canada Limited. The Sullivan mine is one of the world's largest producers of lead-zinc ore.

Hence, the decision was made to conclude the meeting in May. At that session, the Group forecast a balanced position for both lead and zinc during the first half of 1962, and a moderate surplus of lead and a rather large surplus of zinc for the full year. During the October meeting the Group concluded that the statistical position for both lead and zinc was better than foreseen at the May session and that lead requirements for 1962 were expected to exceed new supplies by about 82,000 tons and that all but a small portion of the new supplies of zinc would be consumed during the year. For the first half of 1963, the Group estimated that new supplies of lead and consumption requirements would be in approximate balance and that there would be a small surplus of zinc. No proposal for curtailments of either lead or zinc production in 1963 was considered. In regard to the longer-term problems, member governments were invited to submit, before the next meeting, their views on the objectives and principles of various forms of intergovernmental arrangements or agreements so that the Group could examine them.

PRODUCING MINES

Of the 17 producers of lead in Canada listed in Table 3, COMINCO, from its Sullivan and Bluebell mines in British Columbia, produced 143,060 tons or approximately 68 per cent of the total mine output. The wanton destruction early in March of the two-mile electrical transmission cable suspended across Kootenay Lake, north of Nelson, resulted in the shutdown of the Bluebell mine and a 30-per-cent reduction in output from the Sullivan mine for about a month.

Other major producers, besides COMINCO, were: American Smelting and Refining Company at Buchans, Newfoundland; United Keno Hill Mines Limited at Elsa, Yukon Territory; and Canadian Exploration, Limited at Salmo, British Columbia. These three companies together with COMINCO accounted for 90 per cent of Canada's total output. At most of the mines operated by these companies, reserves are ample to sustain output at close to present levels for a number of years.

In eastern Canada several base-metal producers completed their first full year of production. Among them were The Coniagas Mines, Limited and Magnet Cove Barium Corporation both of which produce ores containing recoverable amounts of lead, the former operating a mine northeast of Senneterre in northwestern Quebec and the latter at Walton, Nova Scotia. Two new producers in 1962 of some consequence were Heath Steele Mines Limited and Solbec Copper Mines, Ltd. which, respectively, operate copper-lead-zinc mines near Bathurst, New Brunswick and Stratford Centre northeast of Sherbrooke, Quebec. These four companies accounted for most of the changes in output recorded in Quebec, Nova Scotia and New Brunswick. Other important producers include Reeves MacDonald Mines Limited and Sheep Creek Mines Limited in British Columbia; Hudson Bay Mining and Smelting Co., Limited in Manitoba and Saskatchewan; and New Calumet Mines Limited in Quebec.

OTHER DEVELOPMENTS

British Columbia

Western Mines Limited continued to report encouraging exploration results on its Buttle Lake base-metal property on Vancouver Island. Ore reserves were reported at 1,487,000 tons averaging 1.8 per cent copper, 1.2 per cent

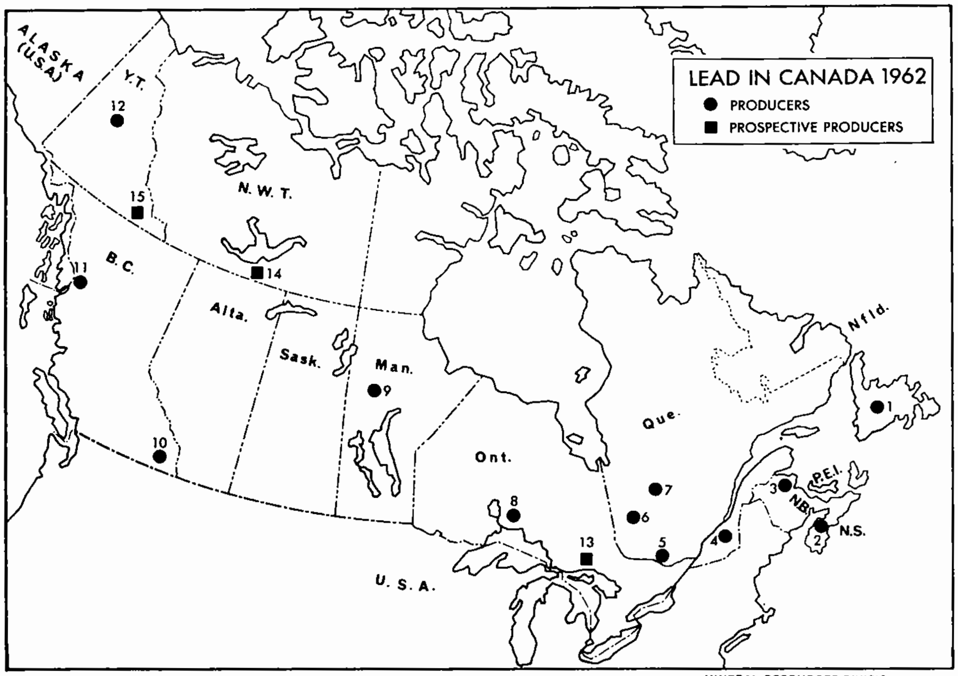
Table 3

PRINCIPAL LEAD PRODUCERS IN CANADA, 1962

Company	Mine	Location	Mill Capacity (short tons /day)	Ore Analyses (Principal Metals) Lead %	Zinc %	Copper %	Silver oz/ton	Ore Produced 1962 (short tons)	Ore Produced 1961 (short tons)	Lead Produced 1962 (short tons)
Yukon Territory										
United Keno Hill Mines Limited (a)	Calumet	Mayo district								
	Elsa	" "	500	5.84	4.42	na	40.55	184,123	186,116	8,794
	Hector	" "								
British Columbia										
Canadian Exploration, Limited	Jersey	Salmo	1,900	2.3	4.4	*	na	384,894	374,032	8,266
Consolidated Mining and Smelting	Sullivan	Kimberley	10,000	na	na	na	na	2,583,068	2,461,695	132,561
Company of Canada Limited, The	Bluebell	Riondel	700	na	na	na	na	237,742	252,821	10,499
	H. B.	Salmo	1,200	na	na	*	na	468,979	472,731	3,638
Mastodon-Highland Bell Mines Limited	Highland-Bell	Beaverdell	70	3.1	3.8	*	43	19,480	18,953	454
Reeves MacDonald Mines Limited	Reeves MacDonald	Remac	1,000	1.22	3.78	*	na	417,448	420,508	4,581
Sheep Creek Mines Limited	Mineral King	Toby Creek	500	2.59	5.50	na	1.17	208,670	211,010	4,600
Manitoba and Saskatchewan										
Hudson Bay Mining and Smelting Co., Limited	Flin Flon	Flin Flon district)	6,000	0.5	5.5	2.42	1.08	1,702,340	1,697,749	4,733
	Coronation	" " ")								
	Schist Lake	" " ")								
	Chisel Lake	Snow Lake, Man.)								

Ontario										
Geco Mines Limited	Geco	Manitouwadge	3,300	0.25	4.68	1.81	2.14	1,282,414	1,276,778	982
Willroy Mines Limited	Willroy	"	1,200	na	5.56	1.69	1.45	495,028	421,772	222
Quebec										
Coniagas Mines, Limited, The	Coniagas	Bachelor Lake	325	2.0	13.0	*	7.5	108,212	79,826	1,510
Manitou-Barvue Mines Limited(b)	Golden Manitou	Val d'Or	1,300	0.77	6.02	(b)	5.03	169,140	162,860	1,054
New Calumet Mines Limited(a)	New Calumet	Grand Calumet Island	750	1.98	7.16	*	4.06	95,623	96,872	1,837
Solbec Copper Mines, Ltd.(c)	Solbec	Northeast of Sherbrooke	1,000	0.62	4.88	1.85	na	271,384	(c)	1,746
New Brunswick										
Consolidated Mining and Smelting Company of Canada Limited, The	Wedge	Bathurst area	(d)	na	na	na	na	223,920	(d)	545
Heath Steele Mines Limited(d)	Heath Steele	" "	1,500	na	na	na	na	na	(d)	na
Nova Scotia										
Magnet Cove Barium Corporation	Magnet Cove	Walton	125	5.4	3.15	0.77	17.05	47,416	9,333	2,422
Newfoundland										
American Smelting and Refining Company (Buchans Unit)	Buchans	Buchans	1,250	7.23	12.44	1.07	4.59	378,000	387,000	25,895

(a) Production - fiscal year ending September 30, 1962.
(b) Manitou-Barvue also milled in a separate circuit, 291,440 tons of copper ore grading 0.99 per cent copper.
(c) Solbec Copper Mines, Ltd. commenced production early in 1962.
(d) Heath Steele Mines Limited commenced milling its own ore and Wedge mine ore in mid-1962, one half of its mill capacity being used to treat Wedge mine ore.
Symbols: na Not available; * Not recovered, if present.



MINERAL RESOURCES DIVISION
DEPARTMENT OF MINES AND TECHNICAL SURVEYS

PRODUCERS*

1. American Smelting and Refining Company (Buchans Unit)
2. Magnet Cove Barium Corporation
3. Consolidated Mining and Smelting Company of Canada Limited, The
   Wedge mine
   Heath Steele Mines Limited
4. Solbec Copper Mines, Ltd.
5. New Calumet Mines Limited
6. Manitou-Barvue Mines Limited
7. Coniagas Mines, Limited, The
8. Geco Mines Limited
   Willroy Mines Limited
9. Hudson Bay Mining and Smelting Co., Limited (Chisel Lake mine)
10. Canadian Exploration, Limited
    Consolidated Mining and Smelting Company of Canada Limited, The (also lead smelter and lead refinery)
    Bluebell mine
    H.B. mine
    Sullivan mine
    Mastodon-Highland Bell Mines Limited
    Reeves MacDonald Mines Limited
    Sheep Creek Mines Limited
11. Silbak Premier Mines, Limited
12. United Keno Hill Mines Limited

PROSPECTIVE PRODUCING AREAS

13. Sudbury Basin
14. Great Slave Lake
15. Watson Lake

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*Omitted are several producers, most of which are in British Columbia.

lead, 9.8 per cent zinc and 3.37 ounces of silver per ton. Early in 1963, the crew at the Buttle Lake property was increased to accelerate exploration and development.

During 1962, former silver-lead-zinc producing properties in the Slocan area received considerable attention, mainly because of their silver-producing possibilities. Some ores and concentrates were shipped to Trail from this area and it is probable, owing to the continuing favorable silver price, that increasing amounts will be shipped in 1963.

New Brunswick

In June, the Honorable Louis Robichaud, Premier of New Brunswick, officiated at a sod-turning ceremony at Bathurst marking the start of construction of production facilities for Brunswick Mining and Smelting Corporation Limited. Earlier, financial arrangements had been completed to bring the company's lead-zinc-copper properties into production at the rate of 3,000 tons a day. Contracts were awarded toward the end of the year to cover mill construction and mine development. An expenditure of $1.5 million to finance the construction of a 15-mile railway from Nepisiguit Junction to Brunswick's number 12 orebody was approved by the federal government in December.

Northwest Territories

Early in February, the construction of a 373-mile Canadian National railway line from Grimshaw, Alberta, to Hay River on the south shore of Great Slave Lake was officially commenced by ground-clearing ceremonies at Roma, a small town near Grimshaw. A spur line, running approximately 65 miles east from a junction near Hay River, will serve the important Pine Point lead-zinc deposits. Following completion of the railway, scheduled for 1966, Pine Point Mines Limited has agreed to ship a minimum of 215,000 tons of concentrates a year from Pine Point for a specified number of years. By the end of 1962, about 73 miles of rail had been laid to Meikle River.

USES

The main industrial applications of lead in Canada and the tonnages used in each are listed in Table 1.

The most valued properties of lead are its resistance to corrosion, its low melting point, its malleability and its high specific gravity. Because of these, lead is used extensively in the manufacture of corrosive-liquid containers, batteries, various types of lead-base babbitts, solders and type metals, plumbing equipment such as pipes, drains and bends, caulking materials, ammunition, etc. Lead is also used in large amounts in the manufacture of pigments and tetraethyl lead.

Lead is being used in increasing amounts as sound barriers in buildings and jetliners and in skyscraper foundations as a vibration absorber. COMINCO'S new offices in the recently-erected CIL building in Montreal have been partially sound-proofed by the use of sheet lead in partitions and the new Place Ville-Marie also in Montreal, rests on lead-asbestos anti-vibration pads. Other less-known uses include the mounting of certain types of equipment such as air-conditioning systems, printing presses, and commercial laundry machines in all of which control of vibration is important; and the use in lead-alloy anodes in impressed-current cathodic systems for the protection of bridges, piers and ship's hulls against corrosion; in reactor installations as shielding against nuclear radiation; and in containers for storing and shipping radioactive substances,

WORLD PRODUCTION OF LEAD

The countries listed in Table 4 are the world's leading producers of lead. Omitted are the countries of the Soviet bloc, which in 1962 produced approximately 705,700 tons.

Table 4

MINE PRODUCTION OF LEAD BY PRINCIPAL PRODUCING COUNTRIES
(thousands of short tons)

	1961	1962
Australia	293.9	405.0
United States	272.8	246.8
Canada	182.5	211.3
Mexico	209.4	197.0
Peru	143.6	164.1
Yugoslavia	104.7	105.8e
Morocco	93.6	98.3
Republic of South Africa	83.9	81.6
Spain	88.0	77.3
Sweden	68.5	71.9
West Germany	60.6	61.2
Japan	51.0	58.9
Italy	52.0	45.5
Argentina	31.9	29.1
France*	30.4	20.3
Burma	19.8	19.8e
Northern Rhodesia	16.9	17.2
Greece	15.9e	15.9e
Bolivia	13.9	20.5
Austria	5.9	5.7
Others**	102.4	81.0
Total	1,941.6	2,034.2

Source: International Lead and Zinc Study Group, December 1963.
* Beginning July 1962, excludes Algeria.
** Beginning July 1962, includes Algeria. Bulgaria, mainland China, Czechoslovakia, Eastern Germany, Poland, Rumania, North Korea and the U.S.S.R. are excluded.
Symbol: e Estimate.

PRICES

Changes in prices quoted f.o.b. Montreal and Toronto during 1962 were as follows:

	(cents per pound)
January 31	10.25 to 10.00
April 3	10.00 to 10.25
June 20	10.25 to 10.00
July 17	10.00 to 9.50
November 1	9.50 to 10.00

TARIFFS

Canadian tariffs on ore and concentrates and certain semifabricated forms were as follows:

	British Preferential	Most Favored Nation	General
Lead ores and concentrates	free	free	free
Pig-lead scrap and blocks	1/2¢ lb	1/2¢ lb	1¢ lb
Lead bars and sheets	10%	10%	25%
Babbitt metal and type metal in blocks, bars, plates and sheet	10%	20%	20%

The United States tariff on the lead content of ores and concentrates remained at 0.75 cents per pound; pig lead, lead bullion, scrap lead and various lead alloys, was unchanged at 1.0625 cents per pound on the lead content. Varying tariffs are applied to imports of lead in other forms.

Lime

J. S. Ross*

Beginning in 1958, large quantities of lime were consumed by the Ontario uranium industry. These amounts, up to 17 per cent of total lime production, reached a peak the following year but have decreased as uranium production declined. However, production now appears to have become more stable after this unusually large fluctuation, and has assumed the general trend established prior to 1958. Nevertheless, about 100,000 tons were consumed by the uranium industry in 1962.

The first grate-type rotary kiln to be installed in a Canadian lime plant went into production at the Joliette, Quebec, operation of Domtar Chemicals Limited. It represents a new approach to lime production which had not been used in North America before 1962. The only official increase in Canada's rated lime output capacity in 1962, amounting to 300 tons per day, was attributed to this kiln.

Production of lime, about half the industry's rated capacity, was 1,424,459 tons valued at $17,646,588. This was a slight increase over 1961 but well below the record 1,685,725 tons established in 1959. Of the total, 1,190,848 tons were quicklime and the remainder, 233,611 tons, were hydrated lime. The only appreciable increase in output was in Ontario where 64 per cent of the country's lime originated. Quebec, the second largest producing province, had reduced sales whereas the remaining provinces showed little change from 1961.

Lime exports, normally relatively small, were much greater in 1962 reaching a record 71,583 tons valued at $1,009,519 - 5 per cent of production. Most of this came from British Columbia, Alberta, and Ontario and virtually all went to the United States. Imports remained small; they were chiefly of special types and came mainly from the United States.

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*Mineral Processing Division, Mines Branch.

Table 1

PRODUCTION AND TRADE

	1961		1962	
	Short Tons	$	Short Tons	$
PRODUCTION*				
By type				
Quicklime	1,142,354	15,631,387	1,190,848	na
Hydrated lime	272,936	3,585,984	233,611	na
Total	1,415,290	19,217,371	1,424,459	17,646,588
By province				
Ontario	865,130	11,548,132	910,930	10,527,910
Quebec	407,427	5,086,976	365,473	4,431,612
Manitoba	48,791	833,238	46,348	800,418
Alberta	47,506	838,365	48,138	842,615
British Columbia	32,616	602,633	36,229	654,157
New Brunswick	13,820	308,027	17,341	389,876
Total	1,415,290	19,217,371	1,424,459	17,646,588
IMPORTS				
United States	38,046	531,701	35,909	550,213
Britain	407	4,253	206	3,750
Total	38,453	535,954	36,115	553,963
EXPORTS				
United States	30,355	528,949	71,077	1,004,585
British Guiana	784	6,916	500	4,586
Netherlands Antilles	-	-	5	290
St. Pierre	4	173	1	58
Bermuda	54	2,203	-	-
Total	31,197	538,241	71,583	1,009,519

Source: Dominion Bureau of Statistics.
Symbols: - Nil; na Not available.
*Producers' shipments plus quantities used by producers.
In 1961, 879,057 tons of the total were shipped for sale and 536,233 tons were used by producers.

PRODUCTION

Both quicklime (calcium or calcium-magnesium oxide) and hydrated lime, the hydroxide, are produced in Canada. Most is of high-calcium quicklime containing not less than 90 per cent calcium oxide. Dolomitic quicklime containing 35 to 45 per cent magnesia and small amounts of magnesium quicklime are also produced. The hydrated counterparts of each type are available.

High-purity limestone is the raw material for the manufacture of primary quicklime in Canada and in 1961, 2,592,831 tons were consumed for that purpose. In general, limestone for lime production is readily available to the more populous areas in all provinces except Saskatchewan and Prince Edward Island. However, primary lime is produced in only six provinces: British Columbia, Alberta, Manitoba, Ontario, Quebec and New Brunswick. In 1962, Ontario and Quebec supplied 90 per cent of the total. The high-calcium type is made in all the primary-lime producing provinces, and dolomitic lime is obtained from Manitoba and Ontario and occasionally from New Brunswick.

In 1962, 35 plants with 97 vertical and 28 rotary kilns were operated. On the average, production was 49 per cent of the combined rated output capacity - 8,100 tons of primary quicklime a day at year-end. In addition, two separate hydrating plants in Winnipeg processed purchased lime. A large unknown amount of secondary lime was recovered from calcium carbonate sludge and recycled at many paper-pulp plants. Statistics regarding secondary lime are not available but the rated production capacity is estimated at a minimum of 1,200 tons a day.

Table 2

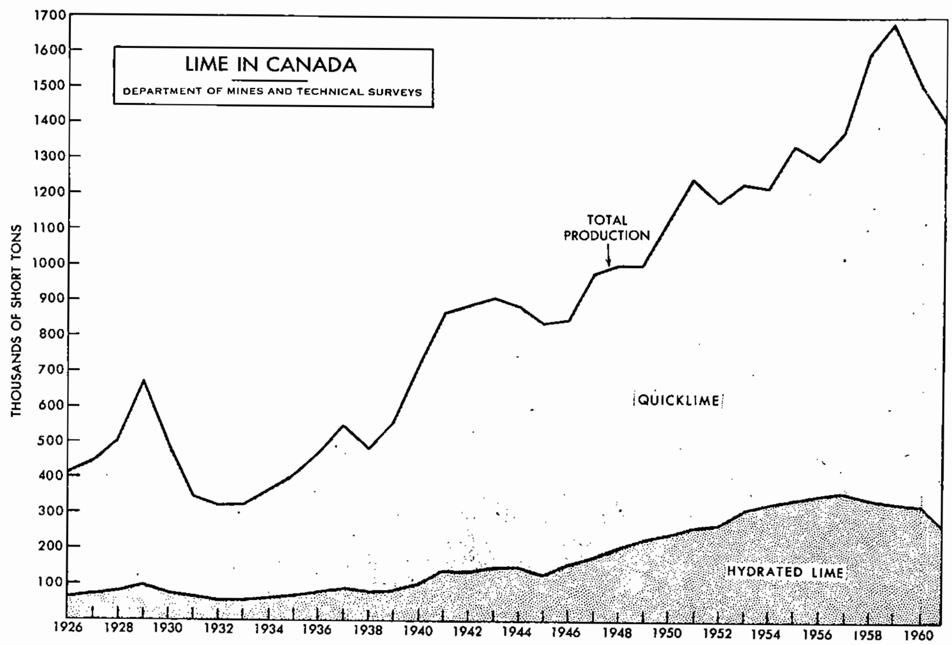
PRIMARY PRODUCERS, 1962

Name of Firm	Plant Location	Type of Quicklime
New Brunswick		
Bathurst Power and Paper Company Limited	Bathurst	High-calcium
Snowflake Lime Limited	Saint John	High-calcium and dolomitic*
Quebec		
Aluminum Company of Canada, Limited	Wakefield	Magnesian*
Bousquet, Adrien	St. Dominique	High-calcium
Dominion Lime Ltd.	Lime Ridge	" *
Lamothe, N.	Pont Rouge	"
Quebec Sugar Refinery	St. Hilaire	"
Shawinigan Chemicals Limited	Shawinigan	"
Domtar Chemicals Limited(a)	Joliette	" *
	St. Marc des Carrieres	"

Table 2 (Cont'd.)

Name of Firm	Plant Location	Type of Quicklime
Ontario		
Bonnechere Lime Limited	Grattan tp.	High-calcium
Brunner Mond Canada, Limited	Anderdon tp.	"
Canada & Dominion Sugar Co. Ltd.	Chatham	"
Canadian Gypsum Company Limited	Guelph tp.	Dolomitic*
Carleton Lime Products Co.	Carleton Place	High-calcium
Chemical Lime Limited	Beachville	"
Indusmin Limited(b)	Coboconk	"
Cyanamid of Canada Limited	Niagara Falls	"
	Ingersoll	"
Dominion Magnesium Limited	Haley	Dolomitic
Domtar Chemicals Limited(a)	Hespeler	"
	Beachville	High-calcium*
Rockwood Lime Company Limited	Rockwood	Dolomitic*
Manitoba		
Building Products and Coal Co. Ltd.	Inwood	Dolomitic*
Manitoba Sugar Company Limited, The	Fort Garry	High-calcium
Winnipeg Supply & Fuel Company Limited, The	Spearhill	"
	Stonewall	Dolomitic
Alberta		
Canadian Sugar Factories Limited	Raymond	High-calcium
	Picture Butte	"
	Taber	"
Loder's Lime Company Limited	Kananaskis	" *
Summit Lime Works Limited	Crowsnest	" *
British Columbia		
Crown Zellerbach Canada Limited	Ocean Falls	"
Domtar Chemicals Limited	Blubber Bay	" *
	Granville Island	"

*The hydrated varieties are also produced.
(a) Formerly listed as Gypsum, Lime & Alabastine Limited.
(b) Formerly listed as Cobo Minerals Limited.



DEVELOPMENTS

Domtar Chemicals Limited installed a grate-type kiln at its Joliette, Quebec, plant. This kiln, the first of its kind to be used in a Canadian lime plant, increased the operation's rated capacity from 200 to 500 tons of lime a day. In addition, construction of a new limestone crushing, screening, and pulverizing plant was completed to replace the old crushing plant. The complete project was estimated to cost $2 million.

Cal-Sil Products Ltd. started construction of a sand-lime brick plant at Ville Jacques Cartier, Quebec. This will provide an additional market for lime produced by Dominion Lime Ltd.

Lime stabilization of soils was used sparingly in Canada and, as in previous years, was virtually confined to Manitoba. However, its application for this purpose increased in 1962 and is expected to be greater in 1963.

CONSUMPTION AND USE

Lime is used by most industries. Chiefly because it is easily available and relatively cheap, it is the most commonly demanded alkali. It also has numerous applications in construction. The consumers of lime are in four main groups - the chemical, metallurgical and related industries; building; agriculture; and other industries - as shown in Table 3.

Most lime is consumed as a chemical,by chemical and related industries. In 1961, 87 per cent of the total consumption went to these industries. Most of this, 536,233 tons or 38 per cent of total production, listed under "other", in Table 3 was consumed captively. Practically all this was used in

Table 3

CONSUMPTION OF LIME

(producers' shipments and consumption by usage)

	1960		1961	
	Short Tons	$	Short Tons	$
Chemical, metallurgical, etc.				
Iron and steel plants	173,711	2,079,593	185,630	2,174,495
Pulp and paper mills	166,527	2,195,109	185,462	2,382,240
Uranium mills.............	214,626	2,589,930	127,616	1,594,236
Nonferrous smelters	138,662	739,947	91,389	640,117
Sugar refineries	31,086	471,966	31,872	452,153
Cyanide and flotation mills..	20,023	240,069	31,678	326,689
Glass works..............	19,539	236,380	22,085	281,458
Tanneries.................	4,689	61,106	5,433	72,817
Fertilizer plants...........	7,406	52,340	7,976	41,944
Insecticides, fungicides	1,522	27,262	1,082	19,852
Other....................	574,681	7,360,143	540,305	7,984,308
Building trade				
Finishing lime.............	74,576	1,682,635	75,105	1,675,038
Mason's lime..............	58,630	987,529	47,121	807,174
Sand-lime brick	12,336	138,746	16,077	169,186
Agricultural	7,731	102,301	10,309	116,120
Other	23,823	336,734	36,150	479,544
Total....................	1,529,568	19,301,790	1,415,290	19,217,371

Source: Dominion Bureau of Statistics.

the production of calcium cyanamide, sodium carbonate and calcium chloride at plants in Anderdon Township and Niagara Falls, Ontario, and Shawinigan, Quebec.

In 1961, consumption by the iron and steel industry increased to a new high. This industry requires lime as a flux in smelting and in the neutralization of waste liquors. The paper-pulp producers use lime in the preparation of dissolving fluids for the sulphite and soda processes. In the recovery of uranium, lime is used to control hydrogen-ion concentration, to recover sodium carbonate, and to neutralize waste sludges. During 1958, 1959 and 1960, the largest non-captive application for lime was at uranium plants.

Lime is used in nonferrous smelters as a flux. In the production of beet sugar, lime serves to precipitate impurities from the sucrate. It is used to regulate alkalinity in the flotation and cyanidation processing of minerals and metals. Lime is an ingredient in glass manufacture and in some fertilizers. It is also used in the tanning of leather and in the manufacture of many materials such as insecticides, fungicides, pigments, glue, acetylene, precipitated calcium carbonate, calcium hydroxide, calcium sulphate, magnesia and magnesium metal.

About 10 per cent of the total production of lime is used by the construction industry as an ingredient in plaster, mortar, artificial stone and brick. Small amounts, included under "other" in Table 3, are used in soil stabilization, ready-mixed mortar and asphalt paving. Soil stabilization with lime, popular in the United States but rarely practised in Canada, is a potential major outlet, particularly in western Canada.

The agriculture industry, which uses lime as a soil conditioner and in manufactured fertilizers, is the third-ranking, although a minor, consumer.

The fourth, or "other" class in Table 3, includes the use of lime in water treatment.

PRICES

Quicklime is marketed in lump, pebble, crushed, and pulverized form. It may be sold as bulk or in bags. Hydrated lime is normally shipped in bags. Prices vary with the type of product, type of shipment, amount sold, and supply and demand. In 1961, quicklime and hydrated lime production averaged respectively $13.69 and $13.14 a ton at the plant.

Limestone

J.S. Ross*

The output of limestone including that for cement and lime reached a record 49.0 million tons in 1961. Preliminary statistics indicate that for 1962 this production dropped to 47.1 million tons. However, final production statistics will probably show an upward revision of this figure.

Virtually all the decrease was in limestone supplied for non-cement and non-lime purposes, output of this type being 35.7 million tons valued at $45.4 million compared with 38.2 million tons at $48.0 million in 1961. These statistics include all shipments of sedimentary limestone, recrystallized limestone, and marl. The first type accounted for more than 99 per cent of the output in 1961. That quarried for cement production increased to an estimated high of 8.8 million tons. Limestone for lime production was down slightly but remained at 2.6 million tons.

Quebec led in the production of limestone for non-lime and non-cement uses and, with Ontario, supplied 94 per cent of that amount. As usual, there was no output from Prince Edward Island and Saskatchewan. In 1961, 478 quarries were operated in the eight producing provinces.

Limestone comprised 82 per cent of the 59,677,011 tons of stone produced in Canada in 1961. The remainder was mainly igneous rock and sandstone and included shale and slate. Stone of all types exclusive of that used in the production of cement and lime remained in thirteenth place in Canada's mineral production.

Canada's trade in limestone with the United States is substantial in both value and tonnage despite the low price of the commodity and the United States tariff. However, it is small compared with production in these countries. In 1962, Canadian export statistics on limestone were available for the first time. For that year, 788,790 tons of crushed limestone and refuse valued at $966,152 were exported - mainly for construction - to the United States. Most of this was from Ontario. The greater part of the chemical-grade limestone was exported from Ontario, British Columbia and Alberta. In addition, smaller quantities of crude and pulverized limestone were exported. There are no separate Canadian import statistics for this commodity but according to the

* Mineral Processing Division, Mines Branch.

Table 1

PRODUCTION, TRADE AND CONSUMPTION

	1961		1962p	
	Short Tons	$	Short Tons	$
PRODUCTION(a)				
By province				
Quebec	19,006,556	23,713,138	17,742,194	22,634,213
Ontario	16,688,807	19,551,695	15,882,006	18,578,490
British Columbia	1,105,162	1,794,887	719,435	1,424,994
Manitoba	594,340	985,624	661,143	1,059,799
New Brunswick	346,774	793,465	323,550	709,835
Newfoundland	322,032	630,123	228,892	458,898
Alberta	81,483	283,300	80,995	294,060
Nova Scotia	75,264	207,327	62,627	201,530
Total	38,220,418	47,959,559	35,700,842	45,361,819
By type				
General(b)	38,043,151			
Marl	109,624			
Recrystallized	67,643			
Total	38,220,418			
	1960		1961	
By use				
Metallurgical	2,009,913	2,298,017	1,912,640	2,081,473
Pulp-and-paper	437,614	1,403,734	612,355	1,644,575
Glass-making	46,662	160,204	50,263	160,356
Sugar-refining	27,924	55,968	35,624	74,145
Other chemical uses	323,664	271,737	274,752	277,683
Pulverized for agricultural and fertilizer uses	896,377	2,270,512	1,234,038	3,262,240
Pulverized for other uses	219,302	738,992	262,746	864,266
Road metal	19,375,150	21,398,317	19,740,454	21,036,857
Concrete aggregate	7,947,937	9,022,705	9,309,635	10,277,302
Rubble and riprap	1,074,913	978,014	1,090,777	1,232,520
Railroad ballast	729,475	728,311	573,386	633,240
Structural(c)	68,035	1,880,220	88,100	2,519,009
Other uses	3,318,405	4,207,092	3,035,648	3,895,893
Total	36,475,371	45,413,823	38,220,418	47,959,559

Table 1 (cont'd)

	1961		1962p	
	Short Tons	$	Short Tons	$
EXPORTS				
Crushed limestone and refuse(d)				
United States............			788,790	966,152
Crude stone not elsewhere specified(d)				
United States............			98,350	187,341
Belgium and Luxembourg.			60	1,590
Total			98,410	188,931
IMPORTS				
Crushed stone				
United States............	790,482	1,185,454	730,122	1,257,127
United Kingdom	-	-	1,657	3,067
Norway................	-	-	220	3,685
Total	790,482	1,185,454	731,999	1,263,879
Crushed, ground and broken limestone exported by United States to Canada(f)	747,201	1,387,874	575,765	1,349,207
CONSUMPTION				
In production of cement....	8,145,376		8,822,000e	
In production of lime	2,592,831		2,569,000e	
Miscellaneous	38,220,418		35,700,842	
Total	48,958,625		47,091,842	

Source: Dominion Bureau of Statistics. (a) Does not include limestone produced for lime and cement but does include small amounts of marl and marble. (b) Includes sedimentary limestone and minor colored recrystallized limestone. (c) Includes building, monumental and ornamental stone as well as flagstone and curbstone. (d) Not available as separate class prior to 1962. (e) Estimate. (f) U.S. Department of Commerce, United States Exports of Domestic and Foreign Merchandise (Report FT 410).

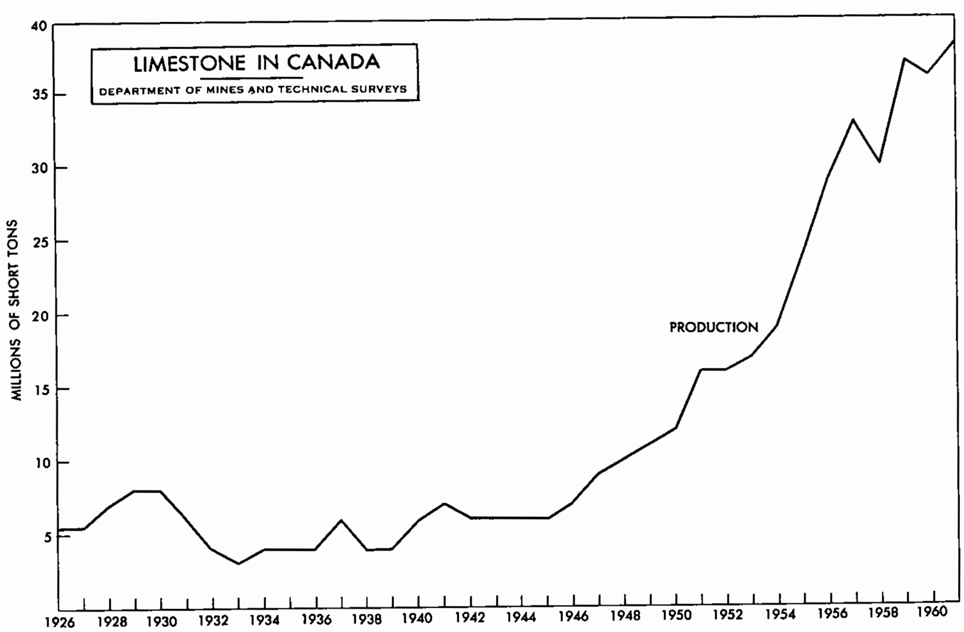
Symbols: p Preliminary; - Nil.

United States Department of Commerce, that country, in 1962, exported to Canada 575,765 tons of crushed, ground and broken limestone valued at $1,349,207. Most of this went to Ontario for construction purposes. Total imports of crushed stone amounting to 731,999 tons valued at $1,263,879 came from the United Kingdom and Norway as well as from the United States.

Major developments in the limestone industry took place in Quebec, Ontario and British Columbia. Domtar Chemicals Limited completed construction of a crushing, screening and pulverizing plant at Joliette, Quebec. This operation supplies stone for chemical and construction purposes. In Ontario, Acton Limestone Quarries Limited and Associated Quarries & Construction (Amalgamated) Limited completed construction of crushing and screening plants near Acton and Milton, respectively. Both King Paving & Materials Limited, and Canada Crushed & Cut Stone Limited, established facilities for the production and washing of sand at their respective operations near Bronte and Niagara Falls.

In British Columbia, two unusually large barges, each with a 10,700-ton capacity, were built to assist in the exportation of high-calcium limestone from that province to the United States. Production and exports from British Columbia are expected to increase appreciably beginning in 1963.

In 1962 a long-overdue equalization of tariffs on limestone between this country and the United States was initiated. For many years there has been no Canadian tariff on crushed limestone from the United States. The United States



tariff on crushed limestone had been 1 1/4¢ per 100 pounds, about 20 per cent. Such a tariff was excessive for a commodity that is plentiful in each country and that is normally transported to foreign consumers at a cost exceeding its low unit value. In 1962 this United States tariff was reduced to 1 1/8¢ per 100 pounds.

DISTRIBUTION OF DEPOSITS

Canada has suitable occurrences of most types of limestone in many of its populated regions, particularly in the southern parts of Ontario and Quebec, where more than 90 per cent of the limestone is quarried and consumed. This material, which is of good quality, is quarried chiefly in or near the cities of these two provinces. Suitable and easily accessible limestone does not occur in central or eastern Alberta, southern Saskatchewan, northwestern Ontario or Prince Edward Island. Chemical-grade dolomitic and high-calcium limestones are shipped from deposits in British Columbia, Manitoba, Ontario, New Brunswick and Nova Scotia. Other producing provinces also supply high-calcium limestone.

USES

Owing to its physical property, abundance, and low value, limestone is generally the preferred type of stone for most uses. Distance to markets is usually the greatest factor in determining the extent of use of a particular limestone. Other criteria include chemical composition, accessibility, texture, hardness and color, as well as thickness and extent of formation.

In descending order of importance, the main uses for limestone are: construction, cement and lime production, chemical manufacture and in agriculture. The rock may be used in large fragments as rubble and riprap, chemical stone, flagstone, curbstone, or building, monumental, or ornamental stone. For chemical and most other purposes, it is crushed and possibly pulverized before being sized as fragments up to 6 inches.

In Canada, most limestone is used by the construction industry. Most of this is for road metal and concrete aggregate and in the production of cement. It is also used as rubble and riprap, railroad ballast, fillers in construction products, structural and ornamental stone, terrazzo, stucco, and in the production of mason's and finishing lime. Except in the production of cement and lime, physical properties of limestone are the most important in construction.

The cement industry employs calcium or high-calcium limestone containing minor amounts of magnesia. Generally, the high-calcium and highly dolomitic types are used in lime production. Most lime is sold as a chemical.

In chemistry and metallurgy, high-calcium limestone is usually desired. It is used as a flux in smelting ferrous and non-ferrous ores and in the preparation of bisulphite liquor for processing paper pulp. This rock type is a raw material in the production of glass and other ceramic products and serves as a filler in the manufacture of paint, linoleum, rubber, plastics, paper, gypsum, asbestos and asphalt products. The high-dolomitic type is used in smelting ferrous ores, in processing paper pulp, and in the production of glass. Dominion Magnesium Limited uses this rock in the production of magnesium metal near Haley, Ontario, and, Steetley of Canada Limited dead-burns dolomitic limestone near Dundas, Ontario, for use as a refractory for open-hearth and electric furnaces. Aluminum Company of Canada, Limited, quarries brucitic limestone near Wakefield, Quebec, and recovers magnesia and lime from it. The magnesia is for refractory, agricultural, and chemical use. Brucitic limestone also serves as chemical stone at pulp mills.

The agriculture industry uses calcium and dolomitic types to control soil acidity and to serve as sources of calcium, magnesium, and other elements. Limestone is also used in manufactured fertilizers and in poultry and stock feed. For all agricultural purposes the rock is pulverized or finely crushed. Marl is also used as a soil additive in several provinces.

PRICES AND TARIFFS

Prices depend on many factors and vary according to location, local supply and demand, quantity of sale, type, quality, and degree of preparation. Limestone screenings may be sold for as little as 50 cents a ton, whereas finished ornamental limestone may be valued at more than $90 a ton. Most limestone, in the crushed form, sells for about $1.25 a ton at the plant. Dry-ground whiting substitute is marketed for about $12 a ton at the plant. Owing to transportation costs, the final price for such a low-priced commodity is usually much greater than plant price.

Canada has no import tariff on crushed limestone from countries in the British preferential or most favored nation categories. For countries in the general category there is a 25 per cent ad valorem tariff.

Import tariffs on limestone entering the United States are as follows:

Crude, broken or crushed when imported for use in manufacture of fertilizers	free
Not suitable for use as monumental or building stone; crude or crushed, but not pulverized	1 1/8¢ per 100 lb
Suitable as monumental or building stone	
Dressed	21%
Unmanufactured, rough	4 1/2¢ per cu ft.

Two of these United States tariffs have been reduced since 1961. For the "crude or crushed, but not pulverized" category the rate has been decreased from 1 1/4 cent per 100 pound and for the last-mentioned category the previous rate was 7 1/2 cent per cubic foot.

Lithium Minerals

J.E. Reeves*

The year 1962 was marked by a continued development of Quebec Lithium Corporation's chemicals operation at the mine site north of Val d'Or. The installation of new equipment, including a second autoclave, in the lithium-carbonate plant will make possible an eventual capacity of about three million pounds of lithium carbonate a year. Regular production of lithium hydroxide monohydrate was not attained during the year, but a modified circuit will be in operation late in 1963.

The mine, concentrator and decrepitator were operated intermittently at a fairly high rate, and decrepitated spodumene concentrate is being stockpiled at the head of the lithium-carbonate circuit. A large new storage bin was built to accommodate the stockpile.

PRODUCTION AND TRADE

Quebec Lithium Corporation's sales in 1962 consisted mainly of lithium carbonate. Shipments of ceramic-grade spodumene concentrate were discontinued early in the year and production at the concentrator was thereafter restricted to chemical-grade spodumene concentrate for the company's own consumption.

A large proportion (reportedly 70 per cent) of the lithium carbonate shipments were exported to the United States. Small quantities were shipped to Britain and to domestic markets. In Britain, high-quality, relatively inexpensive lithium carbonate from Canada undersold lithium carbonate from all other sources. This resulted in a general decline in the price and in the imposition of an anti-dumping duty of 14 cents a pound on the Canadian product.

Available data on imports of lithium chemicals in 1961 indicate that about $100,000 worth of lithium chemicals - mainly lithium hydroxide monohydrate, lithium carbonate and lithium bromide - were shipped to Canada. These imports can be expected to decline.

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*Mineral Processing Division, Mines Branch.

OCCURRENCES IN CANADA

Quebec

Quebec Lithium Corporation's property in Lacorne township, north of Val d'Or, contains one of the largest spodumene deposits in the world. It consists of an extensive family of parallel pegmatite dikes containing proven reserves of more than 20 million tons with an average of 1.15 per cent lithia (Li_2O).

Lithium-bearing pegmatites occur in other parts of Lacorne township and in the neighboring Figuery and Landrienne townships. They are associated with the contact of a large granitic intrusive mass known as the Lacorne batholith. Spodumene is the main lithium mineral in this area, although there are small amounts of lepidolite and lithiophilite.

A pegmatite with a high spodumene content occurs about 80 miles northwest of Chibougamau, near Assinica Lake.

Manitoba

Numerous lithium-bearing pegmatites occur in the Winnipeg River-Cat Lake area, in the southeastern part of the province. The most significant occurrence is that of Chemalloy Minerals Limited, on the north shore of Bernic Lake. Its flat dip and unusual mineral assemblages make it notably different from most other Canadian deposits. Zones containing large quantities of spodumene, lepidolite and amblygonite and an unusual concentration of the cesium mineral, pollucite, make this deposit one of considerable interest. Lithium-mineral reserves have been estimated at nine million tons containing more than two per cent Li_2O.

Other Occurrences

Many occurrences of spodumene-bearing pegmatites have been discovered in several areas of northwestern Ontario, most notably in the Beardmore area, near Lake Nipigon. In the Northwest Territories to the north and east of Yellowknife, pegmatites containing spodumene, lesser amounts of amblygonite, minor amounts of other lithium minerals, and beryl and columbite-tantalite have been described.

WORLD RESOURCES AND PRODUCTION

The United States is the dominant producer and consumer of lithium minerals, chemicals and metal. Its domestic sources of raw material are the large spodumene-bearing pegmatites in North Carolina and the vast brine deposits of Searles Lake, California, from which byproduct dilithium sodium phosphate is obtained. The reserves in both areas are very large. Production in 1962 was slightly lower than in 1961.

Southern Rhodesia is the principal source of lepidolite and petalite, a large part of which is exported to the United States for direct use in the ceramic industry. It also produces small quantities of spodumene, amblygonite and eucryptite. Southern Rhodesia has sizeable reserves of these minerals.

TECHNOLOGY

Lithium is a not uncommon constituent of the earth's crust, but it generally occurs in commercial concentrations only in granitic pegmatites in certain areas. The accompanying table includes most of the lithium minerals, the first four being the principal economic members.

PRINCIPAL LITHIUM MINERALS

Mineral	Simplified Formula	Theoretical Li_2O Percentage	Actual Range Li_2O Percentage
Spodumene	$LiAlSi_2O_6$	8.0	4 - 7.5
Petalite	$LiAlSi_4O_{10}$	4.9	3 - 4.5
Lepidolite	$KLi_2AlSi_4O_{10}(F,OH)_2$	7.7	3 - 5
Amblygonite	$LiAlFPO_4$	10.1	7.5 - 9
Eucryptite	$LiAlSiO_4$	11.9	5.5 - 6.5
Zinnwaldite	$KLiFeAl_2Si_3O_{10}(F,OH)_2$	3.4	2 - 3
Lithiophilite-triphylite	$Li(Mn,Fe)PO_4$	9.6	2 - 6

In North America the chief method of concentrating spodumene is flotation. In Southern Rhodesia, where the various lithium minerals occur in a high degree of natural concentration, handpicking is used.

Most spodumene concentrate, part of the other mineral concentrates and all the byproduct dilithium sodium phosphate, are converted to various lithium chemicals, principally lithium carbonate and lithium hydroxide monohydrate. A small proportion of the spodumene and much of the petalite and lepidolite are consumed directly by the ceramic industry. Petalite is a source of lithia with a low potash, soda and iron content; lepidolite, with its lithia and fluorine content, is a low-melting source of alumina. Relatively little lithium metal is produced.

During 1962, Canadian patent 643,843, which describes an exceptional process for producing lithium carbonate from lithium-mineral concentrates, was issued. It attracted considerable attention. In brief, high-temperature, or beta, spodumene is reacted with an aqueous solution of sodium carbonate to produce lithium carbonate and sodium aluminosilicate; the lithium carbonate is converted to soluble lithium bicarbonate with carbon dioxide and the insoluble aluminosilicate is filtered off; and high-purity lithium carbonate is precipitated by driving off carbon dioxide. Close control of temperatures, pressures and concentrations is important.

USES

The ceramics industry is a principal consumer of lithium chemicals, especially of lithium carbonate, and the sole consumer of lepidolite, petalite and spodumene concentrates. These chemicals and concentrates are important primarily because of their content of lithia, a very strong flux, the carbonate being used when a high percentage of lithia is required. Lithia permits the development of low-temperature bodies that reduce the cost of refractories and fuel. It lowers the maturing temperature and increases the fluidity and gloss of glasses, glazes and enamels. It makes possible glasses that are harder and that have higher electrical, chemical and thermal resistance.

Another important use is in the manufacture of lubricating greases. Lithium stearate, which is derived from lithium hydroxide monohydrate, combines the best characteristics of sodium and calcium soaps, permitting the greases to be effective over a wide range of temperatures, from -60°F to +320°F, and to be highly water-resistant.

Lithium chloride and lithium bromide are becoming increasingly important in air-conditioning and refrigeration. They are extremely hygroscopic and are used primarily for moisture absorption.

Lithium hydroxide monohydrate is added to the electrolyte in nickel-iron alkaline storage batteries to increase their life and output; lithium chloride and fluoride are added to welding and brazing fluxes to remove the oxide film from aluminum and magnesium surfaces.

Lithium as a metal has few applications. It is used as a scavenger of oxygen, nitrogen and sulphur in copper and in some brasses and bronzes, and as a reducing agent in the synthesis of vitamins and antihistamines. Butyl lithium is used as a catalyst in the production of synthetic rubber.

PRICES

Prices of the principal lithium chemicals, per pound, according to Oil, Paint and Drug Reporter of December 31, 1962, were:

Lithium carbonate	$0.58
Lithium hydroxide monohydrate	0.54
Lithium chloride	1.23 1/2
Lithium bromide	2.60
Lithium fluoride	1.55
Lithium stearate	0.47 1/2

E & M J Metal and Mineral Markets of December 31, 1962, gives the selling price of lithium metal, 99.5 per cent, as $9 to $11 a pound.

Magnesite and Brucite

J. S. Ross*

Considerable interest was shown in magnesite deposits in British Columbia and Ontario during the year. A.P. Green Fire Brick Company, Limited, diamond drilled and sampled an occurrence near Brisco, southeastern British Columbia, and Canadian Magnesite Mines Limited explored a newly found occurrence in Deloro and Adams townships, Ontario. The quality of these deposits is of interest because outcrops of the former have a high magnesia content and the latter contains an insignificant amount of calcium oxide, a most objectionable impurity in refractories.

Canada's production value of dead-burned and caustic calcined magnesia reached a record of $3,431,873 in 1962. It was up five per cent from the previous peak of 1960. Production, all from Quebec, consisted of dead-burned magnesia from a magnesite-dolomite deposit and of calcined magnesia from brucitic limestone.

World production closely parallels the demands of the metallurgical industry. According to the United States Bureau of Mines Minerals Yearbook 1962, total production of "crude magnesite" in 1962 was 8.2 million short tons. More than two thirds of this was supplied by Russia, Austria and China in that descending order. In addition, an unknown quantity of magnesia from brine and sea water was produced. About three quarters of the United States output was derived from these sources.

Magnesia and its products command prices which allow them to be traded widely throughout the world. There are no separate Canadian export statistics for these materials. In 1962 Canada exported 1,243,060 tons of crude refractory materials valued at $2,350,853, principally to the United States. Little of that was magnesia. In 1962, according to United States trade statistics, Canada exported to that country, 4,439 tons of magnesia-lime refractory material and 14,982 tons of magnesia brick and shapes, the total value being $2,654,062.

Canada's imports of magnesium compounds were substantial in 1962. They were valued at $3,317,428 and came mostly from the United States. Most of this was dead-burned magnesia and the remainder consisted of salts, fire-brick, caustic calcined magnesia, magnesium carbonate, magnesium sulphate and pipe covering.

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*Mineral Processing Division, Mines Branch.

Table 1

MAGNESITE AND BRUCITE - PRODUCTION AND TRADE

	1961		1962	
	Short Tons	$	Short Tons	$
PRODUCTION(a) (Quebec)				
Dolomitic magnesite and brucite		3,064,403		3,431,873
IMPORTS				
Magnesia, dead-burned and sintered.............				
United States	17,454	1,455,663	16,961	1,395,563
Britain..................	22	2,691	3,629	241,264
Yugoslavia	4,405	245,048	2,230	132,182
Austria	-	-	1,984	141,374
West Germany...........	-	-	33	2,478
Republic of South Africa ..	-	-	16	3,252
Italy	63	4,665	-	-
Total..................	21,944	1,708,067	24,853	1,916,113
Magnesia, caustic calcined				
United States	2,724	185,890	2,581	204,059
Netherlands	15	899	108	6,559
Austria	70	3,672	22	1,324
India	27	4,535	2	392
Total..................	2,836	194,996	2,713	212,334
Magnesian firebrick				
United States		356,201		233,320
West Germany...........		75,266		125,844
Britain		60,011		99,869
Total		491,478		459,033
Magnesium carbonate and magnesium oxide				
United States............	981	110,456	663	88,467
Britain	216	35,468	211	38,848
Total	1,197	145,924	874	127,315
Magnesium salts				
United States	1,683	379,082	1,878	439,946
Britain	66	39,494	152	62,381
West Germany	125	5,636	83	7,019
Austria	-	-	3	3,681
Italy	-	491	-	-
Total	1,874	424,703	2,116	513,027

Table 1 (cont'd.)

	1961		1962	
	Short Tons	$	Short Tons	$
IMPORTS (cont'd.)				
Magnesium sulphate, or Epsom salts				
West Germany	1,849	37,104	2,065	45,845
United States	667	27,645	712	33,294
Britain	75	4,775	29	2,250
Total	2,591	69,524	2,806	81,389
Magnesia pipe covering				
United States		22,330		8,217
EXPORTS				
Crude refractory materials(b)				
United States	808,628	1,711,929	1,242,970	2,348,213
Britain	130	7,428	90	2,640
Total	808,758	1,719,357	1,243,060	2,350,853
Imported by United States(c)				
Magnesia, dead-burned	685	255,515	-	-
Refractory material of magnesia and lime	4,234	224,393	4,439	237,360
Magnesia brick and shapes	13,183	2,157,523	14,982	2,416,702

Source: Dominion Bureau of Statistics except where otherwise indicated.
(a) Includes the value of brucitic magnesia shipped, and of dead-burned magnesia and a small quantity of serpentine used or shipped.
(b) Mainly includes materials other than magnesia.
(c) Not recorded separately in the official Canadian trade statistics. The figures shown are reported in United States Imports of Merchandise for Consumption (Report FT 110). These materials are also exported from Canada to other countries, but the quantities are not available.
Symbol: - Nil.

Table 2

MAGNESITE AND BRUCITE - PRODUCTION*, 1953-62

	$
1953	2,016,640
1954	1,909,163
1955	2,151,820
1956	2,783,181
1957	3,046,298
1958	2,529,161
1959	3,050,779
1960	3,279,021
1961	3,064,403
1962	3,431,873

* Brucitic magnesia shipped and dead-burned magnesia and a small quantity of serpentine used or shipped.

PRODUCTION

Canada's sole production of high-purity magnesia originates from two plants in Quebec. One plant markets calcined magnesia and the other the dead-burned product.

At Kilmar, Canadian Refractories Limited mines a rock comprised mainly of magnesite, dolomite and serpentine. The ore is mined by underground methods, beneficiated in a heavy-media separation plant, dead-burned, and crushed and sized. Most is consumed in the manufacture of basic refractories at the company's nearby plant at Marelan. The remainder is either marketed domestically or exported, mainly to the United States, for refractory use, principally in open-hearth furnaces.

There has been no production from other magnesite deposits in British Columbia, the Northwest Territories, Saskatchewan, Ontario, Quebec, Nova Scotia and Newfoundland.

Calcined magnesia is produced by Aluminum Company of Canada, Limited, near Wakefield, Quebec. The source rock is brucitic limestone, which is calcined after being crushed and sized. The product is hydrated, then separated into magnesia and hydrated lime. After being classified into various grades, the magnesia is sold for use in refractories, fertilizers, chemical processing and for other minor industrial applications.

Brucitic limestone was also produced near Rutherglen, Ontario, but it was shipped in crude form as a direct source of magnesia rather than for the production of the compound, magnesia. Brucite has been noted in other areas of Ontario and Quebec and in British Columbia and Nova Scotia. Finished products, high in magnesia, are produced and marketed from four plants in Canada. Some of these plants are wholly dependent upon imported magnesia. Canadian Refractories Limited at Marelan, Quebec, and General Refractories Company of Canada Limited at Smithville, Ontario, produce basic refractory mixes, bricks and other shapes. Refractories Engineering and Supplies Limited prepares basic refractory mixes at Bronte, Ontario. Norton Company manufactures fused magnesia at Chippawa, Ontario.

DEVELOPMENTS

Normally, exploration for magnesite receives little attention in Canada. However, as previously mentioned, two deposits were of particular interest in 1962.

Canadian Refractories Limited developed two new basic refractory products. One is a tar-bonded brick composed mainly of domestic clinker for use in oxygen converters. The other is an exceptionally high magnesia product for use at unusually high temperatures.

TECHNOLOGY

The minerals, magnesite and brucite, theoretically contain 47.6 and 69.0 per cent magnesia, respectively. They may be converted to magnesia by calcination. Dolomite, sea water, sea-water bitterns and other brines may also be processed into magnesia. Since 1954 there has been an appreciable increase in the recovery of this commodity from brines and sea water in the United States. High-purity products are derived by the calcination of magnesium hydroxide or magnesium chloride resulting from treatment of these solutions.

Calcined and dead-burned magnesia are the two semi-processed products used by industry. The former is chemically active and a product of mild calcination. The latter forms during intense calcination and is chemically inactive. Periclase is dead-burned magnesia containing minor amounts of iron and a minimum of 92 per cent magnesia.

As with most industrial minerals, the specifications are becoming more stringent. Consumers are requesting higher magnesia and lower calcium and silica contents mainly because of the increased temperatures being used.

CONSUMPTION AND USES

Official consumption statistics for magnesia in Canada are unavailable. It is estimated that about 70,000 tons of the dead-burned and calcined types are consumed annually. Of this, about 62,000 tons or more would be used in refractories and up to 8,000 tons for other purposes. More than one third of the total consumption is imported.

Dead-burned magnesia, the most popular type, is used almost entirely in the production of refractory products. Its outstanding characteristic is its ability to withstand the effects of basic slags for reasonable periods. For this reason it is employed as an ingredient in basic refractory bricks and shapes, hearth clinker, gunning and ramming mixes, cements and mortars.

The application of calcined magnesia is expanding as an ingredient in the dissolving liquor for paper-pulp manufacture. On occasion, calcined magnesia is used as a raw material in the production of the dead-burned product for eventual use in refractories. It is a source of magnesium metal and an ingredient in magnesium-oxychloride and magnesium-oxysulphate cements. The compound is also used to control acidity in chemical processing, as a constituent of manufactured fertilizers, and in the production of heating elements, rayon, rubber, petrochemicals, magnesium chemicals, welding-rod coatings and certain types of insulation. Research on new applications and on methods for the development of higher quality calcined magnesia is expanding.

Because of the trend toward increased application, the future for magnesia appears very promising.

PRICES AND TARIFFS

Prices vary depending on quality and demand. The December 31, 1962, issue of E & M J Metal and Mineral Markets quotes the following general United States prices per short ton. These have been unchanged since 1959.

Magnesite, crude, bulk, carload lots	$27.50
Magnesia, calcined, pebble	$37.50
Magnesia, dead-burned, grain, f.o.b. Chewelah, Wash.	
In bulk	$46.00
In bags	$52.00

Canadian and United States tariffs on many of the magnesium compounds are as follows:

Canada	British Preferential	Most Favored Nation	General
Magnesite, crude rock	free	free	free
Magnesia, dead-burned or sintered; magnesia, caustic calcined; plastic magnesia	15%	15%	30%
Magnesium carbonate, basic or otherwise, excepting crude rock, not otherwise provided for	20%	20%	30%
Magnesium carbonate, imported for use in the compounding or manufacture of rubber products	free	20%	30%
Magnesium oxide and magnesium carbonate, not further manufactured than ground, when imported by manufacturers of insulating materials for use exclusively in the manufacture of such insulating materials in their own factories	free	free	free
Dead-burned dolomite	15%	15%	25%

Tariffs (Cont'd.)

United States

Crude magnesite	15/64¢ per lb
Caustic calcined magnesia	15/32¢ per lb
Dead-burned and grain magnesia, and periclase, not suitable for manufacture of oxychloride cements	23/60¢ per lb
Magnesia brick	3/8¢ per lb and 5% ad valorem
Magnesium carbonate, precipitated	0.425¢ per lb
Magnesium chloride, anhydrous	1¢ per lb
Magnesium chloride, not specifically provided for	0.48¢ per lb
Magnesium oxide or calcined magnesia	2.25¢ per lb
Magnesium sulphate (Epsom salts)	3/8¢ per lb
Manufactures of carbonate of magnesia	1¢ per lb
Dolomite ore, crude	free

Magnesium

W.H. Jackson*

Dominion Magnesium Limited is the only magnesium producer in Canada. For the fourth consecutive year the company reported increased smelter production, which in 1962 amounted to 9,526 tons. Shipments were correspondingly high at 9,458 tons in 1962, 7,802 tons in 1961 and 7,426 tons in 1960. In Table 1 and 2, all data are as reported by the Dominion Bureau of Statistics.

Exports increased 9 per cent to 6,571 tons of which 92.9 per cent was marketed in western Europe. Britain took 4,907 tons, down slightly from 1961. Canadian ingot enters Britain duty free; other producers, except Norway pay a duty of 10 per cent. Norway, the only producer in the European Free Trade Association, pays a 6-per-cent tariff. In the highly competitive market of mainland Europe, the production from France, Italy, and Germany is consumed internally, the main consumer being Volkswagen in Germany. Norway and the United States are the main overseas suppliers to the continent; Canada supplies most of British imports of magnesium. A 3-per-cent tariff was established in 1962 by Germany as a member of European Economic Community. By 1970 the ultimate common external tariff of the 6 member countries will be 10 per cent. Negotiated revisions under the General Agreement on Tariffs and Trade resulted in a cut in the United States tariff from 50 to 45 per cent ad valorem by June 30, 1962. There are no competitive shipments from Canada to the United States market. The shipments, listed in Table 1, result from defence sharing arrangements.

Canadian import needs are mainly supplied by the United States. According to the U.S. Department of Commerce, metal exports to Canada in 1962 totalled 1,508 tons valued at $870,436 and semi-fabricated products totalled 158 tons valued at $417,422. The main item in the latter category was sheet upon which the Canadian duty is suspended. U.S. exports of metal, scrap, and semi-fabricated froms to all countries totalled 5,315 tons.

Magnesium ingot consumed in Canada, including imports, increased to 3,614 tons from 2,776 tons in 1961. The largest gain was in alloying with aluminum, followed by an increase in demand for extrusions and anodes.

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*Mineral Resources Division.

Table 1

MAGNESIUM - PRODUCTION, TRADE AND CONSUMPTION

	1961		1962	
	Short Tons	$	Short Tons	$
PRODUCTION (metal)	7,635	4,307,570	8,816	4,821,823
IMPORTS (alloys)				
United States		416,538		176,099
Britain		10,028		2,658
Total		426,566		178,757
EXPORTS (metal)				
Britain	5,465	3,188,691	4,907	2,796,590
West Germany	na	231	950	573,332
United States	53	84,121	212	253,260
France	119	100,558	141	130,939
Poland	77	43,210	123	66,580
Belgium and Luxembourg	3	1,866	70	39,382
Czechoslovakia	143	79,330	56	31,260
Switzerland	33	19,719	36	20,710
Australia	na	86	23	13,454
Other countries	137	90,711	53	42,425
Total	6,030	3,608,523	6,571	3,967,932
CONSUMPTION (metal)				
Castings	395		252	
Extrusions (structural shapes, tubing)	251		556	
Aluminum alloys	1,604		2,175	
All other products*	526		631	
Total	2,776		3,614	

Source: Dominion Bureau of Statistics.

* Including other alloys and magnesium used for cathodic protection and as a reducing agent.

na Not available.

Table 2

MAGNESIUM - PRODUCTION, TRADE AND CONSUMPTION, 1953-62

	Production (short tons)	Imports(b) $	Exports $	Consumption(d) (short tons)
1953	a	144,253	c	1,414
1954	a	99,944	c	1,308
1955	a	186,034	4,887,980	833
1956	9,606	366,837	5,153,509	1,003
1957	8,385	276,742	4,535,570	840
1958	6,796	255,768	2,871,991	711
1959	6,102	273,021	3,879,588	1,668
1960	7,289	336,548	3,232,805	2,199
1961	7,635	426,566	3,608,523	2,776
1962	8,816	178,757	3,967,932	3,614

Source: Dominion Bureau of Statistics.

(a) Production statistics for 1953 to 1955 inclusive are not available for publication. (b) Magnesium alloys. (c) Statistics for 1953 and 1954 are not separately available. (d) Increased consumer coverage for 1959 and the years following.

Dominion Magnesium Limited completed smelter expansion at Haley, Ontario, raising capacity from 8,000 to 10,000 tons a year by the addition of 4 natural-gas-fired furnaces that became fully operational by March; it also converted one of the 10 electric furnaces to gas.

Ore supplies for the Haley smelter are ample. Dolomite of exceptional purity, averaging 21 per cent magnesium oxide, is quarried nearby. In the mill, whose capacity is 225 tons a day, the ore is ground, sized and calcined. Magnesium is obtained by the thermal reduction of a pellet mixture, consisting of calcined dolomite and ferrosilicon, in retorts evacuated to low pressure. Other metals produced by similar methods but from different raw materials are calcium, strontium, barium, titanium, zirconium and thorium.

The following grades and purities of magnesium are available: standard, 99.5 per cent; special, 99.97 per cent; and refined, 99.99 per cent. These are produced in 20-pound, 5-pound, and 1-kilogram ingots, as billets from 4 to 20 inches in diameter, and as granules in minus 4 plus 50 mesh size. The other magnesium products are rods, bars, wire and structural shapes.

WORLD DEVELOPMENTS

Three companies, with a combined capacity of 96,000 tons, produce metal in the United States: the Dow Chemical Company (85,000 tons capacity) by electrolysis of magnesium chloride derived from seawater; and Alabama Metallurgical Corporation (7,000 tons) and Charles Pfizer Company by thermal reduction (4,000 tons). The latter operates the Nelco Metals Inc. plant at Canaan, Connecticut. United States ingot shipments were 69,410 tons in 1962 (55,525 tons in 1961). Production rose substantially to 68,955 tons from 40,745 tons, following depletion of excess inventories.

In Britain production from the new 5,000-ton-a-year plant of Magnesium Elektron Limited is expected in 1963. In Japan, Asahi Chemical suspended primary production leaving the Furukawa Magnesium Company - capacity 4,500 tons - as the only producer. Primary production was 2,086 metric tons; the five secondary producers - Toho Titanium, Nihon Soda, Sumitomo Chemicals, Asahi Chemical and Osaka Titanium produced 2,038 tons. Norsk Hydro-Elektrisk in Norway, following expansion, has 19,000 tons capacity at its Heroya plant. At Bolzano, Italy, Societa Italiana per il Magnesio e Leghe di Magnesio, S.P.A., has a capacity of 7,000 tons. Eastern Bloc countries are believed to have 50,000 tons of annual capacity.

Table 3

WORLD PRODUCTION OF MAGNESIUM
(short tons)

	1960	1961	1962
United States	40,070	40,745	68,955
U.S.S.R.	27,600	34,000	35,000
Norway	11,373	16,018	16,500
Canada	7,289	7,635	8,816
Italy	6,003	6,167	6,200
Britain*	4,119	4,200	4,200
Japan	2,363	2,477	2,300
France	2,359	2,282	2,400
China	1,100	1,100	1,100
West Germany	330	440	440
Poland		165	
Total, world	102,600	115,100	146,000

Source: U.S. Bureau of Mines; Canada, Dominion Bureau of Statistics.

*Includes remelt.

USES

Magnesium is potentially one of the readily available metals as it can be extracted from seawater, dolomite or magnesite. For many potential uses aluminum and zinc are established and competitive.

A major use in Canada is in aluminum-base alloys that possess high strength and resistance to corrosion. Other destructive applications are the cathodic protection of steel structures by magnesium anodes, pyrotechnics, the production of nodular cast iron, and its use as a reducing agent in the production of uranium, titanium, beryllium, zirconium and platinum.

Magnesium-base alloys that contain aluminum, zinc and manganese are used in castings and extrusions. For high-temperature and high-strength applications, alloys containing zirconium and thorium as additives have been developed.

End products range from ladders to aircraft engine components. A new product is diamond drill-rods. The use of magnesium in die castings for small engines and appliances is increasing.

Research on magnesium-lithium alloys is continuing and tests of armor plate for a prototype personnel carrier are underway in the United States.

The only rolling mill for magnesium sheet in North America has never operated at capacity. Lightweight suitcases, shovels, and dockboards are examples of products made from sheet.

PRICES

In 1962, representative base prices for magnesium were as follows: Canada, f.o.b. Haley, 31 cents a pound; United States, in 5-ton lots f.o.b. Velasco, Texas, for consumption in the United States, 35.25 cents a pound; Britain 10 tons and over, delivered, 2s. 3d. a pound. Comparative prices in £ per long ton were as follows: Canada 227, Britain 252, United States 288, Italy 302, France (tax included) 418.

TARIFFS

Canada	British Preferential	Most Favored Nation	General
Sheet or plate of magnesium or alloys of magnesium, plain, corrugated, pebbled, or with a raised surface pattern for use in Canadian manufacturing........................	free	free	25%
Alloys of magnesium, viz: ingots, pigs, sheets, plates, strips, bars, rods, and tubes	5%	10%	25%
Magnesium scrap...................	free	free	free

Tariffs (cont'd.)

United States

Metallic magnesium and metallic magnesium scrap (duty on scrap suspended until June 30, 1963)......	45%
Magnesium alloys, powder, ribbons, sheets, tubing, wire, and all other articles of magnesium not specifically provided for	18¢ per lb on magnesium content plus 9% ad valorem.
Other magnesium alloys, magnesium content..........................	15¢ per lb plus 7 1/2% ad valorem.

United Kingdom	Commonwealth	Most Favored Nation
Unwrought magnesium	free	10%

European Economic Community	Ultimate common external tariff
Unwrought magnesium	10%
Waste	5%
Scrap	0%

Manganese

V. B. Schneider*

In 1962, Canadian imports of manganese ore increased for the third consecutive year. The imports amounted to 90,725 tons valued at $4,037,672, 14,709 tons and $581,359 more than the previous year. Imports of ferro- and silico-manganese valued at $2,931,399 exceeded those of 1961 by $625,063, indicating the serious competition faced by Canadian producers for domestic markets. Added to the problems created by competition from foreign imports, exports of ferromanganese at 136 tons were the lowest since 1946 when the Dominion Bureau of Statistics first reported exports of ferromanganese as a separate classification. Consumption of manganese ore at 85,410 tons, an increase of 6,768 tons over 1961, reflected a record steel production by the primary iron and steel industry. Consumption of ferromanganese at 52,284 tons was also an all time high.

There are more than a hundred manganese minerals but only a few are of commercial significance. These are mostly oxides; the most common being pyrolucite (MnO_2), psilomelane ($MnOMnO_2.2H_2O$), manganite ($Mn_2O_3.H_2O$) and hausmannite (Mn_3O_4). Rhodocrocite ($MnCO_3$) and rhodonite ($MnSiO_3$), a carbonate and silicate, are also mined commercially.

No manganese ore is produced in Canada. In the past, small amounts have been mined from bog deposits in New Brunswick, Nova Scotia and British Columbia. Large low-grade deposits in New Brunswick and Newfoundland may, in time, through technological advances, become economically important. The most notable, situated near Woodstock, New Brunswick, has been estimated to contain more than 50 million tons grading 11 per cent manganese and 14 per cent iron.

Strategic Materials Corporation, through its subsidiary, Stratmat Ltd., owns the Woodstock deposit and Strategic-Udy Metallurgy Limited, controlled by Stratmat, has conducted research in an attempt to find a method of processing the ore economically. However, because of the depressed conditions prevailing in the ferroalloy industry in North America the project has been abandoned for the time being.

In 1962 Chromium Mining & Smelting Corporation, Limited, completed the installation of two 15,000-kilowatt submerged-arc furnaces, one at its plant at Beauharnois, Quebec, the other at the plant at Memphis, Tennessee. Late in the year it ended production at its Spokane, Washington, plant which was operated since 1940 by a subsidiary, Pacific Northwest Alloys Inc.; the lease agreement on the plant was terminated and the facility returned to the United States government.

*Mineral Resources Division.

Table 1

MANGANESE - TRADE AND CONSUMPTION, 1961 and 1962
(short tons - 2,000 pounds)

	1961		1962	
	Short Tons	$	Short Tons	$
IMPORTS				
Manganese ore				
Ghana	25,484	1,080,474	49,632	1,918,664
United States	6,388	691,595	28,013	1,539,797
Brazil	16,785	701,392	10,746	460,316
Greece	-	-	1,308	41,251
India	13,291	350,582	893	25,087
Britain	44	22,579	65	27,765
Japan	83	32,712	61	24,175
France	13	1,410	7	617
French West Africa	13,928	584,569	-	-
Total	76,016	3,465,313	90,725	4,037,672
Ferromanganese under 1% silicon				
Republic of South Africa	9,672	1,268,512	12,051	1,699,327
Japan	1,438	376,562	1,386	378,147
France	387	132,128	1,048	299,595
United States	513	136,223	484	99,314
Britain	55	14,317	17	7,952
Italy	56	16,475	-	-
Total	12,121	1,944,217	14,986	2,484,335
Silicomanganese over 1% silicon				
United States	1,115	189,434	1,090	166,573
Japan	668	118,891	692	106,438
Yugoslavia	56	7,650	346	50,040
Norway	-	-	213	32,316
Mexico	-	-	160	32,548
West Germany	2	994	113	29,232
France	-	-	112	29,917
Belgium and Luxembourg	332	45,150	-	-
Total	2,173	362,119	2,726	447,064

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Table 1 (cont'd.)

	1961		1962	
	Short Tons	$	Short Tons	$
EXPORTS				
Ferromanganese				
United States	216	36,008	123	17,975
Colombia................	22	7,988	13	2,575
Total	238	43,996	136	20,550
CONSUMPTION				
Manganese ore				
Metallurgical grade	76,620		83,490	
Battery and chemical grade	2,022		1,920	
Total	78,642		85,410	

Source: Dominion Bureau of Statistics.
Symbol: - Nil.

WORLD PRODUCTION AND TRADE

The United States Bureau of Mines estimates that world production of manganese ore in 1962 amounted to about 15.6 million short tons* a slight increase over 1961 when it reported world production at about 15.1 million tons.

Manganese ore reserves in Russia, which leads in manganese-ore production, are estimated to constitute more than half the world's total. Most of the remaining known manganese deposits are in India, South Africa, Ghana, Gabon, Brazil and British Guiana. India's and Brazil's reserves have each been estimated at 100 million tons, and Gabon's at 160 million tons. Estimates of world manganese reserves are only approximations; they are believed to exceed 1,000 million tons.

The United States, the leading importer and consumer of manganese ore, took 1,971,232* tons in 1962, the lowest since 1951. Its four main suppliers were Brazil (823,714 tons), Ghana (204,245), the Republic of South Africa (195,804) and India (178,900). Mexico slipped to fifth position in 1962 from fourth in 1961.

United States ferromanganese production, like Canada's, has been depressed by imports. By late 1962, the increase in imports of ferroalloys coupled with an increase in imports of alloy steels had combined to force the operating level of U.S. ferroalloy makers down to 50 - 60 per cent of capacity.

*U.S. Bureau of Mines, Manganese Preprint 1962.

To prevent further distress, the industry early in 1963 appealed to its government for a limitation on imports of chromium and manganese ferroalloys to 7 1/2 per cent of the 1962 domestic consumption; this would be approximately equal to the average imports during the period 1956-1961 inclusive. E. J. Lavino and Company of Philadelphia, Pa. published a well-documented brochure titled 'Imports and the American Ferromanganese Industry' that explained the difficulties facing United States producers of ferromanganese.

According to the United States Bureau of Mines, imports of ferromanganese in 1962 amounted to 125,614 tons (gross weight) valued at $16,631,434*.

CONSUMPTION, USES AND SPECIFICATIONS

About 95 per cent of the world's output of manganese ore is used by the steel industry. The dry-battery industry accounts for three per cent and the chemical industry for the remaining two per cent.

The importance of manganese is due principally to its scavenging action in steelmaking furnaces since it is the cheapest material known for desulphurization and dephosphorization. In the proportion of one to two per cent, it increases strength and toughness in steel. In proportions of 12 to 14 per cent, it greatly increases toughness and resistance to wear and abrasion.

Electrolytic manganese, made in an electrolytic cell where the manganese is deposited on an electrode and stripped off as thin plates, is used in place of low-carbon ferromanganese to reduce the carbon content of stainless steels and thus eliminate the need for a carbon stabilizer. It serves the aluminum industry in the production of high-purity aluminum 'hardener' alloys; in brass mills it is added either as metal or as a 30-70 manganese-copper master alloy in the production of manganese bronzes. Improvements in technology in recent years now enable ferroalloy manufacturers to produce a low-carbon ferromanganese with 0.07 per cent carbon, maximum, and 85-90 per cent manganese at a price competitive with electrolytic manganese for many applications - particularly in the manufacture of the 200 series of stainless steels.

Metallurgical-grade Manganese Ore

Most of the manganese consumed by the steel industry is in the form of high-carbon ferromanganese. The remainder is in the form of low- and medium-carbon ferromanganese and of silicomanganese, spiegeleisen, manganese metal and ore in that order.

For making ferromanganese, the manganese-iron ratio should be 7:1 or more because the production capacity for the ferro-plant is handicapped as this ratio drops. High silica is undesirable because it increases the quantity of slag, which is attended by a manganese loss. In preparing their furnace charges, ferromanganese producers prefer to blend commercial ores to their own specifications. Since no single ore is generally considered ideal, consumers usually purchase ore from more than one source.

General specifications for metallurgical-grade manganese ore are a minimum of 48 per cent manganese and maxima of seven per cent iron, eight per cent silica, 0.15 per cent phosphorus, six per cent alumina and one per cent zinc. The ore should be in hard lumps of less than four inches and not more than 12 per cent should pass a 20-mesh screen.

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*U.S. Bureau of Mines, <u>Manganese Preprint 1962</u>.

Table 2

MANGANESE - TRADE AND CONSUMPTION, 1953-62

(short tons - 2,000 pounds)

	Imports			Exports	Consumption	
	Manganese Ore	Manganese Alloys		Ferromanganese	Ore	Ferromanganese
		Under 1% Silicon	Over 1% Silicon			
1953	66,682	1,044	18	683	69,533	31,379
1954	48,962	8,527	19	3,639	66,052	24,312
1955	175,282	3,945	272	29,404	113,075	32,358
1956	207,977	2,191	1,130	59,445	219,141	37,420
1957	131,318	743	2,257	46,733	195,088	37,906
1958	42,060	2,483	2,185	225	46,143	31,242
1959	118,454	2,334	2,989	193	90,311	40,976
1960	56,350	15,495	2,366	729	73,019	40,177
1961	76,016	12,121	2,173	238	78,642	44,545
1962	90,725	14,986	2,726	136	85,410	52,284

Source: Dominion Bureau of Statistics.

Table 3

WORLD PRODUCTION OF MANGANESE ORE, 1961 and 1962
(short tons - 2,000 pounds)

	1961	1962
U.S.S.R.	6,583,000e	7,000,000e
China (Communist)	1,100,000e	1,100,000e
Republic of South Africa	1,562,718	1,614,589
India	1,338,200	1,307,340
Brazil	1,101,699	900,000e
Ghana	431,282	513,622
Morocco	629,512	517,377
Republic of the Congo	348,595	348,547
Japan	335,236	340,259
Others	1,642,758	1,948,266
Total	15,073,000	15,590,000

Source: 1961 - United States Bureau of Mines, Manganese Preprint 1962.

Symbol: e Estimate.

Battery-grade Manganese Ore

Manganese ore for dry-cell use must be pyrolusite (MnO_2) of not less than 75 per cent MnO_2 and not more than 1.5 per cent iron; it should be very low in arsenic, copper, zinc, nickel and cobalt. The physical properties of the oxide are also important. It should be porous and moderately hard.

Chemical-grade Manganese Ore

Chemical-grade manganese ore should contain at least 35 per cent manganese. It is used to make manganese sulphate and manganese fertilizer, and in the production of other salts for use in the glass, dye, paint, varnish and photographic industries.

CANADIAN CONSUMERS

Union Carbide Canada Limited, Metals and Carbon Division, uses metallurgical-grade ore to manufacture silicomanganese and high- and low-carbon ferromanganese at its Welland, Ontario, plant. Chromium Mining & Smelting Corporation, Limited, produces manganese alloys at its Beauharnois, Quebec, plant.

The main consumers of ferromanganese are The Algoma Steel Corporation, Limited, Sault Ste. Marie, Ontario; Dominion Steel and Coal Corporation, Limited, Sydney, Nova Scotia; The Steel Company of Canada, Limited, and Dominion Foundries and Steel, Limited, both at Hamilton, Ontario; and Atlas Steels Company, a Division of Rio Algom Mines Limited, Welland, Ontario.

Electrolytic manganese imported from the United States is used by Atlas Steels Company in making low-carbon stainless steel. It is also used by the aluminum-, magnesium- and copper-alloy industries.

Consumers of battery-grade ore are National Carbon Limited and Mallory Battery Company of Canada Limited, both of Toronto; Burgess Battery Company Limited, Niagara Falls; and Ray-O-Vac (Canada) Limited, Winnipeg.

PRICES

Prices of manganese in the United States, according to E & M J Metal and Mineral Markets of December 31, 1962, were as follows:

Manganese ore	
Per long-ton unit, 46-48% Mn, c.i.f. U.S. ports, import duty extra	
Indian (max. Al + Si 13%)	80.00¢ to 85.00¢ (nominal)
South African (max. Al + Si 13% Fe 9%, P 0.05%)	80.00¢ to 85.00¢ (nominal)
Manganese metal	
Per lb, 99.9%, electrolytic, f.o.b. shipping point, freight allowed east of Mississippi, carload	31.25¢ to 33.75¢
Premium per lb for hydrogen removed	00.75¢
Ferromanganese	
Per lb contained Mn, carload lots, lump	
Standard (74-76% Mn), f.o.b. shipping point	9.50¢ to 11.00¢
Medium-carbon (80-85% Mn, 1 1/4 - 1 1/2% C), f.o.b. shipping point	24.00¢
Low-carbon (85-90% Mn, max. 0.07% C), basis as for medium-carbon	35.10¢
Silicomanganese	
Per lb, carload lots, lump, f.o.b. shipping point	
1.5% C max., 18 1/2 - 21% Si	10.6¢
2% C max., 16 - 18% Si	10.3¢
3% C max., 12 1/2 - 16% Si	10.10¢
Spiegeleisen	
Per gross ton, carload lots, lumps, f.o.b. Palmerton, Pa.	
3% Max. Si, 16 - 19% Mn	$88.00
3% Max. Si, 19 - 21% Mn	$90.00
3% Max. Si, 21 - 23% Mn	$92.50

TARIFFS

Canada	British Preferential	Most Favored Nation	General
Manganese ore	free	free	free
Ferromanganese (on Mn content)	free	1¢ per lb	1 1/4¢ per lb
Silicomanganese (on Mn content)	free	1 1/2¢ per lb	1 3/4¢ per lb

United States	
Manganese ore	1/4¢ per lb on Mn content
Ferromanganese*	
Not over 1% C	0.7¢ per lb on Mn content and 5% ad valorem
Over 1% C but under 4% C	15/16¢ per lb on Mn content
4% or more C	5/8¢ per lb on Mn content
Spiegeleisen	
Over 1% C	75¢ per long ton
Less than 1% C	15/16¢ per lb on Mn content and 7 1/2% ad valorem
Manganese metal	1 7/8¢ per lb on Mn content and 15% ad valorem

*These classes must contain 30 per cent or more Mn.

Mica

J. E. Reeves*

Total production of mica in Canada in 1962 was lower than in 1961, but generally at a level similar to the last eight years. In terms of volume, a relatively large proportion of this production was ground phlogopite and muscovite for domestic consumption; the highest value was borne by the small phlogopite sheet that was exported to Japan.

Canada is dependent on foreign sources for muscovite - most particularly India for muscovite sheet and the United States for wet-ground muscovite. In 1962, imports of unmanufactured mica reached 2,306,300 pounds, the highest level in history. By contrast, exports of phlogopite, mostly to Japan and the United States, declined to 200,200 pounds, the lowest level since before the turn of the century.

PRODUCERS

Small phlogopite sheet, phlogopite scrap, ground phlogopite and ground muscovite schist constituted Canadian production in 1962.

The phlogopite came from several deposits in southwestern Quebec and southeastern Ontario. Blackburn Brothers, Limited mined sheet phlogopite and dry-ground scrap phlogopite near Cantley, Quebec, a few miles from Ottawa.

Some ground muscovite was produced by Magcobar Mining Company, Limited, at Rosalind, Alberta, from muscovite schist that originated near Cedarside in east-central British Columbia.

WORLD REVIEW

There is a considerable amount of world trade in mica. Its unique physical characteristics make it important in industrial countries, many of which lack adequate resources or cheap experienced labor. India is widely accepted as the important source of high-quality muscovite.

TECHNOLOGY

The importance of mica in industry is due to its unusual physical characteristics. It has consistent and relatively high dielectrical properties, high temperature resistance and low thermal conductivity, and its perfect basal cleavage permits it to be readily split into very thin sheets that are flexible,

*Mineral Processing Division, Mines Branch.

Table 1

MICA - PRODUCTION, TRADE AND CONSUMPTION

	1961		1962	
	Pounds	$	Pounds	$
PRODUCTION (shipments)				
Trimmed	56,585	44,124	na	na
Sold for mechanical splittings..	24,577	6,925	na	na
Splittings	22,556	4,836	na	na
Rough, mine-run or rifted	73,541	3,975	na	na
Ground or powdered	1,434,097	63,435	na	na
Scrap and unclassified	204,804	2,082	na	na
Total	1,816,160	125,377	1,204,034	84,598
IMPORTS				
Unmanufactured				
United States	1,382,200	126,638	2,051,400	207,411
India	67,700	36,842	158,100	59,533
Britain.....................	20,000	853	78,400	3,509
Brazil	5,900	11,122	18,400	15,594
Total.....................	1,475,800	175,455	2,306,300	286,047
Manufactured				
United States		347,860		425,473
Britain		9,947		12,298
Mexico		642		1,298
Total		358,449		439,069
EXPORTS				
Rough and scrap				
Japan......................	113,000	48,747	74,400	29,040
United States	28,600	1,825	23,500	1,315
Belgium and Luxembourg	39,500	1,785	-	-
Total	181,100	52,357	97,900	30,355
Trimmed and ground				
United States	600	1,119	47,400	2,914
Japan	37,000	47,809	44,700	54,348
Brazil	-	-	10,200	7,201
Australia...................	3,200	5,522	-	-
Cuba	400	1,083	-	-
Venezuela	100	112	-	-
Total.....................	41,300	55,645	102,300	64,463

Table 1 (continued)

CONSUMPTION (available data)	1960 pounds	1961 pounds
Paints and wall-joint sealing compounds	2,210,000	2,178,000
Rubber	520,000	474,000
Asphalt products	204,000	652,000
Paper..................................	198,000	254,000
Electrical apparatus.......................	124,000	120,000
Other products	192,000	104,000
Total	3,448,000	3,782,000

Source: Dominion Bureau of Statistics.
Symbols: - Nil; na Not available.

Table 2

MICA - PRODUCTION, TRADE AND CONSUMPTION, 1953-62
(pounds)

	Production*	Imports**	Exports**	Consumption
1953	2,265,128		1,994,600	3,786,321
1954	1,706,770	232,700	771,200	3,429,848
1955	1,640,708	198,900	362,800	3,356,904
1956	1,843,811	324,900	277,800	4,524,810
1957	1,282,416	501,900	362,200	4,028,926
1958	1,504,933	1,047,700	300,100	3,547,396
1959	813,834	1,340,400	423,800	3,622,000
1960	1,702,605	1,838,800	488,800	3,448,000
1961	1,816,160	1,475,800	222,400	3,782,000
1962	1,204,034	2,306,300	200,200	na

Source: Dominion Bureau of Statistics.
*Producers' shipments.
**Unmanufactured mica.
Symbol: na Not available.

elastic, strong and generally transparent. The preparation of sheet mica is done mostly by hand and requires experience. When ground to a fine powder, mica retains its flaky particle shape, which is advantageous in its many uses as a filler and dusting agent.

High-quality muscovite possesses the best dielectric properties of all types of mica and is used extensively for insulation at high frequencies and voltages and in capacitors. Its high strength and transparency make it useful for glazing. It may be colorless, reddish, green or brown and is found in granitic pegmatites. The wet-grinding of select muscovite scrap and waste yields a polished, well-delaminated powder with a high reflectivity.

Phlogopite, or amber mica, varies considerably in dielectric strength, hardness, structural strength and other properties, but its superior thermal resistance gives it some value. It is found in parts of southwestern Quebec and southeastern Ontario, frequently in irregular veins with green apatite and pink calcite. Its properties vary relative to its composition, and it may range from almost colorless to a deep brown.

USES

Mica is used in three forms: natural sheet, splittings and ground mica.

Natural-sheet mica is used for insulation in electrical and electronic equipment and appliances for home and industry. In lesser amounts it is used in thermal insulation and for glazing boiler gauges and furnace windows. It is sold according to variety, size, and quality, depending on the intended application. A trend toward the use of substitute materials, where possible, has developed but the highest-quality muscovite is in increasing demand.

Mica splittings are used in the manufacture of built-up sheet, tape and cloth. To make built-up sheet, the splittings are bonded with a suitable resin into sheets of required size and the product is baked and pressed. Built-up sheet is used in place of natural sheet, within the limits of its dielectric characteristics, and may be cut or moulded into washers, tubes and other forms. More than 90 per cent of the splittings used are muscovite.

In recent years mica paper and mica board have been developed as substitutes for built-up sheet; essentially, their production follows paper-making techniques, frequently with an inorganic binder.

Most of the mica consumed is ground mica. Dry-ground mica, muscovite or phlogopite is used for dusting asphalt products, and rubber tires and tubes; as a filler in wall-joint sealing compounds and some paints; and as an aid against loss of circulation of drilling mud in oil-well drilling. Wet-ground muscovite is used as an extender pigment in paints, a filler in plastic products and hard rubber, a mould lubricant and dusting agent in the manufacture of rubber tires, and, to a minor extent, for adding decorative effects to wallpaper.

Table 3

WORLD PRODUCTION OF MICA - 1962
('000 pounds)

United States	215,765
India	68,757
Brazil	11,000
Republic of South Africa	4,903
Malagasy Republic	2,961
Norway	2,205
Australia	1,320
Canada	1,204
Other countries	91,885
Total	400,000

Source: U.S. Bureau of Mines, Mica Preprint 1962.

SPECIFICATIONS

Natural Block Muscovite

Block muscovite is graded for size and quality according to Designation D351-57T of the American Society for Testing and Materials. For grading size, this classification uses the area of minimum rectangle and the minimun dimension of one side; for grading visual quality, it uses the degree of staining by included impurities.

Natural Phlogopite Sheet

In Canada, phlogopite sheet is graded in terms of its linear dimensions (in inches), the following sizes being in common use: 1 x 1, 1 x 2, 1 x 3, 2 x 3, 2 x 4, 3 x 5, 4 x 6, 5 x 8, and larger.

No formal quality-grading for phlogopite has been established, but the softer, lighter-colored varieties are generally regarded as having the best electrical qualities.

Ground Mica

The only formal specification is for mica pigment. A.S.T.M. Designation D607-42 requires a wet-ground muscovite with a maximum bulk density of 10 pounds per cubic foot, very low moisture and other impurity contents, and a particle size that is 93 per cent minus 325 mesh. For other uses, the specifications are a matter of agreement between producer and consumer.

Dry-ground mica is sold in a wide range of particle sizes, from as coarse as minus 20 mesh for use as a dusting agent to as fine as minus 200 mesh for other purposes. Wet-ground mica is generally at least minus 200 mesh. Mica ground in a fluid-energy mill is becoming more important because of the increasing demand for a particle size below 325 mesh.

BUYERS

The following Canadian companies buy mica: all grades - Walter C. Cross & Co., 209 Eddy Street, Hull, Quebec; block and sheet - Mica Company of Canada Ltd., 4 Lois Street, Hull, Quebec; scrap - Blackburn Brothers, Limited, 85 Sparks Street, Ottawa, Ontario.

There is currently little demand for phlogopite sheet and a small demand for clean phlogopite scrap.

PRICES

Prices for mica in the United States, according to <u>E & M J Metal and Mineral Markets</u> of December 31, 1962, included:

	Dollars
Punch mica, per lb	0.07 - 0.12
Wet-ground mica, per short ton	160.00 - 180.00
Dry-ground mica, per short ton	34.00 - 75.00
Scrap mica, per short ton	30.00 - 40.00

Mineral Pigments and Fillers

J.S. Ross*

Synthetic and artificial pigments have largely replaced mineral pigments. Commonly, the synthetic variety is produced from minerals that are converted into pigments by chemical and metallurgical processing. Mineral pigments normally undergo beneficiation and may not be in the mineral state when marketed. They are derived from inert natural oxides and are used to impart color and opacity to materials. Iron oxides are the only true mineral pigments produced in Canada, although some industrial minerals are produced for their combined filler and whiteness qualities. The consumption of mineral pigments is small but the uses are widespread.

In contrast with mineral pigments, mineral fillers are used in moderate quantities. Fillers are industrial minerals which impart desirable physical properties and take the place of more expensive materials in industrial products while remaining relatively chemically inert. Mineral fillers produced in Canada include asbestos, barite, bentonite and various other clays, cement, whiting substitute and other types of limestone, mica, nepheline syenite, shale, silica, talc and diatomite. Fillers also include aggregates of gravel, crushed rock and of lightweight and heavy mineral products used in masonry and concrete. Some of these industrial minerals also impart color and, on a smaller scale, serve as pigments but are rarely used solely as pigments because of their low hiding power and limited color range. Whiting is the only filler dealt with in detail in this review. Others are discussed individually in other reviews.

IRON OXIDE

In 1962 the natural iron-oxide pigment industry continued to be in a depressed state owing to a limited demand for its products. The main reason for this low production is competition from synthetic iron-oxide pigments of excellent quality and with a greater range of colors. Shipments of crude and processed bog iron oxide were similar to those in 1961 and amounted to 771 tons valued at $58,363, the lowest value in over a decade. Canada's output is now dependent upon demands by the pigment and abrasives industries rather than upon the producer-gas industry. In addition an unknown quantity of synthetic iron oxide was produced.

Total exports of natural and synthetic iron-oxide pigments continued to decrease and in 1962 amounted to 1,865 tons valued at $365,582. The United States received 77 per cent of this amount. The amount of iron-oxide pigment imports is unknown for 1962 but they have been relatively small.

*Mineral Processing Division, Mines Branch.

Table 1

IRON OXIDES - PRODUCTION, TRADE AND CONSUMPTION

	1961		1962	
	Short Tons	$	Short Tons	$
PRODUCTION (shipments)				
Natural (crude and calcined)	808	68,199	771	58,363
EXPORTS				
Natural and synthetic iron oxides				
United States	1,751	292,698	1,442	257,336
France	93	16,573	95	16,817
The Netherlands	5	990	93	16,268
Australia	53	9,174	75	17,151
West Germany..................	203	37,184	56	9,999
Other countries	103	19,550	104	48,011
Total	2,208	376,169	1,865	365,582
IMPORTS*				
Ochres, siennas, umbers				
United States	574	59,797		
Britain	48	4,024		
Spain	27	1,116		
Total	649	64,937		
	1960		1961	
CONSUMPTION by the paint industry				
Calcined and synthetic iron oxide	1,858	440,614	1,755	434,206
Ochres, siennas, umbers........	150	48,241	130	45,481

Source: Dominion Bureau of Statistics.
*Not available as a separate class for 1962.

OCCURRENCES AND PRODUCTION

In Canada, pigment-grade iron oxide is recovered from bog deposits formed by the precipitation of iron oxides leached from ferruginous rocks and overburden. Many such bog deposits occur in Champlain County, Quebec, principally near Three Rivers. Several of these are worked by The Sherwin-Williams Company of Canada, Limited, the only current producer of iron-oxide pigment from natural sources. The ore is trucked to the company's mill at Red Mill, Quebec, air-dried, calcined when necessary, ground and sized. Much of the output is exported. On occasion, small quantities of bog oxide have been recovered by other interests.

Table 2

IRON OXIDES - PRODUCTION TRADE AND CONSUMPTION, 1953-62
(short tons)

	Production	Imports		Exports	Consumption*		
					Coke and Gas Industries	Paint Industry	
	Natural	Ochres Siennas Umbers	Oxides Fillers Colors etc	Natural and Synthetic		Natural and Synthetic	Ochres Siennas Umbers
1953	10,308	1,171	5,258	3,048	7,989	2,456	243
1954	5,798	1,052	4,443	3,111	9,167	2,190	212
1955	7,702	986	5,707	3,623	6,835	2,298	221
1956	8,803	1,162	6,237	3,203	8,745	2,166	220
1957	7,518	946	4,826	3,440	5,999	1,895	263
1958	1,632	680	4,923	2,401	237	1,826	158
1959	1,235	833	6,103	2,624	100	1,889	138
1960	909	615	4,908	2,523	na	1,858	150
1961	808	649	4,903	2,208	na	1,755	130
1962	771	na	na	1,865	na	na	na

Source: Dominion Bureau of Statistics.
*Partial
Symbol: na Not available.

Bog-iron oxide also occurs in Laviolette and Yamaska counties, Quebec; Colchester County, Nova Scotia; near New Westminster, British Columbia; and in other areas of British Columbia, Saskatchewan, Manitoba and Ontario.

USES AND SPECIFICATIONS

Canada's output of refined bog-iron oxide is consumed mainly by the abrasives and paint industries.

As an abrasive, the commodity is used for glass and metal polishing. As pigments, the natural and synthetic varieties compete, but the synthetic material has become by far the most popular because of the variety of product. Both types are extensively used in paints, rubber, linoleum, plastics, ceramics, concrete, mortar and oilcloth and in wood, paper, leather stains and other materials. Iron oxide is desired because of the variety and permanence of its color and its ability to inhibit the oxidation of metal surfaces. For pigmentary use it should either compare with a standard color or have tinting strengths that can be conditioned to compare with those of standards. The particle size should be less than 325 mesh, and the oil absorption should approximate that of a specific standard. The degree of opacity and hiding power is important; chemical composition, within limits, is not.

PRICES

Ochre per ton, bagged, f.o.b. mills in Georgia and Virginia is quoted by E & M J Metal and Mineral Markets of December 31, 1962 as being $31 to $34.50 and $24.50 to $25.50, respectively.

For various types of iron oxides, Oil, Paint and Drug Reporter of December 31, 1962 quotes 6 to 16 cents a pound.

WHITING SUBSTITUTE

Whiting substitute is pulverized white or near-white limestone composed mainly of calcium carbonate. True whiting is ground chalk, whereas precipitated whiting is calcium-carbonate precipitate.

Canada produces only whiting substitute for whiting purposes. Virtually all is derived from limestone from Missisquoi County, Quebec. Production is relatively small - estimated at 13,356 tons for 1962. In addition, substantial amounts of off-white limestone are produced. While this latter material is a lower-grade product it does compete for a few of the uses served by whiting.

Canada rarely exports whiting substitute and the quantities involved are not reported separately. Imports include the three types: natural and precipitated whiting and whiting substitute. In 1962 they included the natural and precipitated varieties which came mainly from the United States but also from Britain and France. For the last three years these imports have been constant amounting in 1962 to 8,142 tons valued at $259,258. Whiting substitute is imported chiefly from the United States but statistics are unavailable.

Table 3

WHITING - PRODUCTION, IMPORTS AND CONSUMPTION

	1961		1962	
	Short Tons	$	Short Tons	$
PRODUCTION				
Stone processed for whiting	14,301	178,579	13,356	162,410
IMPORTS(a)				
Whiting				
United States	3,949	183,217	4,242	208,901
Britain	2,613	39,281	2,265	39,668
France	1,846	10,865	1,635	10,689
Total	8,408	233,363	8,142	259,258
CONSUMPTION(b)				
Ground chalk, whiting and whiting substitute				
Pharmaceuticals	156		180	
Paints	16,970		18,378	
Soaps and toilet preparations	216		200	
Ceramics	1,470		1,664	
Linoleum and oilcloth products	22,010c		12,516c	

Table 3 (Cont'd.)

	1961		1962	
	Short Tons	$	Short Tons	$
CONSUMPTION (cont'd)				
Rubber goods	9,047c		11,025c	
Tanneries	357		20	
Gypsum products	5,632c		5,451c	
Adhesives	441		525	
Paper	2,799		2,255	
Miscellaneous chemicals	307		356	
Starch and glucose	12		6	
Miscellaneous	3,024		1,180	
Total	62,442c		53,756c	

Source: Dominion Bureau of Statistics.
(a) Import statistics for whiting substitute are not available.
(b) These quantities are calculated from information provided by the Dominion Bureau of Statistics. Consumption statistics for 1962 are not yet available.
(c) Includes ground, off-white limestone.
Symbol: e Estimate.

Table 4

WHITING - PRODUCTION, IMPORTS AND CONSUMPTION, 1953-62
(short tons)

	Production(a)	Imports(b)	Consumption(c)
1953	16,913	12,247	27,668
1954	15,460	10,824	28,370
1955	16,007	11,905	33,171
1956	17,448	11,356	34,241
1957	21,527	9,844	31,374
1958	11,900	11,121	37,268
1959	11,633	10,322	64,933d
1960	10,319	8,835	52,226d
1961	14,301	8,408	67,365d
1962	13,356	8,142	53,756

Source: Dominion Bureau of Statistics.
(a) Whiting substitute only.
(b) Whiting only.
(c) Whiting and whiting substitute; includes some ground, off-white limestone.
(d) Calculated from information provided by the Dominion Bureau of Statistics.

USES

In general, all types of whiting are used to improve physical properties or to replace more expensive materials in industrial commodities. They may act as a diluent or may increase the whiteness, opacity, smoothness, absorption or weight of a product. Because whiting and whiting substitute are the least expensive, they are used basically as fillers. The precipitated variety is used mainly because of its whiteness. However, the opacities of these commodities are low in comparison with those of such synthetic pigments as titanium dioxide and zinc oxide. Thus, as a group, whiting is primarily employed as a white filler. Off-white limestone serves as a filler where color is unimportant or in some cases where dark colors are involved.

Whiting is used mainly as a filler in paints where color, particle size, chemical composition, bulk density and, on occasion, oil absorption are important. Considerable quantities go into the manufacture of linoleum, oilcloth and vinyl and asphalt flooring. It is also used as a filler in rubber, paper, asbestos, pharmaceutical and adhesive products as well as in soaps. On occasion, it is incorporated in gypsum products, although off-white limestone is commonly preferred owing to economics. Small amounts of whiting are used because of its chemical properties, such as in ceramics. Other miscellaneous applications are in explosives, plastics and cleansers.

<u>Oil, Paint and Drug Reporter</u> of December 31, 1962 quotes these prices, bagged, in carlots, per ton, at works:

Calcium carbonate,	natural, dry-ground, 325 mesh	$10.50
	natural, water-ground, 30 microns	$17.00-$30.00
	chalk, 325 mesh	$32.00-$34.00
	precipitated, dense	$30.00-$38.50

SOME OTHER PIGMENTS

Canada produces synthetic pigments which have largely replaced the natural varieties. This country, through the efforts of Northern Pigment Company, Limited, New Toronto, Ontario, is a leading producer of synthetic iron oxide. Part of the output is exported.

Titanium dioxide, a white pigment, is produced by two companies in Quebec. Both consume, as the basic raw material, titania slag marketed by Quebec Iron and Titanium Corporation of Sorel, Quebec. Quebec Iron and Titanium mines ilmenite near Havre St. Pierre and ships it to Sorel where it is concentrated, roasted and then reduced in electric furnaces into titania slag and iron. Most of the slag is exported. A strike, which began in the latter part of August and continued well into 1963, severely curtailed slag production. However, pigment output was not affected in 1962.

Canadian Titanium Pigments Limited produces refined titanium dioxide at Varennes. Its plant has a rated output capacity of 25,000 tons a year. The second producer, British Titan Products (Canada) Limited, began operations in November 1962 and has a similar type of plant at Ville-de-Tracy with a rated annual capacity of 22,000 tons of titanium-dioxide pigment. Canada now has a capacity sufficient to provide practically all its requirements. Continental

Titanium Corp., which produces ilmenite for heavy aggregate at Baie St. Paul, Quebec, is contemplating construction of a pigments plant at that town.

Canada's output of titanium-dioxide pigments is relatively small compared with that of the United States, the chief world producer.

In 1962, imports, down slightly from the previous year, were 12,620 tons of titanium dioxide valued at $5,735,561 and 12,323 tons of the extended pigment valued at $2,354,541.

In 1961, Canada consumed 23,584 tons of refined titanium dioxide and 13,104 tons of the extended variety. All of the latter and 73 per cent of the former was used in paints. The remaining refined oxide was used in paper, linoleum and coated products, rubber goods, textiles, toilet preparations and chemicals.

Canadian Chemical Processing of October 1962 quotes these prices:

Titanium dioxide, per hundredweight, bags, carlots, delivered eastern Canada.

Anatase pigment	$23.75
Rutile pigment	$25.50
Calcium pigment, 30% TiO_2	$11.10 to $11.40
Calcium pigment, 50% TiO_2	$17.15
Technical	$30.40

Molybdenum

V.B. Schneider*

In 1962, production of molybdenum in Canada increased for the third consecutive year. Shipments of molybdenum contained in molybdic oxide (MoO_3) and molybdenite (MoS_2) concentrates were 817,705 pounds valued at $1,261,451 This compares with 771,358 pounds valued at $1,092,201 in 1961. Domestic consumption of 1.3 million pounds of molybdenum was at an all-time high for peace time having been exceeded only once - in 1942.

World mine production for 1962 has been estimated by the United States Bureau of Mines** at 75 million pounds of contained molybdenum. This decrease from the all-time high of 87.9 million pounds in 1961 was mainly attributable to a labor strike that greatly reduced production at the Climax, Colorado, mine of Climax Molybdenum Company.

PRODUCTION

Canada

Molybdenite Corporation of Canada Limited was the sole Canadian producer of molybdenite. Its property is at the junction of La Motte, Lacorne, Vasson and Malartic townships, 23 miles north of Val d'Or, Quebec. Bismuth is produced as a byproduct. On October 1, ore reserves, blocked out or broken in stopes, were 298,210 tons averaging 0.32 per cent MoS_2. The concentrator, operating on a six-day week, treated an average of 900 tons of ore a day, assaying 0.273 per cent MoS_2. The company intends to raise mill grade to 0.30 per cent MoS_2 in 1963. A roasting plant at the mine site converts molybdenite to technical-grade molybdic oxide (MoO_3), the material from which all types of molybdenum salts and compounds are produced.

Preissac Molybdenite Mines Limited, in which Molybdenite Corporation of Canada Limited holds a substantial interest, continued development and exploration work on its property in Preissac township, about five miles north of Cadillac, Quebec. During World War II the Preissac mine was operated by Indian Molybdenum Limited and produced about 419,432 pounds of molybdenite concentrate.

Anglo-American Molybdenite Mining Corporation continued development and exploration work on its property, also in Preissac township. Shaft-sinking operations were completed to 375 feet in 1961 with stations cut at the 150-foot and 300-foot horizons. During 1962, drifting and diamond-drilling from underground stations was continued. Plans call for a 750- to 1,000-tons-a-day-capacity operation.

*Mineral Resources Division.

**U.S. Bureau of Mines, Molybdenum Preprint 1962.

Table 1

MOLYBDENUM - PRODUCTION, IMPORTS AND CONSUMPTION

	1961		1962	
	Pounds	$	Pounds	$
PRODUCTION (shipments)(a)....	771,358	1,092,201	817,705	1,261,451
IMPORTS				
Molybdic oxide(b)				
United States................	266,399	212,172	328,424	302,881
Calcium molybdate (grouped with vanadium oxide and tungsten oxide for the manufacture of steel)				
United States................	44,662	84,135	100,298	177,922
France.....................	-	-	2,976	1,680
West Germany	1,986	3,605	-	-
Total	46,648	87,740	103,274	179,602
Ferromolybdenum				
United States(c)	211,779	323,725	131,358	234,066
CONSUMPTION (Mo content)				
By type				
Molybdic oxide..............	715,520		713,074	
Ferromolybdenum...........	354,520		468,726	
Molybdenum metal	4,166		9,414	
Molybdenum wire	5,821		6,985	
Other forms(d)..............	55,583		63,181	
Total	1,135,610		1,261,380	
By end-use				
Ferrous and nonferrous alloys.....................	1,068,562		1,186,033	
Lubricants and pigments.....	53,538		64,049	
Electrical and electronic products	5,829		7,004	
Unspecified	7,681		4,294	
Total.....................	1,135,610		1,261,380	

Source: Sominion Bureau of Statistics. (a)Producers' shipments of molybdic oxide and molybdenum concentrates (Mo content). (b)Gross weight. (c)United States exports of ferromolybdenum (gross weight) to Canada as reported by the U.S. Bureau of Commerce in the United States Exports of Domestic and Foreign Merchandise (Report 410, Part II). Imports of ferromolybdenum are not available separately in official Canadian trade statistics. (d)Molybdic acid, molybdenum disulphide, ammonium molybdate, barium molybdate, calcium molybdate and sodium molybdate.
Symbol: - Nil.

Table 2

MOLYBDENUM - PRODUCTION, TRADE AND CONSUMPTION, 1953-62
(pounds)

	Production(a)	Exports(b)	Imports Calcium Molybdate(c)	Imports Molybdic Oxide(d)	Imports Ferro-molybdenum(g)	Consumption(h)
1953	194,344	na	197,758	358,124	201,626	548,455
1954	451,450	na	121,339	423,344	79,856	374,118
1955	833,506	1,478,900	139,130	658,060	174,504	634,061
1956	842,263	1,318,200	322,295	955,308	495,748	855,468
1957	783,739	6,009,800i	285,576	477,304	237,233	698,420
1958	888,264	1,892,200	135,333	304,822	196,000	519,124
1959	748,566	3,748,300	75,987	305,762	164,366	928,505
1960	767,621	na	236,936	656,062	230,600	1,042,077
1961	771,358	na	46,648	266,399	211,779	1,135,610
1962	817,705	na	103,274	328,424	131,358	1,261,380

Source: Dominion Bureau of Statistics. (a)From 1953 to 1956 inclusive, producers' shipments of molybdenum concentrates (Mo content): from 1957, molybdic oxide and molybdenum concentrates (Mo content). (b)For 1955 and 1956, exports of molybdenum concentrates (gross weight); for 1957 to 1959 inclusive, exports of molybdic oxide and molybdenum concentrates (gross weight). (c)Gross weight, including vanadium oxide and tungsten oxide. (d)Gross weight. (g)United States exports to Canada reported in United States Exports of Domestic and Foreign Produce. Gross weight. (h)Molybdenum addition agents (Mo content) reported by consumers. (i)Includes 4,892,600 pounds of molybdic oxide exported to the United States. This was derived from molybdenum concentrates imported from the United States for roasting in Canada.
Symbol: na Not available.

Molybdenum Corporation of America carried on an exploration program on the property of Copperstream-Frontenac Mines Limited in Grayhurst and Dorset townships, about 50 miles southeast of Thetford Mines, Quebec. The development program included slashing drifts for diamond drill stations and drilling horizontal holes from these stations.

Gaspe Copper Mines, Limited, a wholly-owned subsidiary of Noranda Mines, Limited, began the construction of an addition to its concentrator to recover MoS_2 as a byproduct of its copper concentrator. The molybdenum recovery unit should be in operation late in 1963 and a daily recovery of 1,260 to 1,300 pounds of MoS_2 is expected. This rate should increase as the molybdenum content of the ore at the Gaspe property increases at depth.

Noranda Mines, Limited, continued its exploration program on the Boss Mountain property in British Columbia, on which it took an option from H.H. Huestis and Associates in March 1961. About 4,200 feet of a proposed 6,000-foot drift was completed during the year. When the drift is completed the deposit will be explored by diamond drilling from underground stations.

Friday Mines Limited conducted an exploration program on its King Edward copper-molybdenum prospect in the Susap Creek-Hunter Creek area seven miles southeast of Keremeos, British Columbia. The program included geological mapping, surveying, sampling, and retimbering the entrance of an old adit.

United States

The United States is the largest producer and consumer of molybdenum and molybdenum products. In 1962, production and shipments amounted to 51.2 million and 50.5 million pounds of contained molybdenum in concentrates. These were well below the 1961 amounts of 66.6 million and 66.8 million pounds. Exports of molybdenum contained in concentrates and in molybdic oxide, at 15.6 million pounds, were about 20 million pounds below the all-time high of 35.7 million pounds of 1961.

The Climax mine of Climax Molybdenum Company, a division of American Metal Climax, Inc., is the largest producer of molybdenum in the world; it is also the only mine in the United States operated chiefly for molybdenum. Production at the Climax mine in 1962 declined as a result of a strike to 32,659,000 pounds of molybdenum in MoS_2 concentrate from 48,047,000 pounds the previous year.

Among the major producers of byproduct molybdenum are Kennecott Copper Corporation, Bagdad Copper Corporation, Phelps Dodge Corporation, San Manuel Copper Corporation, Union Carbide Nuclear Company, American Smelting and Refining Company and Duval Sulphur & Potash Company. Kennecott, the world's second largest molybdenum producer, reported the production of 25,429,000 pounds for 1962.

Molybdenum Corporation of America is second to American Metal Climax as a producer of molybdic oxide and ferromolybdenum. Since 1937, Molybdenum Corporation has purchased a very large part of its molybdenum concentrates from Kennecott.

Other Countries

Chile is second in the Free World as a producer of molybdenum, all of which is obtained as a byproduct of its large porphyry-copper operations. Since 1939, molybdenite concentrate has been recovered by Braden Copper Company from the copper ores of its El Teniente mine. In 1958, the Anaconda Company installed a molybdenite-recovery unit on its Chuquicamata copper property. The copper ore of Anaconda's El Salvador mine also contains considerable molybdenum. Most of Chile's output of molybdenite concentrate was exported to western Europe. Japan, Norway and Yugoslavia are minor producers. China, North Korea and the U.S.S.R. also produce molybdenum but data on their output are not available. Recent reports indicate that three large molybdenum deposits have been discovered in China, somewhere in the middle section of the Ch'in Ling Mountains of Shensi province and in Shansi and Kirin provinces. The United States Bureau of Mines has estimated that production in the Sino-Soviet bloc totalled 15 million pounds in 1962. This would place Russia second to the United States, with an annual output of about three times that of Chile.

During 1962, exploration work continued on the molybdenum deposits near Mestersvig, Greenland. Preliminary reports on estimated tonnage and possibility of extracting the ore economically, indicate ore reserves in excess of 50 million tons of mineable grade material. The Danish government, American Metal Climax Inc. and Northern Field Mines Inc. are combining to explore the prospect.

Table 3

WORLD PRODUCTION OF MOLYBDENUM
IN ORES AND CONCENTRATES, 1961 and 1962

(short tons)

	1961	1962
United States	33,282	25,622
U.S.S.R.	5,950	6,250
Chile	1,850	2,636
China	1,650	1,650
Japan	404	405e
Canada	386	409
Norway	266	265e
Other countries	162	263
Total	43,950	37,500

Source: Dominion Bureau of Statistics; U.S. Bureau of Mines, Molybdenum Preprint 1962.
Symbol: e Estimate.

CONSUMPTION AND USES

About 67 per cent of the molybdenum consumed is in the form of molybdic oxide, which is followed (in order of quantity) by ferromolybdenum and molybdenum-metal powder. Molybdenum is used in lesser amounts in calcium, sodium and ammonium molybdate, in molybdenum disulphide and in molybdenite concentrate added directly to steel.

Small additions of molybdenum promote uniform hardness and strength throughout heavy steel sections. This ability to improve combinations of strength and toughness is the most notable effect of molybdenum as a steel additive.

Metallic molybdenum is a refractory metal produced in the form of bars, sheet, plate, tube and wire. It is superior in high-temperature applications and is used extensively in electronics and for missile parts that have a short working life; but the design of solid-fuel rocket engines which will operate beyond the melting point of molybdenum will reduce the role of this metal in certain missile parts.

The use of molybdenum chemicals has been increasing in recent years. As a catalyst, molybdenum is applied in processes designed to raise the octane rating of gasoline and in desulphurization. About 55 per cent of the molybdenum consumed by the pigment industry is employed in the production of molybdenum orange. The use of molybdenum as a trace element, though still small, is becoming increasingly important as a soil conditioner.

Molybdenum is of great strategic value to the United States, not only for its own particular alloying properties but also because it can be used as a partial substitute for tungsten, nickel, chromium and vanadium in low-alloy and certain high-speed steels.

Table 4

UNITED STATES CONSUMPTION OF MOLYBDENUM, BY USE
('000 pounds of contained molybdenum)

	1960	1961	1962
Steel			
High-speed	1,756	1,740	2,273
Other alloys	19,480	21,202	21,043
Miscellaneous*	613	592	718
Gray and malleable castings	2,757	2,578	3,248
Rolls (steelmills)	1,152	953	1,564
Welding rods	259	245	239
High-temperature alloys	1,346	1,398	1,314
Molybdenum metal (wire, rod and sheet)	2,336	1,476	2,250
Chemicals			
Catalysts	372	370	690
Pigments and other color compounds	856	831	859
Miscellaneous**	910	1,236	1,476
Total	31,837	32,621	35,674

Source: U.S. Bureau of Mines, Minerals Yearbook 1960 and 1961; U.S. Bureau of Mines Molybdenum Preprint 1962.

*Includes castings as well as hot-work and tool steels. **Includes special alloys, lubricants, refractories, magnets and corrosion- and heat-resistant castings. na Not available.

75807—25½

Among the more important Canadian consumers of molybdenum primary products are : in Ontario - Atlas Steels Limited, Welland; The Algoma Steel Corporation, Limited, Sault Ste. Marie; Dominion Foundries and Steel, Limited, Hamilton; Welland Electric Steel Foundry Limited, Welland; Canadian General Electric Company Limited, Toronto; The Steel Company of Canada, Limited, Hamilton; and Dominion Colour Corporation Limited, New Toronto; in Quebec - L'Air Liquide, Montreal; Canadian Steel Foundries Limited, Montreal; and Dominion Brake Shoe Company, Limited, Joliette; in Nova Scotia - Dominion Steel and Coal Corporation, Limited, Sydney.

PRICES

E & M J Metal and Mineral Markets of December 31, 1962 quotes molybdenum prices in the United States as follows:

Molybdenum powder, per lb, carbon-reduced, f.o.b. shipping point	$3.35
Molybdenum ore, per lb contained Mo, 95% MoS_2, f.o.b. shipping point Climax, cost of containers extra	1.40
Molybdic trioxide, per lb Mo, f.o.b. shipping point	
Bags	1.59
Cans	1.60
Ferromolybdenum, per lb contained Mo, packed, f.o.b. shipping point, 58-64% Mo, powdered	
Lots 5,000 lb or more	1.95
Other sizes	1.89
Calcium molybdate, per lb Mo, lumps, packed	1.63

TARIFFS

Canada	British Preferential	Most Favored Nation	General
Calcium molybdate and molybdic oxide	free	free	5%
Molybdenum strip	free	free	30%
Molybdenum wire, rod, and tubing and molybdenum imported by manufacturers of radio tubes and parts	free	free	30%
Ferromolybdenum	free	5%	5%
Molybdenum ores and concentrates	free	free	free

Tariffs (cont'd)

United States

Molybdenum ores and concentrates per lb contained Mo	27¢
Calcium molybdate, ferromolybdenum, metallic molybdenum, molybdenum powder and all other alloys and compounds of molybdenum, per lb contained Mo	22.5¢ plus 6 1/2% ad valorem
Molybdenum bars, ingots, shot, and scrap containing more than 50% molybdenum carbide, or combinations thereof (duty on scrap suspended to June 30, 1963)	21%
Other forms	25 1/2%

Natural Gas

D.W. Rutledge*

In 1962, production of natural gas continued to increase, as it has since 1956, at a rate much greater than most other major Canadian mineral resources. In the late 1950's, much of this growth was brought about by increasing demand in Canada; more recently the growth is the result of a rising demand in the United States. In 1962, the first full year of operation of the Alberta to California gas pipeline, exports of natural gas nearly doubled. Despite the significant expansion of production and sales in 1962, capital investment in some segments of the industry decreased. Investment in large gas transmission pipelines and processing plants was substantially below 1961 levels, but investment in new gas distribution systems was greater, especially in Ontario. Fewer gas wells were completed in 1962, but several important gas discoveries were made in northeastern British Columbia. Although the increase in natural gas reserves was less than in 1961, recent gas discoveries may lead to the development of additional large reserves.

PRODUCTION

In 1962, net new production of natural gas, which excludes withdrawals from storage and gas flared and wasted, amounted to 946,703 million cubic feet, or 2,594 million cubic feet per day. This is an increase of 44.4 per cent - a greater rate of growth than in any of the preceding three years. A greater percentage increase was recorded in 1958 but the absolute increase was much smaller in that year than in 1962. In 1962 Alberta produced 81.6 per cent of Canada's net output of natural gas; British Columbia, 12.8 per cent; Saskatchewan, 4.1 per cent; and Ontario, 1.7 per cent. Only minor amounts were produced in New Brunswick and the Northwest Territories. Output increased 53.9 per cent in Alberta, 17.5 per cent in British Columbia, 4.2 per cent in Saskatchewan, 7.6 per cent in Ontario, 36.1 per cent in the Northwest Territories, and decreased 0.6 per cent in New Brunswick.

*Mineral Resources Division.

In Alberta, expansion of output has been rapid in those fields that supply gas to the new Alberta to California gas pipeline. Such fields include the first- and second-largest producers, the Crossfield and the Westerose South fields. The former now includes the Calgary field. The latter field has some of the most productive gas wells in operation in Canada, output coming from a mere five 'capable' gas wells. Although production increased very sharply in the Harmattan-Elkton and Pine Creek fields in 1962 (Table 1) the gas was not marketed but was re-injected underground for pressure maintenance purposes (Table 2 footnote b). Gas from the Harmattan-Elkton field is solution gas produced in conjunction with oil. Gas from the Pine Creek field is used to replace Windfall field gas which is processed to recover liquid hydrocarbons.

EXPLORATION AND DEVELOPMENT

British Columbia

In 1962, drilling in British Columbia amounted to 1,554,408 feet of which 36.1 per cent was for exploration. An increase of nearly 45 per cent in footage included a 31 per cent increase in exploratory drilling and a 54 per cent increase in development. A total of 320 wells (excluding service wells) were drilled, of which 96 were dry - a higher rate of failure than in 1961. Sixty-five successful gas wells were completed, and although most were development wells, there were several important gas discoveries. As in 1960 and 1961, gas discoveries outranked oil discoveries in importance, and some large gas fields will probably be developed from some of the isolated gas wells drilled

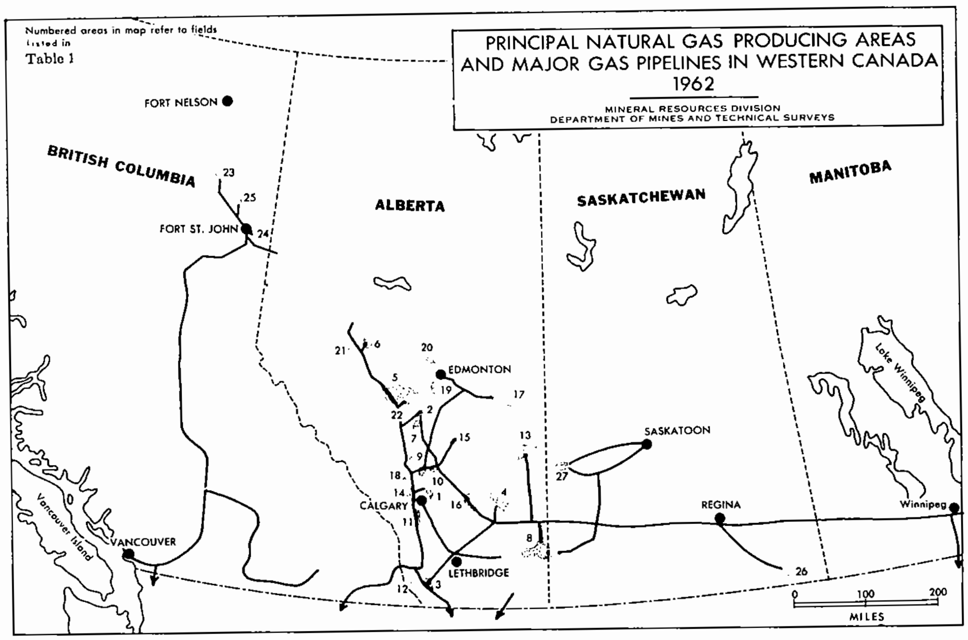


Table 1

NATURAL-GAS FIELDS PRODUCING 10,000,000 MCF* OR MORE
(Mcf)

The numbers following field names refer to map locations

	1961	1962
Alberta		
Crossfield (1)	2,446,102	67,284,940
Westerose South (2)	31,476,682	54,340,303
Pincher Creek (3)	46,456,637	48,822,471
Cessford (4)	46,609,048	46,184,976
Pembina (5)	34,427,668	33,812,055
Windfall (6)	11,385,648	32,532,163
Homeglen-Rimbey (7)	16,873,574	30,692,212
Medicine Hat (8)	25,431,249	28,684,789
Harmattan-Elkton (9)	4,361,853	25,479,460
Carstairs (10)	23,454,855	25,256,473
Turner Valley (11)	23,838,913	24,110,415
Waterton (12)	818,775	23,259,937
Provost (13)	22,054,307	22,178,351
Jumping Pound (14)	24,437,709	21,695,325
Nevis (15)	17,993,352	21,264,592
Hussar (16)	16,595,197	19,491,987
Viking-Kinsella (17)	12,434,416	16,836,304
Wildcat Hills (18)	92,648	15,777,404
Leduc-Woodbend (19)	13,909,231	15,182,955
Alexander (20)	14,308,502	15,128,608
Pine Creek (21)	1,426,980	14,620,969
Minnehik-Buck Lake (22)	317,333	13,117,906
British Columbia		
Jedney (23)	10,894,047	15,498,649
Fort St. John (24)	12,889,110	11,648,831
Buick Creek West (25)	11,161,782	8,850,897
Saskatchewan		
Steelman (26)	18,277,492	18,906,690
Coleville-Smiley (27)	15,169,169	15,321,919

Source: Provincial government reports: gross reservoir withdrawals.
*Mcf = 1,000 cubic feet.

Table 2

NATURAL GAS STORAGE AND INJECTION OPERATIONS
(Mcf)

	1961		1962	
	Input	Reproduction	Input	Reproduction
Alberta fields(a)				
Bonnie Glen...........	-	-	-	-
Bow Island	1,784,914	882,638	1,718,511	1,387,703
Campbell-Namao......	-	-	-	-
Duhamel..............	83,875	-	89,053	-
Golden Spike..........	1,688,875	-14,395	2,950,635	-
Harmattan East.......	30,600	-	1,753,000	-
Harmattan-Elkton.....	3,636,237	-	22,379,367	-
Jumping Pound........	2,425,322	1,779,480	1,985,157	1,585,374
Leduc-Woodbend......	2,756,856	-	6,089,501	-
Pembina..............	5,625,329	-	7,191,328	-
Pincher Creek........	3,035,457	5,307,574	165,139	3,399,230
Sundre...............	720,470	-	752,897	-
Taber	-	-	-	-
Turner Valley	220,949	301,383	526,509	602,773
Viking-Kinsella.......	2,010,093	2,010,093	311,533	311,533
Westerose............	911,546	-	1,306,047	-
Windfall..............	9,557,133	-	14,678,758 b	-
Total (14.65 psia)....	34,487,656	10,266,773	61,897,435	7,286,613
Pressure adjusted to 14.73 psia(c)	34,301,423	10,211,332	61,563,188	7,247,265
Ontario fields(a) Total (14.73 psia).....	21,839,101	18,475,843	22,455,876	24,058,628
Saskatchewan fields(d) Total (14.73 psia).....	1,079,994	411,198	2,185,682	465,900
Canada Total (14.73 psia)	57,220,518	29,098,373	86,204,746	31,771,793

(a)From provincial government reports.
(b)Mainly from Pine Creek field, for pressure maintenance.
(c)'psia': pounds per square inch absolute.
(d)From monthly 'Gas Utilities' of Dominion Bureau of Statistics and provincial government reports.
Symbol: - Nil.

Table 3

PRODUCTION OF NATURAL GAS(a)

	1961		1962	
	Mcf(b)	$	Mcf(b)	$
Gross new production(c)				
New Brunswick.......	96,318		95,750	
Ontario..............	14,544,165		15,648,294	
Saskatchewan	58,414,635		61,993,601	
Alberta..............	559,422,522		836,530,208	
British Columbia.....	103,916,428		128,833,842	
Northwest Territories	41,678		56,707	
Total, Canada	736,435,746		1,043,158,402	
Waste and Flared				
Saskatchewan	21,222,040		23,147,869	
Alberta	58,578,622		65,567,086	
British Columbia.....	897,440		7,740,720	
Total, Canada	80,698,102		96,455,675	
Net new production(d)				
New Brunswick	96,318	143,215	95,750	134,476
Ontario..............	14,544,165	5,614,048	15,648,294	5,802,387
Saskatchewan	37,192,595	4,050,274	38,845,732	2,295,783
Alberta	500,843,900	48,882,365	770,963,122	88,660,759
British Columbia.....	103,018,988	9,714,690	121,093,122	11,724,236
Northwest Territories	41,678	17,326	56,707	23,518
Total, Canada	655,737,644	68,421,918	946,702,727	108,641,159

Source: Dominion Bureau of Statistics.
(a)Volume measured at 14.65 pounds per square inch absolute with the exception of Ontario where pressure base is 14.73 psia.
(b)Mcf = 1,000 cubic feet.
(c)Excludes withdrawals from storage.
(d)Gross new production less waste and flared.

Table 4

VALUE OF GAS PRODUCTION, 1959-62

	1959		1960		1961		1962	
	Total Value ($)	Average Value (¢ per Mcf)*	Total Value ($)	Average Value (¢ per Mcf)*	Total Value ($)	Average Value (¢ per Mcf)*	Total Value ($)	Average Value (¢ per Mcf)*
Alberta	24,995,790	8.4	34,148,675	8.9	48,882,365	9.8	88,660,759	11.5
British Columbia	4,558,023	6.6	7,587,403	8.9	9,714,690	9.4	11,724,236	9.7
Saskatchewan	3,327,684	9.9	3,722,992	10.1	4,050,274	10.9	2,295,783	5.9
Northwest Territories	22,718	33.8	12,219	30.7	17,326	41.6	23,518	41.5
Ontario	6,516,784	38.7	6,573,990	38.7	5,614,048	38.6	5,802,387	37.1
New Brunswick	188,394	160.3	151,603	154.0	143,215	148.7	134,476	140.4
Total, Canada	39,609,393	9.5	52,196,882	10.0	68,421,918	10.4	108,641,159	11.5

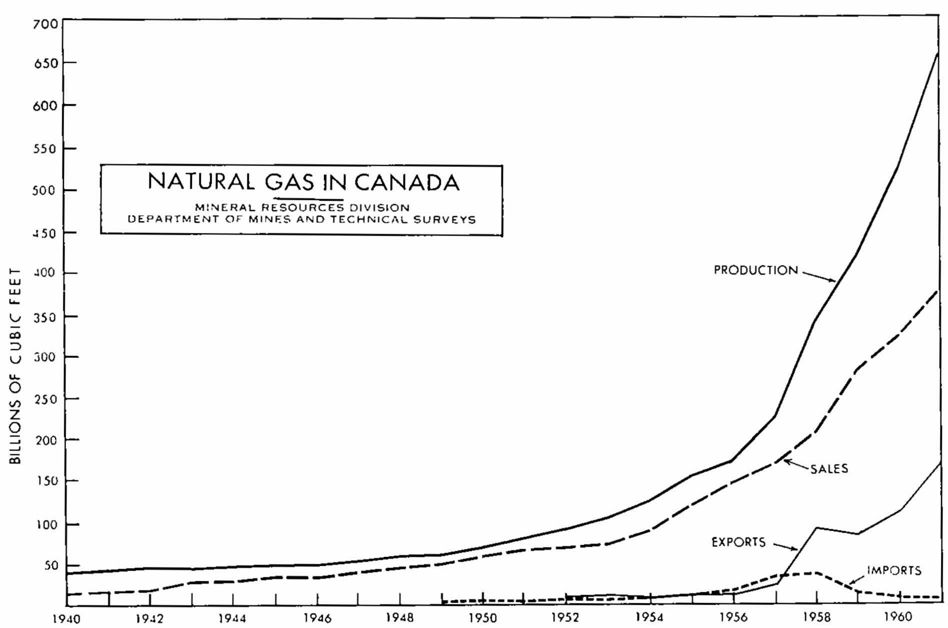
Source: Dominion Bureau of Statistics.
* Mcf = 1,000 cubic feet.

Table 5

PRODUCTION, TRADE AND TOTAL SALES, 1950-1962
(Mcf)

	Production	Imports	Exports	Sales in Canada
1950	67,822,230	3,253,523	2,312	58,098,290
1951	79,460,667	3,698,763	3,963	65,056,253
1952	88,686,465	5,981,635	7,957,907	66,005,785
1953	100,985,923	6,097,001	9,407,879	70,667,965
1954	120,735,214	6,235,859	6,983,985	87,466,838
1955	150,772,312	11,165,756	11,356,252	117,800,311
1956	169,152,586	15,695,359	10,828,338	143,725,649
1957	220,006,682	30,550,944	15,731,072	168,783,456
1958	337,803,726	34,716,151	86,971,932	206,553,170
1959	417,334,527	11,962,811	84,764,116	283,230,089
1960	522,972,327	5,570,949	91,045,510	325,609,411
1961	655,737,644	5,574,355	168,180,412	377,064,902
1962	946,702,727	5,575,466	319,565,908	420,029,073

Sources: Dominion Bureau of Statistics.
Production and Total Sales, from The Crude Petroleum and Natural Gas Industry.
Imports, from Trade of Canada.
Exports 1950-1956, from Gas Utilities.
1957-1962, from Trade of Canada.



during the past several years. One of the best 1962 gas finds was made 10 miles west of the Kotcho Lake fields by the Western Natural et al Yoyo a-74-H well. This was a Devonian Slave Point reef discovery, as was Imperial Junior c-98-C which also found significant quantities of gas 60 miles east of Fort Nelson. Apache Fort Nelson b-76-G extended the Clarke Lake gas field 5 miles southwestward. A new gas-bearing structure was confirmed in the northern foothills, 25 miles southwest of the Jedney field, by Sinclair Pink c-90-C.

Although most of the development wells were drilled in oil fields, 48 successful gas development wells were completed. Most of these were drilled in the Rigel, Nig Creek, Beg, and Jedney fields. In December 1962, 175 of the 357 gas wells, capable of production, were in operation. Many wells, including all those in the Fort Nelson area, lack pipeline access to markets. Gathering pipelines extend only as far north as the Laprise Creek field, which is 100 miles south of Fort Nelson.

Alberta

In Alberta one third of the 272 gas wells completed in 1962 were new discoveries - the remainder were development wells. A significant gas discovery was made six miles west of Edson. The well, Hamilton HB Edson 11-14, found wet gas in Mississippian strata, and by early 1963 a productive area 10 miles long had been partly outlined. Two interesting gas discoveries were made in the Foothills about 60 miles northwest of Calgary. TGS et al Hunter Valley 2-26 gave strong flows of natural gas from two Mississippian zones and TGS et al Panther River 5-23 found gas that was predominantly hydrogen sulphide in a Devonian reef.

Rapid expansion of markets for Alberta natural gas led to a continuing strong development of gas fields. At the end of the year, although nearly 80 per cent of the province's 1,257 'capable' gas wells were in operation, 1,388 gas wells remained capped. Much of the development was carried out in large fields such as Crossfield and Medicine Hat. Many formerly capped gas wells were uncapped, particularly in the Waterton, Savanna Creek, Provost, Harmattan-Elkton and Pine Creek fields. The last two fields supplied natural gas to the newly expanded gas re-injection projects at Harmattan and Windfall, respectively.

Saskatchewan and Manitoba

In Saskatchewan four exploratory gas wells were completed but no important gas discoveries were made. Eleven gas-development wells were completed. Solution gas produced from some of the large oil fields accounted for much of the province's gas production. There has never been any natural gas well completions in Manitoba.

Table 6

DRILLING RESULTS, 1961 and 1962*

	Gas Wells		Oil Wells		Dry and Abandoned Holes		Total	
	1961	1962	1961	1962	1961	1962	1961	1962
Alberta	344	272	783	688	445	584	1,572	1,544
Saskatchewan	7	11	484	397	152	212	643	620
Manitoba	-	-	10	14	18	10	28	24
British Columbia	64	65	88	159	55	96	207	320
Northwest Territories and Yukon	1	-	-	-	14	8	15	8
Total, western Canada	416	348	1,365	1,258	684	910	2,465	2,516
Ontario	81	70	55	30	114	105	250	205
Quebec	17	7	-	-	40	2	57	9
Maritimes	-	-	-	-	-	-	-	-
Total, eastern Canada	98	77	55	30	154	107	307	214
Total, Canada	514	425	1,420	1,288	838	1,017	2,772	2,730

Sources: Provincial government reports and Department of Northern Affairs and National Resources.
*Service wells excluded.
Symbol: - Nil.

Yukon and Northwest Territories

No major natural gas accumulations were found in the eight exploratory wells completed in the territories in 1962 although minor gas shows were noted in the deep well completed on Melville Island. The big gas discovery at Beaver River in 1961 in northern British Columbia, was followed up by another well 13 miles farther north, in the Yukon Territory, on what was thought to be the same structure. By early 1963, drilling on this well, Pan Am et al Kotaneelee A-1, was still in progress below the originally proposed depth.

Table 7

FOOTAGE DRILLED IN CANADA, BY PROVINCES, 1961-62*

	Exploratory		Development		All Wells	
	1961	1962	1961	1962	1961	1962
Alberta	2,956,024	3,161,657	6,986,248	5,945,022	9,942,272	9,106,679
Saskatchewan	456,681	731,383	1,861,377	1,566,505	2,318,058	2,297,888
British Columbia	428,868	561,327	645,474	993,081	1,074,342	1,554,408
Manitoba	29,347	7,580	32,281	52,634	61,628	60,214
Northwest Territories	74,337	52,701	-	-	74,337	52,701
Total, western Canada	3,945,257	4,514,648	9,525,380	8,557,242	13,470,637	13,071,890
Ontario	161,758	167,367	201,014	203,308	362,772	370,675
Quebec	17,588	4,445	3,645	1,607	21,233	6,052
Maritimes	-	-	-	-	-	-
Total, eastern Canada	179,346	171,812	204,659	204,915	384,005	376,727
Total, Canada	4,124,603	4,686,460	9,730,039	8,762,157	13,854,642	13,448,617

Sources: Provincial-government departments and agencies;
Northern Affairs and National Resources,
Canadian Oil and Gas Industries.

*Service wells included.

Symbol: – Nil.

Eastern Canada

In Ontario five off-shore gas discoveries were made in Lake Erie. Seventy-three dry exploratory wells were drilled, including three in Lake Erie. Of the 65 successful development gas wells, 32 were in Lake Erie. As in previous years, most of the new gas wells produce from formations of Silurian age. The average depth of wells of all types, excepting service wells, was 1,759 feet, compared to 1,379 feet in 1961.

In Quebec two exploratory wells, both dry, were completed - a deep one on the Gaspé Peninsula and a shallow one at Lake St. John. Two deep tests were being drilled at the year-end - near Three Rivers and on Anticosti Island. Development drilling declined in the region around the Pointe du Lac gas pool where numerous shallow wells were drilled in 1961. Seven gas wells were completed in the Pleistocene drift at Pointe du Lac.

RESERVES

A smaller rate of increase in Canada's reserves of natural gas was evident in 1962. The net increase (gross recoverable increase less production) was 5.7 per cent compared to 9.3 per cent in 1961. The Canadian Petroleum Association compilation shows that, after allowance for the year's production, reserves of natural gas increased in 1962 by 1,899,042 million cubic feet to a recoverable total of 35,436,892 million cubic feet. Eighty-four per cent of the gross increase was a result of revisions of estimates and extensions of known gas pools; the remainder was the result of new discoveries. At the 1962 rate of gross new production, reserves are sufficient to last 34 years. Additions to reserves increased British Columbia's share of the total from 10.8 to 13.9 per cent. Alberta's share decreased from 84.6 to 82.3 per cent and Saskatchewan's decreased from 3.8 to 3.0 per cent.

Table 8

ESTIMATED YEAR-END RECOVERABLE RESERVES OF NATURAL GAS
(millions of cubic feet)

	1961	1962
Alberta	28,370,122	29,177,363
British Columbia	3,618,629	4,932,600
Saskatchewan	1,264,227	1,062,201
Eastern Canada	221,062	201,771
Northwest Territories	62,563	61,897
Manitoba	1,247	1,060
Total	33,537,850	35,436,892

Source: Canadian Petroleum Association.

Table 9

GAS-PIPELINE MILEAGE IN CANADA, 1957-62

	1957	1958	1959	1960	1961	1962
Gathering*						
New Brunswick	11	11	6	6	6	6
Ontario	941	940	955	910	1,314	1,374
Saskatchewan......	92	311	280	285	275	275
Alberta	972	1,634	1,860	2,075	2,852	2,901
British Columbia...	120	213	335	410	429	449
Total............	2,136	3,109	3,436	3,686	4,876	5,005
Transmission*						
New Brunswick	11	11	15	15	13	13
Quebec............	26	26	25	25	25	25
Ontario	2,520	3,466	3,530	3,565	3,135	3,148
Manitoba..........	354	375	390	445	457	514
Saskatchewan......	1,093	1,395	1,780	2,100	2,274	2,407
Alberta	2,127	2,581	3,095	3,460	4,088	4,172
British Columbia...	1,101	1,101	1,105	1,105	1,225	1,311
Total............	7,232	8,955	9,940	10,715	11,217	11,590
Distribution						
New Brunswick	65	65	30	30	32	32
Quebec............	963	971	1,025	1,115	1,123	1,130
Ontario	5,770	8,095	9,145	9,530	10,184	10,399
Manitoba..........	433	510	690	835	854	869
Saskatchewan......	879	947	1,060	1,205	1,273	1,392
Alberta	2,075	2,202	2,455	2,560	2,896	2,985
British Columbia...	1,902	2,380	2,710	3,135	3,183	3,211
Total............	12,087	15,170	17,115	18,410	19,545	20,018

Source: Dominion Bureau of Statistics.

*Some lines in Ontario and Saskatchewan were reclassified or discontinued in 1961, and some in New Brunswick were discontinued.

TRANSPORTATION

Construction of natural gas pipelines in 1962 was on a considerably smaller scale than in the preceding year. Approximately 1,000 miles of gas pipeline were laid, of which more than half was small- to medium-diameter distribution line. In Ontario, The Consumers' Gas Company and its subsidiaries constructed more than 300 miles of distribution and transmission lines and Union Gas Company of Canada, Limited, built 203 miles of pipeline. Saskatchewan Power Corporation added 232 miles of transmission pipeline and 149 miles of distribution line to its Saskatchewan systems. A comparatively small amount of large-diameter transmission line was constructed in 1962. Trans-Canada Pipe Lines Limited added 4 sections of 34-inch loop, totalling 59 miles, in Manitoba and Saskatchewan. The Alberta Gas Trunk Line Company laid 10 miles of 34-inch loop just west of the Alberta-Saskatchewan boundary. The same company constructed 39 miles of 12-inch pipeline from the Worsley gas field to the pipeline of Westcoast Transmission Company Limited at the Alberta-British Columbia boundary, and commenced gas deliveries in October.

NATURAL GAS PROCESSING

The growth of natural gas processing facilities in 1962 continued at about the same rate as in 1961. At the end of 1962, Canada had a total natural gas plant capacity of 3,703 million cubic feet a day of which nearly 85 per cent was in Alberta. Seventy of the eighty gas plants were in Alberta. The largest gas processing plants to come on stream in 1962 were the sour gas plants at the Waterton and Windfall fields. Large gas-cycling plants were completed at the Harmattan-Elkton and Carson Creek fields. At the Carson Creek plant, gas liquids are extracted and the residue gas is returned to the reservoir for pressure maintenance.

USES

Methane (CH_4) is the main chemical constituent of marketed natural gas, but minor amounts of other combustible hydrocarbons such as ethane, propane and butane may be included. Natural gas, although odorless and non-poisonous, is artificially supplied with a characteristic strong odor as a safety measure. Heating value of natural gas averages about 1,000 British Thermal Units per standard cubic foot of gas.

A conservative estimate places the number of different applications of natural gas at more than 25,000 although in most of these it is used as a fuel. Table 14 shows the amount of natural gas used in Canada for residential, industrial, and commercial purposes. An important use in each of these categories is for space heating and water heating. Gas is now extensively used in cooking, and is fast developing into an important fuel for air conditioners, incinerators, dishwashers and laundry equipment. The steel industry uses natural gas in metallurgical processing and natural gas now constitutes one of the main fuels in blast furnaces. The clean, easily-controlled flame enables

Table 10

NATURAL GAS PROCESSING PLANTS IN OPERATION - END OF 1962
(millions of cubic feet a day)

Fields Served	Raw Gas Capacity	Residue Gas Produced
Alberta		
Acheson	5	4
Alexander	55	45
Black Butte, Aden	10	10
Bonnie Glen, Glen Park, Wizard Lake......	30	24
Boundary Lake South	25	22
Crossfield	150	125
Carbon	67	65
Carson Creek	75	re-injected
Carstairs, Crossfield	225	150
Cessford (5 plants).......	191	183
Chigwell (2 plants).......	12	10
Countess	18	17
Enchant	5	5
Gilby (2 plants)..........	33	31
Golden Spike	26	22
Harmattan-Elkton........	107	re-injected
Homeglen-Rimbey, Westerose South	326	280
Hussar (2 plants)	80	62
Innisfail	15	10
Jumping Pound, Sarcee	110	90
Kaybob	41	40
Kessler	4	3
Leduc-Woodbend	35	31
Minnehik-Buck Lake	57	51
Morinville, St. Albert-Big Lake, Campbell-Namao ..	25	25
Nevis	56	48
Nevis, Stettler, Fenn-Big Valley	35	24
Okotoks	30	13
Oyen	3	3
Pembina (9 plants)	96	77
Pembina (Cynthia)	10	6
Pembina (Lobstick)	25	22
Parkland................	6	5
Pincher Creek	204	145
Prevo	5	4
Princess (3 plants).......	19	19
Provost (2 plants)........	93	69
Redwater	11	8
Samson	3	3
Savanna Creek...........	75	59
Sedalia	5	5
Sibbald	6	5
Three Hills	5	5
Turner Valley	100	85
Waterton................	180	121
Wayne-Rosedale (2 plants)..............	17	15
Wildcat Hills	96	83
Windfall	204	110
Wood River	5	5
Worsley	55	52
Pipeline at Edmonton.....	70	66
Saskatchewan		
Alida, Nottingham, Carnduff	9	6
Coleville................	60	59
Smiley	4	3
Steelman, West Kingsford.	38	30
Cantuar	25	24
British Columbia		
Fields in Fort St. John area	395	300
Boundary Lake	10	10
Ontario		
Fields in southwestern Ontario (3 plants)	21	21

Source: Department of Mines and Technical Surveys, Natural Gas Processing Plants in Canada (Operators List 7), January 1963.

the desired temperature to be attained in rolling, shaping, drawing and tempering steel. Other industrial applications include vitreous enamelling of aluminum alloy and glass blowing. Gas is now a major source of raw material for the petrochemical industry. Among the products which use natural gas as a basic raw material are ammonia, fertilizers, nylon, orlon, dacron, acrilan, plastics, synthetic rubber, insecticides, detergents and dyes. Important future uses may include gas fuel cells and power generator systems driven by gas turbines. Canada has recently become one of the world's largest suppliers of sulphur, a by-product from the hydrogen-sulphide-bearing sour gas fields in western Canada.

Table 11

PRODUCTION OF BYPRODUCTS FROM NATURAL GAS

(ALBERTA, SASKATCHEWAN AND BRITISH COLUMBIA), 1951-62

	Propane (barrels)	Butane (barrels)	Natural Gasoline* (barrels)	Plant Condensate (barrels)	Sulphur** (long tons)
1951	248,554	84,527	515,027	-	-
1952	337,678	140,228	579,873	-	7,974
1953	433,083	198,401	602,771	-	16,337
1954	529,117	245,189	682,378	18,083	19,929
1955	796,482	492,051	868,416	160,100	25,976
1956	925,716	591,638	913,572	164,573	29,879
1957	1,111,355	747,709	968,162	153,278	89,916
1958	1,123,797	748,972	978,085	116,568	165,116
1959	1,690,114	1,424,452	1,396,979	862,434	261,015
1960	2,064,623	1,536,621	1,444,687	1,015,962	404,591
1961	2,875,823	2,157,309	1,875,001	3,569,033	487,679
1962	3,671,683	2,744,044	2,000,942	8,801,494	1,035,988

Sources: Dominion Bureau of Statistics and provincial government reports.
*Partly a byproduct of crude-oil production.
**Elemental sulphur from natural gas.
Symbol: - Nil.

Table 12

SALES OF NATURAL GAS IN CANADA, 1962

	Mcf*	$	Average $/Mcf	Number of Customers Dec. 31, 1962
New Brunswick.....	88,442	242,889	2.75	2,852
Quebec	23,137,854	22,899,639	0.99	239,439
Ontario............	149,082,419	128,914,912	0.86	553,621
Manitoba...........	18,345,781	12,781,978	0.70	58,269
Saskatchewan	37,985,900	17,656,203	0.46	83,956
Alberta............	157,867,525	45,141,763	0.29	224,877
British Columbia ...	33,521,152	29,952,061	0.89	145,071
Total, Canada ...	420,029,073	257,589,445	0.61	1,308,085
Previous totals				
1959	283,230,089	159,781,809	0.56	1,062,976
1960	325,609,411	194,422,714	0.60	1,149,101
1961	377,064,901	226,678,494	0.60	1,227,658

Source: Dominion Bureau of Statistics. * Mcf = 1,000 cubic feet.

Table 13

SALES OF NATURAL GAS IN CANADA, ON PERCENTAGE BASIS

	1961	1962
Alberta	38.74	36.57
Ontario	33.19	35.57
Saskatchewan	9.40	8.41
British Columbia	7.86	8.75
Quebec	6.42	5.21
Manitoba	4.37	5.47
New Brunswick	0.02	0.02
Total	100.00	100.00

Source: Dominion Bureau of Statistics.

MARKETS AND TRADE

In Canada,sales of natural gas increased by 11.4 per cent in 1962, compared to 16 per cent in 1961. Industrial sales accounted for 51.7 per cent and residential sales for 32.7 per cent of consumption. The remaining sales were to commercial and miscellaneous customers. Alberta is still the leading consumer accounting for 37.5 per cent of all sales in Canada. Ontario is rapidly taking over a larger share of the market; in 1962 sales there accounted for 35.5 per cent of the total.

Exports of natural gas increased by 90 per cent in 1962 to nearly 320,000 million cubic feet. Most of this increase is attributable to the first full year of operation of the Alberta to California gas pipeline, through which 45 per cent of Canada's exported gas moved in 1962. Twenty-nine per cent of the exported gas was piped through the line of Westcoast Transmission Company Limited at Huntingdon, British Columbia, and 18 per cent was exported by way of the lateral of Trans-Canada Pipe Lines Limited at Emerson, Manitoba.

Since the completion of the Trans-Canada pipeline in 1958, imports of natural gas into Ontario have decreased sharply. Imports now are a comparatively small part in Canada's natural-gas trade. Approximately 5,570 million cubic feet of gas is imported into Ontario each year. This amount will probably be unchanged until the gas-export licence expires in 1967. In 1962, Ontario took 98.7 per cent of the imported gas and Alberta received the remainder.

Table 14

NATURAL GAS - SUPPLY AND DEMAND
(millions of cubic feet)(a)

	1961	1962
Supply		
Gross new production(b)	732,460	1,038,152
Field waste and flared gas	-80,262	-96,508
Net new production	652,198	941,644
Removed from storage	29,098	31,771
Placed in storage	-56,715	-86,205
Net withdrawals from storage	-27,617	-54,434
Net supply of domestic gas	624,581	887,210
Imports	5,574	5,575
Total supply	630,155	892,785
Demand		
Exports	168,180	319,566
Residential sales	122,030	137,454
Industrial sales	197,282	217,330
Commercial sales	57,648	65,245
Miscellaneous sales	105	-
Total domestic sales	377,065	420,029
Consumption and losses in production	70,616	122,496
Pipeline consumption, losses and metering differences	13,204	22,095
Line Pack changes	1,317	156
Gas unaccounted for	-227	+8,443
Total demand	630,155	892,785
Total domestic consumption(c)	461,975	573,219
Average daily domestic consumption	1,266	1,570

Sources: Dominion Bureau of Statistics, and provincial government reports.
(a) At 14.73 pounds per square inch absolute.
(b) Excludes gas reproduced from storage.
(c) Total demand minus exports.
Symbol: - Nil.

Nepheline Syenite

J. E. Reeves*

Production statistics indicate that, after a minor decline in 1961, shipments of Canadian nepheline syenite increased to an all-time high in 1962. Total exports, however, remained at approximately the same level as for the two previous years. Canadian trade statistics for the year show a modest increase in exports of this commodity to the principal customer, the United States. Exports to Britain also increased in 1962, but exports to most other countries declined.

PRODUCERS

The only nepheline syenite in Canada of current commercial interest is the large Blue Mountain deposit in Methuen township in southeastern Ontario. At the southwestern end of the deposit Industrial Minerals of Canada Limited operates a 600-ton per day mill which produces glass-grade nepheline syenite and small quantities of several fine-ground, high-quality grades and several lower-quality (higher-iron) by-product grades. In June 1962, the company formed a subsidiary, Indusmin Limited, to handle all its mining and processing operations, but retains control of sales and market research.

At the northeastern end of the deposit International Minerals & Chemical Corporation (Canada) Limited has a processing plant in which predominantly glass-grade nepheline syenite is obtained. During the year the capacity of the plant was increased to about 600 tons a day. All mining on Blue Mountain is by quarry.

OTHER CANADIAN OCCURRENCES

In the Bancroft and Gooderham areas of southeastern Ontario there are numerous small deposits of nepheline gneiss. The nepheline content of these deposits is more erratic than in Blue Mountain, but in places is relatively high.

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* Mineral Processing Division.

NEPHELINE SYENITE - PRODUCTION, EXPORTS AND CONSUMPTION

	1961		1962	
	Short Tons	$	Short Tons	$
PRODUCTION (shipments) ...	240,320	2,572,169	254,418	2,605,421
EXPORTS				
United States..............	177,740	1,972,665	179,105	2,023,852
Britain..................	10,170	144,436	11,263	130,090
Puerto Rico...............	1,450	21,665	1,000	12,305
Dominican Republic........	250	11,331	595	7,259
Belgium and Luxembourg...	2,692	44,058	560	12,040
Netherlands...............	774	13,810	286	5,865
West Germany.............	392	7,559	250	5,160
Australia.................	455	21,571	239	6,597
Other countries...........	675	12,253	360	7,666
Total	194,598	2,249,348	193,658	2,210,834
CONSUMPTION*				
Glass	32,056		33,407	
Glass fibre................	2,593		3,015	
Mineral wool..............	806		572	
Other ceramic products	4,054		5,632	
Other products	225		453	
Total	39,734		43,079	

Source: Dominion Bureau of Statistics.
* Available data.

Some of these deposits were mined in a small way before 1942. Elsewhere in Ontario there are relatively large deposits - in Bigwood township northeast of Georgian Bay, and adjacent to the north shore of Lake Superior near Port Coldwell.

Nepheline syenite also occurs in southeastern British Columbia in national parkland in the Ice River area near Field, and in the vicinity of the Big Bend of the Columbia River.

In several places in northern Ontario and southeastern Quebec, nepheline is common in alkaline-rock complexes.

FOREIGN PRODUCTION

Outside Canada, there is commercial exploitation of nepheline-bearing rocks to produce ceramic raw materials only in Russia and Norway.

In late 1960, mining and dry processing of nepheline syenite began from a large deposit on the island of Stjernøy, off the northern coast of Norway. A high-quality glass-grade and a high-quality fine-ground product are produced, which have an alumina (Al_2O_3) content of more than 24 per cent, a total alkali content of about 17 per cent - with potash (K_2O) predominating slightly over soda (Na_2O) - and an iron content of less than 0.1 per cent Fe_2O_3.

For many years Russia has produced a by-product nepheline concentrate from the large quantity of apatite-nepheline rock that is mined annually from the famous and unusual Khibiny deposits, located near Kirovsk in the Kola Peninsula. The nepheline concentrate contains about 29 per cent Al_2O_3, 11 per cent Na_2O, 9 per cent K_2O and about 4 per cent Fe_2O_3, and is useful as a raw material for green-glass manufacture. It has also become important as an aluminum ore, and has focused attention on nepheline-bearing rock from deposits in other parts of the U.S.S.R. as sources of aluminum.

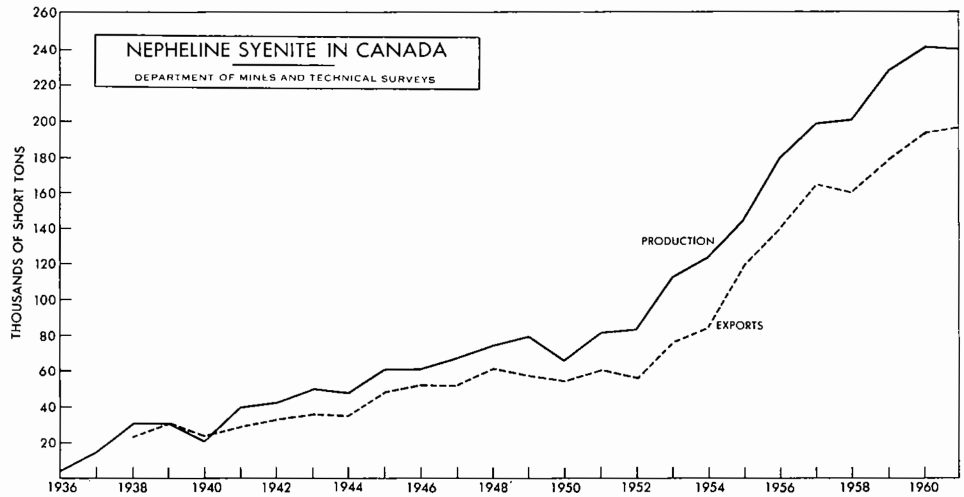
TECHNOLOGY

Nepheline syenite from the Blue Mountain deposit is a quartz-free crystalline rock consisting principally of the minerals nepheline (a sodium-aluminum silicate) and feldspar (both soda and potash varieties, with the soda variety predominating). Present also are small quantities of the iron-bearing minerals, magnetite, biotite and hornblende. To produce a commercial product, essentially all of the iron minerals are removed by high-intensity dry magnetic separators, with a reduction of the iron content from about 2 per cent to less than 0.1 per cent Fe_2O_3.

Ground and beneficiated nepheline syenite is industrially valuable because of its comparatively high alumina content (typically 23.3 per cent) and alkali content (about 15 per cent, with a soda-potash ratio of 2:1), and its relatively low melting temperature.

USES AND SPECIFICATIONS

In glass-manufacturing nepheline syenite is important primarily as a source of alumina and alkalis. In the Canadian glass industry it has replaced feldspar; in the northeastern United States it has been extensively substituted



for feldspar in the glass industry. The specification for particle size is minus 30 plus 200 mesh, U.S. Standard. In general, the iron content, expressed as Fe_2O_3, must be less than 0.1 per cent.

In smaller quantities, nepheline syenite is used in the whiteware industry as both a body and a glaze ingredient. Because of its lower fusion temperature, many Canadian manufacturers of sanitaryware, dinnerware, wall tile and pottery have substituted it for feldspar. Particle size specifications require that the nepheline syenite be mainly minus 325 mesh, the proportion of this size depending on the end use. An Fe_2O_3 content of less than 0.1 per cent is also necessary.

Because of its relatively low fusion temperature, fine-ground nepheline syenite is used as a frit ingredient for porcelain enamels. Specifications are similar to those for whitewares. Very small quantities of fine-ground material are finding acceptance as a filler in paints and other manufactured products.

Cheaper, lower-grade by-products are used to some extent in groundcoat enamels, structural-clay products and glass fibre and in the body and glaze of sewer pipe; in all of these the higher iron content is of no importance. Some crude is used in the manufacture of mineral wool.

PRICES

Prices are not generally quoted for Canadian nepheline syenite, however, the approximate price of glass-grade, f.o.b. the Blue Mountain area, is $9 a ton. According to Canadian Chemical Processing of October 1962, the finest-ground, high-quality product, bagged, in car lots, f.o.b. works, is $28.50 a short ton.

Nickel

C.C. Allen*

Canadian nickel production for 1962 was 232,242 tons valued at $383,784,622. This was comparable to the 1961 production though the 1962 value was considerably higher. Noteworthy events included initial production from Marbridge Mines Limited, Quebec's first nickel producer, and Nickel Mining & Smelting Corporation in northwestern Ontario. North Rankin Nickel Mines Limited, on the west side of Hudson Bay, ran out of minable-grade ore and closed in September. The year 1962 was the first full year of production from the Thompson mine of The International Nickel Company of Canada, Limited. Falconbridge Nickel Mines, Limited completed contract deliveries to United States government stockpiles.

Nickel marketing was characterized by keen competition. Supply was greater than demand for the first time in many years due to increased production capacity and the cessation of nickel deliveries to the United States stockpiling programs. Increased supply resulted in a 2 1/4 cents per pound reduction in the price of nickel by Falconbridge Nickel Mines, Limited, which was followed by all companies, and a 13 per cent reduction in production in the fourth quarter by International Nickel. Further, Société le Nickel of France began marketing small amounts of nickel of New Caledonia origin in the United States.

On the world market, there was little change in the source of nickel. Canada and New Caledonia supplied most of the Free World's nickel, and U.S.S.R. and Cuba that of the Iron Curtain countries. Production from new sources commenced in East Germany, Czechoslovakia and Brazil but these were all minor suppliers. A change in future ore supply will result from the agreement whereby Indonesia will sell, monthly, 10,000 tons of lateritic-nickel ore to Japan; this will considerably lessen Japanese ore requirements from New Caledonia. For 1963, Japan also contracted for 3,000 tons of contained nickel in matte from New Caledonia.

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* Mineral Resources Division

Table 1

NICKEL - PRODUCTION, TRADE AND CONSUMPTION

	1961		1962	
	Short Tons	$	Short Tons	$
PRODUCTION				
All Forms(a)				
Ontario	196,218	295,423,149	166,582	274,219,955
Manitoba	32,978	50,039,745	61,482	102,586,082
British Columbia	2,090	3,194,037	1,738	2,902,850
Quebec	-	-	1,540	2,571,898
Northwest Territories	1,705	2,604,789	900	1,503,837
Total	232,991	351,261,720	232,242	383,784,622
EXPORTS				
In ores, concentrates, matte or speiss				
Britain	54,103	81,814,986	41,861	67,830,193
Norway(b)	36,056	43,506,966	33,396	47,204,005
Japan	2,339	2,265,543	1,673	1,643,801
United States	431	459,887	479	677,388
Belgium and Luxembourg	-	-	1	1,000
West Germany	9	9,674	-	-
Total	92,938	128,057,056	77,410	117,356,387
In oxide sinter				
United States	11,015	14,325,608	6,503	9,344,301
Britain	1,956	1,730,741	2,744	2,244,011
Australia	745	913,033	609	856,553
Italy	947	1,341,189	409	657,726
France	1,257	1,749,696	323	520,609
Sweden	950	1,317,056	295	475,743
Belgium and Luxembourg	403	571,471	187	298,534
Austria	201	292,366	50	80,402
Other countries	548	653,898	-	279
Total	18,022	22,895,058	11,120	14,478,158

Table 1 (cont'd)

	1961		1962	
	Short Tons	$	Short Tons	$
EXPORTS (Con'd)				
Nickel and nickel-alloy scrap				
United States	313	266,255	785	430,971
Netherlands	54	15,559	83	4,391
West Germany	127	58,010	77	22,995
France	-	-	15	8,750
Other countries	124	86,916	9	6,726
Total	618	426,740	969	473,833
Anodes, cathodes, ingots, rod and shot				
United States	98,674	136,596,934	104,577	158,315,562
Britain	14,273	19,830,036	9,921	15,157,513
West Germany	4,690	6,853,505	2,000	3,223,209
Japan	1	1,891	1,052	1,775,188
Brazil	879	1,343,528	808	1,368,246
Italy	1,403	2,047,334	727	1,168,421
Australia	279	490,387	689	1,271,467
India	369	569,900	423	714,599
Austria	856	1,245,868	308	490,113
Sweden	1,939	2,837,802	284	466,192
Other countries	10,141	15,396,547	923	1,567,157
Total	133,504	187,213,732	121,712	185,517,667
Nickel and nickel-alloy fabricated materials not elsewhere specified				
United States	2,631	3,794,481	3,182	5,087,157
Britain	104	372,798	104	429,504
West Germany	14	34,446	50	85,608
Sweden	12	15,599	43	52,711
India	38	66,371	42	70,513
New Zealand	15	60,018	33	150,236
Other countries	37	89,893	57	163,062
Total	2,851	4,433,606	3,511	6,038,791

Table 1 (cont'd)

	1961		1962	
	Short Tons	$	Short Tons	$
IMPORTS				
Primary and Semi-fabricated(c)				
Norway	2,495	4,230,702	5,595	9,671,199
United States	1,793	4,217,059	1,873	5,004,815
Britain	14	49,200	18	64,490
Other countries	2	7,870	8	23,292
Total	4,304	8,504,831	7,494	14,763,796
Manufactures				
United States		1,636,254		870,712
Britain		240,215		97,650
West Germany		243,500		82,345
Japan		48,887		34,750
Italy		27,224		20,934
Other countries		106,348		23,871
Total		2,302,428		1,130,262
Total imports		10,807,259		15,894,058
CONSUMPTION (d)				
all forms	4.935		5,259	

Source: Dominion Bureau of Statistics.

(a) Refined nickel and nickel in oxides and salts produced, plus recoverable nickel in matte and concentrates exported.

(b) For refining and re-export.

(c) Nickel in bars, rods, strips. sheets and wire; nickel and nickel-silver in ingots; nickel-chromium in bars.

(d) Consumption of nickel, all forms (refined metal, oxide and salts) as reported by consumers.

Symbol: - Nil.

Table 2

NICKEL - PRODUCTION, TRADE AND CONSUMPTION, 1952-62

(short tons)

	Production(a)	Exports				Imports(b)	Consumption(c)
	All Forms	In Matte etc.	In Oxide Sinter	Refined Metal	Total		
1952	140,559	63,753	1,211	77,058	142,022	1,650	2,223
1953	143,693	63,909	1,299	79,909	145,117	3,083	2,275
1954	161,279	65,823	1,486	91,410	158,719	1,584	2,595
1955	174,928	65,954	1,453	106,473	173,880	2,103	5,020
1956	178,515	70,715	1,767	104,356	176,838	2,554	5,545
1957	187,958	73,694	1,706	103,258	178,658	2,091	4,532
1958	139,559	67,659	1,393	85,168	154,220	2,155	4,099
1959	186,555	65,657	4,157	102,111	171,925	1,857	3,689
1960	214,506	73,910	13,257	108,350	195,517	1,762	4,861r
1961	232,991	92,938	18,022	133,504	244,464	4,304	4,935
1962	232,242	77,410	11,120	121,712	210,242	7,494	5,259

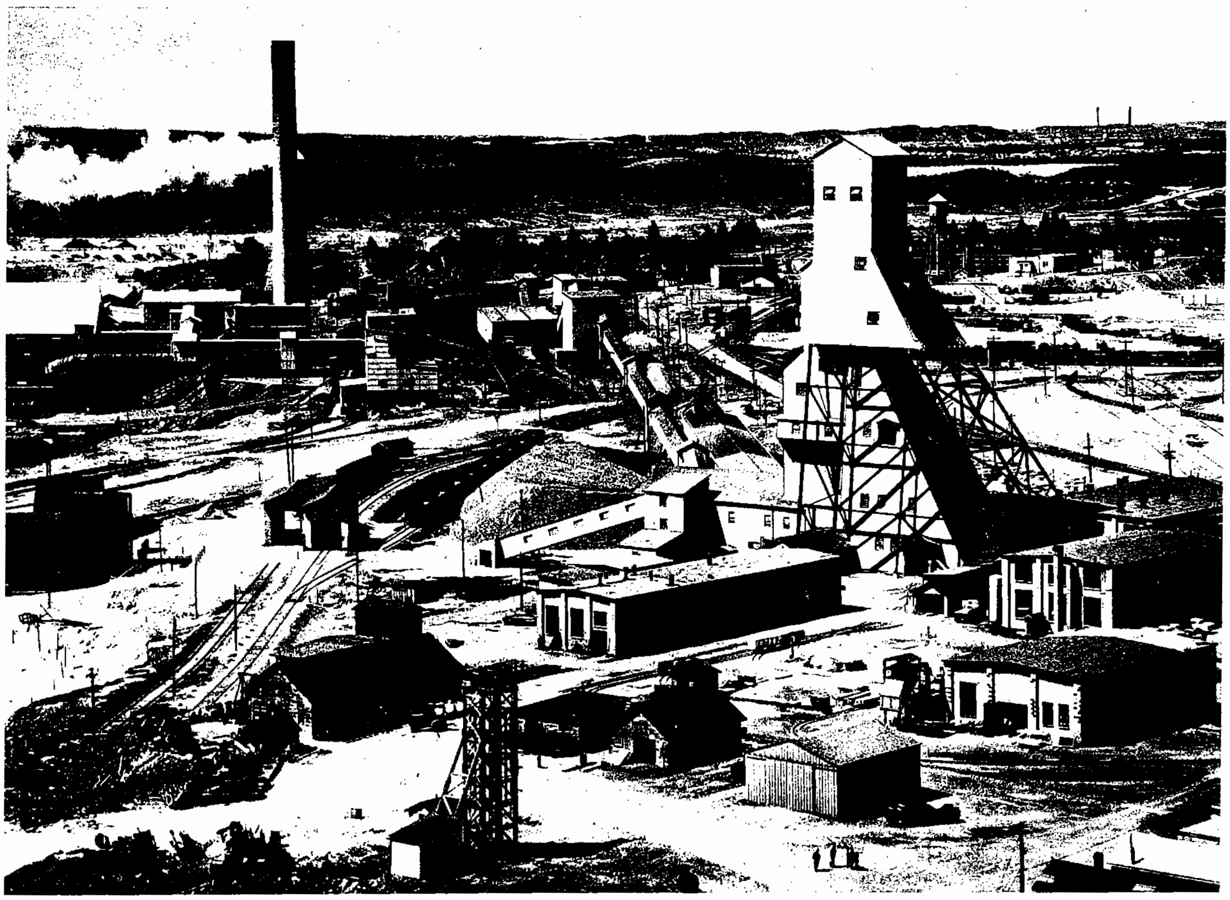
Source: Dominion Bureau of Statistics.

(a) Refined metal and nickel in oxides and salts produced, plus recoverable nickel in matte and concentrates exported.

(b) Nickel in semifabricated forms; including nickel in bars, rods, strips, sheets and wire; nickel and nickel-silver in ingots; nickel-chromium in bars.

(c) To 1959, producers' domestic shipments of refined metal; after 1959, consumption of nickel, all forms (refined metal, oxide and salts) as reported by consumers.

Symbol: r Revised from previously published figure.



The main shaft-headframe (right) and smelter (left) of Falconbridge Nickel Mines, Limited, near Sudbury, Ontario. In the background the Copper Cliff smelter of The International Nickel Company of Canada, Limited, is visible. The Sudbury area produces 60 per cent of the Free World's nickel.

Canadian Developments

Sudbury continued to be the main source of Canadian nickel production though an appreciable part came from Manitoba. International Nickel operated 7 mines at Sudbury - Creighton, Frood-Stobie, Garson, Levack, Murray as underground mines and the new Clarabelle and Ellen as open pits. The Ellen was subsequently closed and the Crean Hill mine, ready for production, was maintained on a standby basis. At the Copper Cliff North mine, Sudbury, shaft-sinking to the 3,000-foot level continued, at year end a depth of 2,105 feet had been reached. Ore production from mines in Ontario and Thompson, Manitoba, amounted to 13,794,000 tons compared to 17,489,000 tons in 1961. On December 31, 1962, ore reserves in Ontario and Manitoba totalled 299,416,000 tons; the nickel-copper content was 9,006,300 tons. Comparable reserves in 1961 were 297,419,000 tons containing 8,937,000 tons of nickel and copper.

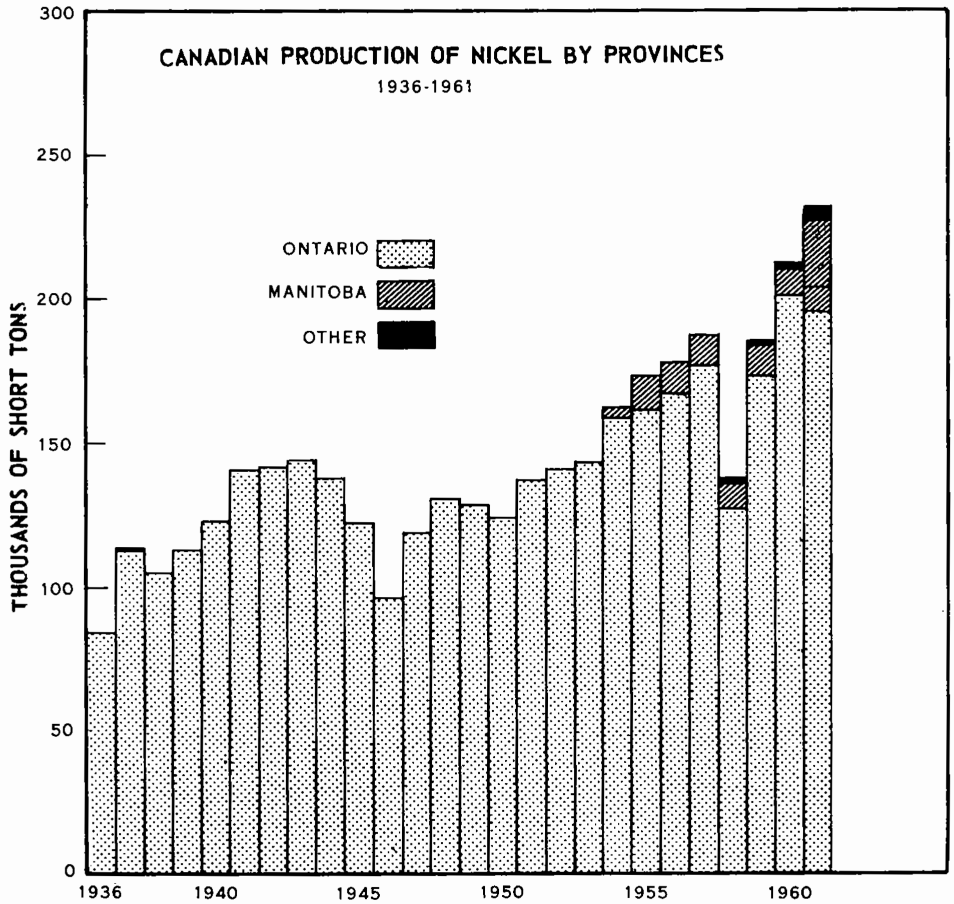
In September, International Nickel announced a fourth-quarter cutback from 92 million to 80 million pounds of nickel. The thirteen-per-cent reduction necessitated the lay-off of 2,500 employees, mostly in the Sudbury area. The reduced production was not entirely due to a lowering of demand but primarily to surplus production above world demand and INCO's inventory requirement. The company continued construction on the enlargement of its Copper Cliff, Ontario, iron-ore recovery plant designed to increase production from 300,000 to 900,000 short tons of pellets a year. The project is scheduled for completion in 1963.

Falconbridge Nickel Mines, Limited, whose refinery is at Kristiansand, Norway, operated the Falconbridge and East mines in the Falconbridge, Ontario, area, and the Hardy, Onaping and Fecunis on the north rim of the Sudbury basin. At the Strathcona deposit shaft-sinking was completed to the 3,205-foot horizon and lateral development was underway at the year end. At the East mine, a contract was let for sinking a winze from the 4,025-foot level to the 6,050-foot level. Additional work was done at Norduna Mines Limited to extract a small quantity of ore below the 700-foot level. This was accomplished and the mine subsequently closed.

Falconbridge nickel deliveries during the year amounted to 61,061,000 pounds, 4,485,000 pounds fewer than in 1961. Ore delivered to treatment plants was 2,407,520 tons. Ore reserves at the year end - slightly greater than 1961 - were: developed ore, 21,096,850 tons at 1.62 per cent nickel, 0.84 per cent copper and indicated ore, 27,166,150 tons at 1.32 per cent nickel and 0.77 per cent copper. Total reserves were 48,263,000 tons at 1.45 per cent nickel and 0.80 per cent copper.

Other mine developments in eastern Canada were the coming into production of Marbridge Mines Limited and Nickel Mining & Smelting Corporation. Marbridge, in LaMotte township adjacent to Malartic, is Quebec's first nickel producer. Official production commenced in June after which 100,000 tons of ore were treated. Bulk nickel-copper concentrates are trucked to Falconbridge Nickel Mines at Falconbridge, Ontario, for smelting. Reserves at year end totalled 217,000 tons averaging 2.29 per cent nickel and 0.10 per cent copper. Drilling suggested a downward extension of the ore lens below the

900-foot horizon. Nickel Mining & Smelting is milling at a rate of 500 tons daily. Its bulk nickel-copper concentrates are trucked to Lac du Bonnet, Manitoba, then rail shipped to International Nickel at Copper Cliff for smelting.



MINERAL RESOURCES DIVISION
DEPARTMENT OF MINES AND TECHNICAL SURVEYS

In Manitoba the Thompson property of International Nickel experienced its first full year of production and its production plus that of Sherritt Gordon Mines, Limited totalled 62,099 tons of nickel. Manitoba now accounts for approximately 26 per cent of Canadian nickel production. At Thompson, surface preparations were made for the sinking of a second production shaft, extending to the 2,400-foot level. Nickel production capacity at Thompson during the year was increased to over 90 million pounds from 75 million pounds.

Sherritt Gordon's Fort Saskatchewan refinery, near Edmonton, Alberta, continued to treat Lynn Lake concentrates and purchased concentrates from North Rankin Nickel Mines Limited. At the Lynn Lake mine of Sherritt Gordon, the Farley shaft is to be deepened from its present 2,637 feet to 3,450 feet with the 3,000-foot level to be the main haulage and exploratory level. Additional ore is expected in the block of ground below the present working levels. Two areas of mineralization were discovered on the 2,000-foot level, the first of which is a new ore body and the second, while the overall grade is not economic, contains concentrations of ore grade. Ore reserve tonnage at the year end was the same as the previous year - 14 million tons grading 0.94 per cent nickel and 0.55 per cent copper. The grade was slightly better than that of the previous year. Ore mined during the year totalled 1,262,502 tons, 43,345 tons more than for 1961. At the Fort Saskatchewan refinery, construction work was completed on both the urea plant and on the addition to the ammonia plant.

North Rankin closed in September, prior to the closure of the shipping season, when minable grade ore was exhausted. Before closure 48,677 tons were milled grading 2.50 per cent nickel and 0.74 per cent copper. The mining and milling plants were dismantled and the townsite sold.

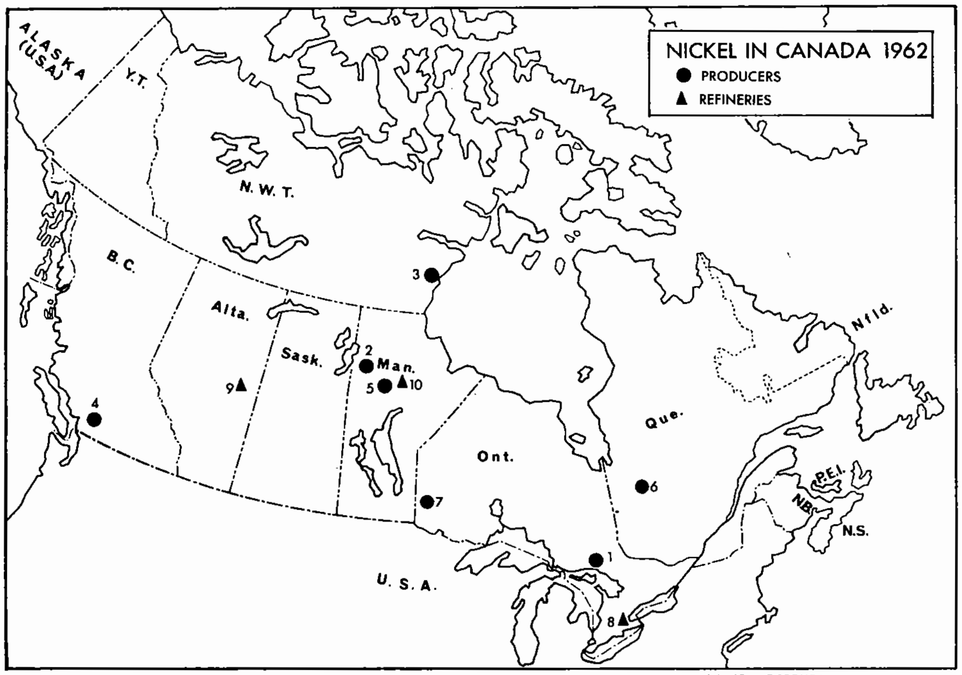
Giant Nickel Mines Limited in British Columbia, wholly-owned subsidiary of Giant Mascot Mines, Limited, completed its expansion to 1,200 tons daily. Concentrates are exported to Japan. The 311,443 tons treated averaged 0.85 per cent nickel and 0.32 per cent copper.

Exploration and Development

There were encouraging results from the exploration for new nickel deposits in Canada during 1962. Raglan Nickel Mines Limited, operating in the Ungava area of far northern New Quebec, had increased estimated reserves by mid-year to 6.4 million tons averaging 1.60 per cent nickel and 0.80 per cent copper.

The nickel-copper prospect of Cochenour Willans Gold Mines, Limited on Pipestone Bay, at the west end of Red Lake in northern Ontario, was optioned to Falconbridge Nickel and subsequently dropped. McIntyre-Porcupine Mines, Limited optioned a nickel-copper prospect in the Belleterre area of northern Quebec near the boundary of Blondeau and Gaboury townships, about 13 miles southwest of Belleterre. At last report the sulphide lens being drilled was about 250 feet in length and open at depth. Two diamond drills continued operating. On the northwest, the property adjoins that of Consolidated Regcourt Mines Limited on which exploration was done prior to 1962.

Marmal Nickel Mines Limited, with property in the Cross Lake area of northern Manitoba, was formed from the holdings of Consolidated Marbenor Mines Limited and Rio Tinto Canadian Exploration Limited. Falconbridge subsequently optioned the Marmal holding for further exploration and development. Diamond drilling on the Macassa Gold Mines Limited's Bicroft nickel property in eastern Ontario indicated 2,200 tons per vertical foot to one thousand feet that averaged one per cent nickel and 0.25 per cent copper. Metallurgical and feasibility studies were continuing.



MINERAL RESOURCES DIVISION
DEPARTMENT OF MINES AND TECHNICAL SURVEYS

Producers

1. Sudbury area
   International Nickel Company of Canada, Limited, The (7 mines, 2 smelters)
   Falconbridge Nickel Mines, Limited (5 mines, 1 smelter)
   Norduna Mines Limited
2. Sherritt Gordon Mines, Limited, Lynn Lake, Manitoba
3. North Rankin Nickel Mines Limited
4. Giant Nickel Mines Limited, near Hope, British Columbia
5. International Nickel Company of Canada, Limited, The (Thompson mine)
6. Marbridge Mines Limited
7. Nickel Mining & Smelting Corporation

Refineries

8. International Nickel Company of Canada, Limited, The, Port Colborne, Ontario
9. Sherritt Gordon Mines, Limited, Fort Saskatchewan, Alberta
10. International Nickel Company of Canada, Limited, The, Thompson, Manitoba

Foreign Developments

In 1962 Japanese nickel interests decided to reduce imports of nickel laterite-ore from New Caledonia from roughly one million tons a year to 600,000 tons. Japan and Indonesia signed an agreement on a joint development project of the Celebes lateritic-nickel deposits. Initial production plans for 10,000 tons of ore monthly would necessitate a partial switch of ore supply from New Caledonia. Japanese imports of nickel ore from New Caledonia for 1963 are expected to be less than 400,000 tons. Japan also imported forty-five tons of nickel-platinum concentrates from the Philippines; these were a byproduct of chromite processing grading 21 to 23 per cent nickel.

Societe le Nickel commenced marketing New Caledonia ferronickel and nickel oxide in the United States at a planned rate of about 3 million pounds a year.

Three small nickel refineries commenced production in 1962. That at Sered in Czechoslovakia is rated at 2,000 tons annually and uses imported Albanian laterite-ore. Brazil's new plant in Minas Gerais province was scheduled for production by fall. Its production rate, not disclosed, would probably amount to a few hundred tons a year, sufficient to satisfy Brazilian nickel requirements. Production also commenced at the St. Egidien refinery in East Germany where rated annual capacity is 4,500 tons of nickel, about half of it electrolytic and half ferronickel.

In the Republic of South Africa, Anglo-American Corporation of South Africa, The International Nickel Company of Canada, Limited, and South African Minerals Corporation Limited announced plans to explore an 80,000-acre property in the Rustenburg area. South African Minerals Corporation also announced plans to re-open its nickel mine in the same area where blocked-out ore reserves in 1936 were 125,000 tons grading 3.30 per cent nickel and 0.73 per cent copper.

Table 3

WORLD PRODUCTION OF NICKEL, 1962

(short tons)

Canada	232,242
Russia	90,000
New Caledonia	32,609
Cuba	13,900
United States	11,217
Republic of South Africa	2,700
Finland	2,310
Other countries	5,022
Total	390,000

Source: American Bureau of Metal Statistics, and for Canada, Dominion Bureau of Statistics.

Table 4

FREE WORLD*NICKEL PRODUCTION CAPACITY, 1962

(short tons)

International Nickel (including Thompson).....	200,000
Falconbridge	35,000
Sherritt Gordon	13,750
Total Canada	248,750
New Caledonia (French and Japanese)	47,500
Hanna Nickel Smelting Company	11,750
Finland	2,500
South Africa	3,000
Brazil	1,100
Total	314,600

Source: Company reports.
* Cuba excluded.

CONSUMPTION AND USES

Table 5

FREE WORLD NICKEL CONSUMPTION, BY PRODUCTS, 1958-62

	1958 %	1959 %	1960 %	1961 %	1962 %
Stainless steels	27	29	32	33	30
High-nickel alloys	16	16	15	15	16
Electroplating...........	13	15	16	15	16
Nickel-alloy steels	16	15	13	14	13
Foundry products........	12	12	12	11	12
Copper-nickel alloys.....	6	4	4	4	4
All other products	10	9	8	8	9

Source: The International Nickel Company of Canada, Limited

Stainless steels continued to be the largest single outlet for nickel in 1962. The main change in the pattern of nickel consumption was a 3-per-cent decline in the relative importance of stainless steels and proportionate gains in other uses. In almost every use of nickel, whether it be in utensils, electrical appliances, transportation equipment, machines or structures, its suitability as an alloy metal is its chief attraction.

After nickel is added to steel in amounts of 1/2 to 5 per cent, these low-nickel bearing steels acquire increased strength, toughness and resistance to wear. Their uses are many: structural beams, marine engines, locomotives, railway and passenger cars, automobile parts and engines, agricultural implements and mining and earth-moving equipment etc. Other nickel steels have been designed primarily to meet extreme low-temperature conditions in which ordinary steels become brittle. Steels containing nickel and chromium are highly resistant to rust and corrosion and can be used in high temperature conditions. Thus, stainless steel with 8 per cent nickel and 18 per cent chromium is particularly suitable for food-processing equipment. Additional uses are as curtain-walls and in the petroleum, chemical and pulp and paper industries. Nickel is alloyed with iron to produce non-magnetic alloys for airplane instruments, and magnetic alloys for radios and telephones. Nickel added to cast iron increases its strength, wear and corrosion resistance, and toughness. Many engineering uses are being found for foundry products given increased ductility by the addition of nickel. Nickel can be alloyed with copper, brass and bronze, aluminum, molybdenum, cobalt, titanium and gold to produce a variety of products.

Among the newer developments in the use of nickel is that of TD-nickel consisting of thorium oxide dispersed in nickel. This new product provides increased strength in the temperature range of 1,600-2,400°F and is less costly than the hard-to-work refractory metals. For corrosion resistance in automobiles, stainless steel is meeting competition from other materials through the use of type 433 which is dipped in zinc and type 201 which is rolled thinner by temper rolling, thus maintaining strength and resistance.

PRICES

From January 1 to May 7, 1962, the Canadian price of electrolytic nickel, f.o.b. Port Colborne, Ontario, was 82.50 cents a pound. On May 7 the price rose to 86.25 cents a pound, declining to and remaining at 84.00 cents a pound from May 24 to the year end.

The United States price, including the 1 1/4-cent-a-pound import duty, was 81.25 cents (U.S.) a pound from January 1 to May 23. On May 24 the price dropped to 79 cents a pound where it remained for the rest of the year.

TARIFFS

	British Preferential	Most Favored Nation	General
Canada			
Nickel, and alloys consisting of 60% or more of nickel by weight, not otherwise provided for, viz: ingots, blocks and shot; shapes or sections, billets, bars and rods, rolled,extruded or drawn (not including nickel processed for use as anodes); strip; sheet and plate (polished or not); seamless tube.........	free	free	free
Rods, consisting of 90% or more of nickel, when imported by manufacturers of nickel electrode wire for spark plugs for use exclusively in manufacture of such wire for spark plugs in their own factories	free	free	10%
Metal, alloy strip or tubing, not being steel strip or tubing, consisting of not less than 30% by weight of nickel and 12% by weight of chromium, for use in Canadian manufactures...........	free	free	20%
Anodes of nickel	5%	7 1/2%	10%
Articles of iron, steel or nickel, or of which iron, steel or nickel is the component material of chief value, of a class or kind not made in Canada, when imported by manufacturers of electric storage batteries for use exclusively in manufacture of such storage batteries	10%	10%	20%
Ferronickel	free	5%	5%

United States

Nickel ore, nickel matte and nickel oxide	free
Nickel, and alloys in which nickel is component material of chief value:	
In cathodes, cubes, grains, ingots, pigs, shot or similar forms	1 1/4¢ lb
In anodes, bars, castings, electrodes, plates, rods, sheets, strands, strips or wire....	11%
In tubes or tubing	6 1/4%
Any of the foregoing, if cold-drawn, cold-rolled or cold-worked, shall be subject to an additional duty as follows:	
Tubes and tubing	2 1/2%
Anodes, bars, castings, electrodes, plates, rods, sheets, strands, strips or wire	4 1/2%
Other forms	5%

Niobium (Columbium) and Tantalum

V.B. Schneider*

St. Lawrence Columbium and Metals Corporation continued to be the only Canadian producer of columbium concentrate. The company reported that 1962 mine production was 971,623 pounds of columbium pentoxide (Cb_2O_5) contained in concentrates grading a minimum of 50 per cent Cb_2O_5 with a value at the mine of $966,403.69. Shipments totalled 1,016,514 pounds. This output probably made St. Lawrence Columbium the world's largest single supplier of columbium ore. The company sells three grades of columbium concentrates, the analyses of which are:

	Type A %	Type B %	Type C %
Cb_2O_5	50.0 +	52.0 to 56.0	55.0 to 58.0
TiO_2	4.0 to 7.0	4.0 to 7.0	4.0 to 6.0
SiO_2	1.5 to 4.0	1.0 to 4.0	0.5 to 1.0
P	0.08 to 0.25	0.03 to 0.05	0.03 to 0.05
S	0.3 to 0.6	0.03 to 0.05	0.03 to 0.05
SnO_2	0.01 to 0.02	0.01 to 0.015	0.005 to 0.01
H_2O	0.01 to 0.3	0.01 to 0.3	0.01 to 0.3
Cb: Ta ratio:	100:1	100:1	100:1

Geo-Met Reactors Limited, Ottawa, continued to produce standard and self-reducing ferrocolumbium. The self-reducing additive is a mixture of pyrochlore and a reductive such as aluminum or ferrosilicon. Generally, Geo-Met manufactures additives on a custom basis to meet particular metallurgical requirements.

CANADIAN OCCURRENCES

Northwest Territories

There are many columbium-tantalum occurrences in the Yellowknife area, north of Great Slave Lake. The presence of columbite-tantalite has been noted in many pegmatite dikes in association with beryl, spodumene and amblygonite.

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*Mineral Resources Division.

Table 1

NIOBIUM (COLUMBIUM) AND TANTALUM
PRODUCTION, TRADE AND CONSUMPTION

	1961		1962	
	Pounds	$	Pounds	$
PRODUCTION (shipments)				
Columbium pentoxide (Cb_2O_5)......	62,229	65,619	1,016,514	1,006,349
IMPORTS* from United States				
Columbium metal and alloys semifabricated	5	1,600	1,404	16,043
Tantalum metal and alloys, crude and scrap	2,028	30,937	231	23,290
Tantalum metal, semifabricated ...	340	38,124	125	19,598
EXPORTS** to United States				
Columbium ore and concentrates ...	35,575	32,918	1,509,928	720,878
CONSUMPTION by steel industry				
ferrocolumbium and ferrotantalum-columbium (Cb and Ta-Cb content)	22,000		26,000	

Source: Dominion Bureau of Statistics. * From United States Exports of Domestic and Foreign Merchandise (Report FT 410, Part II). ** From United States Imports of Merchandise for Consumption (Report FT 110).

British Columbia

The placer deposits on Bugaboo, Vowell and Forster creeks about 45 miles southeast of Golden consist of columbium-bearing gravel. In 1956, Quebec Metallurgical Industries Ltd., at Billings Bridge, Ontario, processed gravity concentrates from these deposits to produce high-purity columbium oxide, columbium alloys and columbium sponge. The project was discontinued, however, as uneconomical.

Manitoba

Minor amounts of Ta_2O_5 are associated with the lithium-bearing pegmatites in the Bernic Lake area. The most significant occurrence at present is that of Chemalloy Minerals Limited. However, Ta_2O_5 would have to be recovered as a byproduct of a cesium-lithium operation.

Ontario

The columbium-uranium deposits of Nova Beaucage Mines Limited are six miles west of North Bay, in an area covering the Manitou Islands of Lake Nipissing. Estimates of tonnage and grade vary considerably, but the reserves in the zone east of Newman Island, on which considerable exploration work has been conducted, are reported to amount to 2.7 million tons averaging 0.69 per cent Cb_2O_5 and 0.042 per cent uranium oxide (U_3O_8). In 1959 and 1960 investigations related to concentration of the company's pyrochlore were conducted at Kimberley, British Columbia, at the company plant at North Bay, and at the Mines Branch of the Department of Mines and Technical Surveys in Ottawa. The original financing of Nova Beaucage was provided by Inspiration Mining and Development Company, Limited*. In 1958, The Consolidated Mining and Smelting Company of Canada Limited (COMINCO) acquired controlling interest in the property and supplied funds for research and management through December 1960. At that time COMINCO decided not to exercise further stock options and the management agreement terminated.

Dominion Gulf Company has outlined two areas of columbium mineralization in Chewett township, one area containing an estimated 20 million tons of material averaging 0.5 to 0.8 per cent Cb_2O_5. Laboratory test work was conducted in 1960-61 to develop an economical recovery process but no action had been taken to the end of 1962 to bring the property into production. The Chewett ore has so far not proven to be amenable to beneficiation methods for recovery of pyrochlore concentrates. The company has developed two alternative recovery processes that lead directly to good-quality columbium pentachloride with recoveries of about 90 per cent that would then have to be reduced to columbium metal. The process to be employed will depend on the scale of operation desired as the economics of both are about the same. Development of the property will probably be delayed until there is greater demand for columbium metal.

Multi-Minerals Limited has outlined two pyrochlore-bearing deposits on its Nemegos property, about 14 miles southeast of Chapleau. In 1962 the company arranged for Chemical Research Associates, of New Jersey, to conduct beneficiation tests on its material, which contained apatite, magnetite and columbium. It is hoped that columbium may be recovered as a byproduct.

Quebec

Large pyrochlore deposits near the town of Oka, 20 miles west of Montreal, are controlled by Quebec Columbium Limited, jointly owned by Molybdenum Corporation of America and Kennecott Copper Corporation; Columbium Mining Products Ltd., jointly owned by Headway Red Lake Gold Mines Limited and Coulee Lead and Zinc Mines Limited; and St. Lawrence Columbium and Metals Corporation.

The mineral deposits associated with and contained in what is referred to as the Oka complex are about two miles east of Oka, at La Trappe. Few outcrops are to be seen as the overburden varies from six to 100 feet in thickness and in places may be as much as 200 feet thick.

The grade and quality of the mineralized material in the Oka area is not known. One estimate of reserves suggests that 18 billion tons grading 0.25 per cent Cb_2O_5 may be present, but a grade of 0.25 per cent Cb_2O_5 cannot be considered economic at present.

*Name changed 31 August 1962 to Inspiration Limited

St. Lawrence Columbium and Metals Corporation has calculated that there are 62.7 million tons of indicated and proven pyrochlore ore containing 500 million pounds of Cb_2O_5 on the explored part of its property. This calculation concerns only ore containing, as a computed average, a minimum of eight pounds of Cb_2O_5 a ton or an average grade of 0.4 per cent Cb_2O_5. The capacity of the mill, built and operated in 1961, was increased in November 1962 from 500 tons a day to 1,000 tons.

Columbium Mining Products Ltd. believes it has reserves amounting to 100 million tons assaying 0.3 per cent Cb_2O_5. Quebec Columbium Limited, the largest property holder in the area, has not released ore-reserve figures.

WORLD MINE PRODUCTION

Non-communist world production of columbium - tantalum concentrate amounted to some 4,150 short tons, an increase of 410 tons from 1961. This was the fourth consecutive year that non-communist world production of columbium - and tantalum - bearing concentrates increased after a decline from a record high of 5,865 tons in 1955 to 2,440 tons in 1958.

Columbium is extracted commercially from the minerals columbite and pyrochlore; tantalum is extracted from the mineral tantalite. Tantalite and columbite have the theoretical compositions $(FeMn)O.Ta_2O_5$ and $(FeMn)O.Cb_2O_5$. They are seldom if ever found pure, tantalum and columbium replacing one another in widely variable proportions between the theoretical limits. Concentrates from different sources show a range in content of tantalum pentoxide (Ta_2O_5) from 0.8 per cent to 82 per cent, and of columbium pentoxide (Cb_2O_5) from 3.5 per cent to 78 per cent. Combined contents of the two oxides in columbite-tantalite concentrates usually total about 80 per cent. Pyrochlore is essentially $(NaCa)_2Cb_2O_6$ F + $ThO_2$and rare-earth elements. Ta_2O_5 can replace Cb_2O_5 in pyrochlore but is seldom present in any appreciable amount.

The Araxa pyrochlore deposit in Minas Gerais, Brazil is the largest and highest-grade deposit in the world and is believed to contain some 7,500 short tons of columbium in ore averaging more than three per cent Cb_2O_5. It is owned by Wah Chang Corporation, Molybdenum Corporation of America and Brazilian interests. The deposit was mined during 1962 but most of the concentrates produced were stockpiled awaiting Brazilian government permission to export them. The lack of an export licence was instrumental in St. Lawrence Columbium becoming a large producer and at the same time establishing itself in the United States market, which is by far the world's largest for columbium-bearing concentrates.

Nigeria leads in the production of columbium concentrate (columbite); the Republic of the Congo (Leopoldville) is the principal source of tantalum concentrate (tantalite). Southern Rhodesia ranks second as a producer of tantalite, with a 1962 production of 160,000 pounds. Sources of columbium ore are far more numerous than those of tantalum.

The Sove mine, in the Fen area, near Ulefoss, which is 72 miles southwest of Oslo, Norway, produces a 50 per cent Cb_2O_5 concentrate. This concentrate, with a columbium-tantalum ratio of 100:1, is shipped to the European market.

Table 2

FREE WORLD PRODUCTION OF
COLUMBIUM-TANTALUM CONCENTRATE, 1961 and 1962
(tons of 2,000 lb)

	1961	1962a
Nigeria	2,642	2,552
Republic of the Congo	139ab	142ab
Canada	31	508
Norway	354	331c
Mozambique	152	110
Brazil	151c	180c
Federation of Malaya	106	123
Other	165	204
Total	3,740	4,150

Source: Dominion Bureau of Statistics and U.S. Bureau of Mines, Columbium and Tantalum Preprint 1962.
(a) Includes Ruanda - Urundi
(b) U.S. imports
(c) Exports

World reserves of columbium ore are not well documented; the following table, though probably incomplete, shows Canadian reserves relative to known world reserves.

CONSUMPTION AND USES

The United States is the largest importer of columbium-tantalum ores and the largest consumer of columbium and tantalum products. The United States Bureau of Mines* estimated that 1962 imports of columbium-tantalum concentrates totalled 3,320 short tons. The metal content of industrial consumption in 1961 was 1,283 tons, up some 775 tons from 1960.

The Bureau of Mines* also reported that metals and alloys are produced in the United States from columbium-tantalum concentrates by 12 companies. Ferrotantalum-columbium are consumed by more than 50 firms. Columbium consumption is proportioned roughly 85 per cent in steelmaking and 15 per cent in nonferrous alloys; tantalum consumption is proportioned roughly 60 per cent by electronics applications, 35 per cent in nonferrous alloys and five per cent in carbides.

In Canada, the need is for ferrocolumbium and ferrotantalum-columbium. In 1962, about 17 tons of columbium addition agents were consumed by the Canadian iron and steel industry. Indications are that an increase in consumption is imminent, with wider application in carbon steels to which columbium additions provide higher strengths. This could be important in the fabrication of skelp and plate for use in oil- and gas-transmission piping.

*U.S. Bureau of Mines, Division of Minerals, Columbium and Tantalum Preprint 1962.

Table 3

PRINCIPAL OCCURRENCES OF COLUMBIUM ORES

Country	Deposit	Ore	% Cb_2O_5	Reserves '000 Tons	Comments
Brazil	Araxa	Pyrochlore	3 - 4	120,000	Controlled by Wah-Chang Corp., Molybdenum Corp. of America and Brazilian Gov't.
Canada	Oka, Quebec	Pyrochlore	0.25	vast	Not economical grade at present.
			0.3 - 0.4	160,000+	Controlled by 3 companies: 1. Quebec Columbium Limited; jointly owned by Molybdenum Corporation of America and Kennecott Copper Corporation. No reserve figures published. Now dormant. 2. Columbium Mining Products Ltd.; jointly owned by Headway Red Lake Gold Mines Limited and Coulee Lead and Zinc Mines Limited. Building a pilot mill. Trying to arrange senior financing to bring property into production at an annual rate of 375 tons a year of 45-48% Cb_2O_5 concentrate. Reserves estimated to be 100 million tons of 0.3+% Cb_2O_5, by company geologists. 3. St. Lawrence Columbium and Metals Corporation. Started production in 1961 and produced 61,050 pounds of contained Cb_2O_5 in a 52% concentrate. Mill designed to handle 1,000 tons of feed a day and produce approximately 10 tons a day of 50% Cb_2O_5.

	North Bay, Ontario	Pyrochlore	0.69	2,700	Nova Beaucage Mines Limited. Complex columbium-uranium ore. Considerable research on concentration has been conducted. Property now dormant.
	Chewett, Ontario	Pyrochlore	0.5 - 0.8	20,000	Controlled by Dominion Gulf Company.
Uganda	Sukulu	Pyrochlore	0.25	200,000	Not commercial grade at present.
			0.3	large	Controlled by Tororo Industrial Chemicals & Fertilizers Limited. Planned production at about 40 tons a year of 55% Cb_2O_5 as a byproduct operation in the manufacture of fertilizer.
Tanganyika	Panda Hill	Pyrochlore	0.33	81,000	Controlled by Billiton and Colonial Development Corp.
Congo	Lueshe	Pyrochlore	1.34	30,000	Newly discovered, not many details available.
	Ruanda-Urundi	Tin-columbite-tantalite	na	na	Major producing area, controlled by Société des Mines d'Étain du Ruanda-Urundi. Reserve figures are not available but are not believed to be great.
Nigeria	Kaffo Valley	Pyrochlore	0.26	140,000	Not producing.
	Tin fields	Columbite	na	na	Reserve figures not available. Has accounted for 63% of the Free World's Cb_2O_5 production since 1949.

Source: Compiled from information gathered from numerous trade papers. In addition to countries listed above, columbium ores are mined from limited reserves in Argentina, Norway, Portugal, Spain, Federation of Malaya, Mozambique, Southern Rhodesia, Australia and the Republic of South Africa. Total Free World columbium reserves are estimated to be between 20 billion and 30 billion pounds of Cb in ores that are now minable or expected to be made minable by improved technology within the next couple of decades. This could be expedited by increased demand. na Not available.

Union Carbide Canada Limited, Metals and Carbon Division; Metallurgical Products Company Limited; and Metallurg (Canada) Ltd. are the principal Canadian suppliers of ferrocolumbium. Metallurgical Products is sales agent for Geo-Met Reactors Limited.

The more important Canadian consumers of columbium and tantalum are: Atlas Steels Company, Welland; Black Clawson-Kennedy Ltd., Owen Sound; Dominion Foundries and Steel, Limited, Hamilton; Canadian Westinghouse Company Limited, Hamilton, all in Ontario; and Shawinigan Chemicals Limited, Shawinigan, in Quebec.

PRICES

The following quotations are from E & M J Metal and Mineral Markets. All prices are from the issue of December 31, 1962.

	Dollars
Columbium metal, 99 1/2%, per lb	
Roundels	36.00
Rough ingots	50.00
Tantalum metal, f.o.b. shipping point, per lb	
Powder	30.00 - 58.60
Sheet	50.35 - 59.18
Rod	73.04 - 80.23
Ferrocolumbium, 50-60% Cb, max. 0.4% C, max. 8% Si, ton lots, lump (2 inches), packed, delivered continental U.S.A., per lb contained Cb	3.45
Columbite ore, 65% Cb_2O_5 and Ta_2O_5 f.o.b. shipping point, per lb	
Ratio 10 to 1	0.90 - 1.00
Ratio 8 1/2 to 1	0.85 - 0.90

TARIFFS

Canada	British Preferential	Most Favored Nation	General
Columbium and tantalum ores and concentrates	free	free	free
Ferrocolumbium, ferrotantalum, ferrotantalum-columbium	free	5%	5%
Columbium metal or tantalum metal in pure form, in lumps, powder, blocks, ingots	free	15%	25%
Columbium metal or tantalum metal if in alloy form, in rods, sheet or any semiprocess form	15%	20%	25%

Tariffs (cont'd)

United States

Columbium and tantalum ores and concentrates	free
Columbium and tantalum metal	11%
Ductile columbium or niobium metal, ductile nonferrous alloys of columbium or niobium metal or tantalum metal, and ductile tantalum metal	40%
Ferrocolumbium, ferrotantalum, ferrotantalum-columbium	11%

Petroleum

D.W. Rutledge*

Canadian crude-oil producers had a highly successful year in 1962 and an all-time production record was established. The 14.3 per cent increase in output of crude oil and natural gas liquids resulted from greater use of Canadian oil in Ontario and in the United States Puget Sound and Great Lakes regions, as well as from substantially increased consumption in the four western provinces, which are served only by domestic oil. A moderate increase in exploratory activity, particularly drilling, became evident in western Canada during 1962; several oil discoveries late in the year were significant enough to encourage increased investigations in a few specific areas. Development drilling continued to decline because no large oil fields have been discovered in the past five years and large established fields have been almost fully developed. A highlight of the year was the granting by the Alberta government of the first permit for the commercial extraction of oil from the Athabasca bituminous sands; other applications are under consideration by the Conservation Board. Of considerable importance were the takeovers of several independent Canadian companies by large integrated oil companies.

PRODUCTION

Output of all liquid hydrocarbons - crude oil plus natural gas liquids - amounted to 268,319,921 barrels for the year, or an average of 735,123 barrels a day. Production of crude oil alone was recorded at 244,115,152 or 10.5 per cent more than the 1961 output. The 24,204,769 barrels of natural gas liquids produced represented a 74.9 per cent increase over the previous year's production. Total liquid hydrocarbon output increased in Alberta by 10.1 per cent; in Saskatchewan by 15.4 per cent; British Columbia, 349 per cent; and Northwest Territories, 10.6 per cent. The trend of declining production that has been evident in Manitoba and New Brunswick in the past few years continued through 1962. Crude-oil output in Ontario decreased slightly after sustaining small annual increases for many years.

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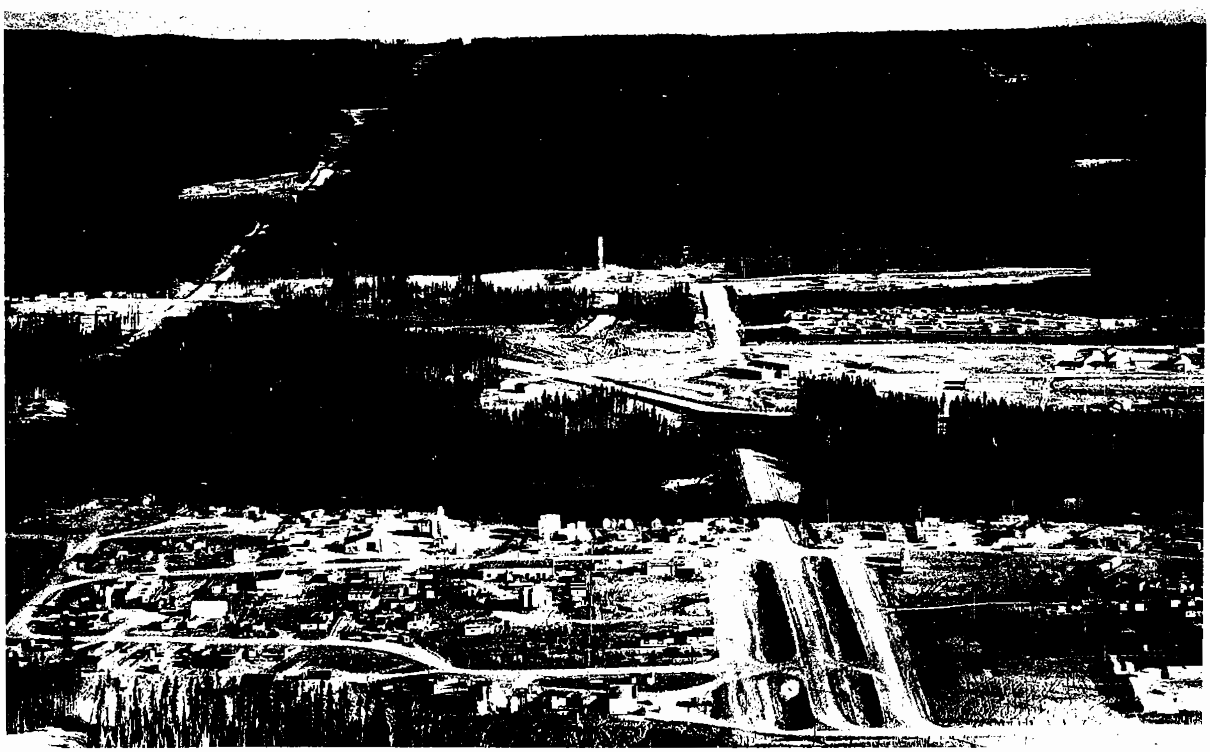
*Mineral Resources Division.



Oil companies are moving from the easily accessible plains region of the Prairies to the rolling, heavily wooded areas in their search for oil. This area, Swan Hills about 175 miles northwest of Edmonton is typical. The photo shows clearings for roadways, wellsites and a townsite.

Table 1

PRODUCTION OF CRUDE OIL, BY PROVINCE AND FIELD(a)

(Numbers in parentheses give locations of fields in the accompanying map)

	1961		1962	
	bbls	$	bbls	$
Alberta				
Pembina(1)	42,733,575		38,041,625	
Redwater(3)	15,416,554		17,668,512	
Leduc-Woodbend(2)	15,136,404		12,635,305	
Swan Hills(4)	8,376,621		11,549,961	
Bonnie Glen(2)	6,343,722		8,714,836	
Fenn-Big Valley(8)	6,111,136		6,000,469	
Judy Creek(4)	3,058,977		5,488,439	
Wizard Lake(2)	3,469,534		4,594,689	
Joffre(5)	5,666,283		4,340,171	
Golden Spike(2)	2,852,353		4,222,917	
Innisfail(6)	2,524,727		2,843,732	
Joarcam(7)	3,322,581		2,836,722	
Sturgeon Lake South(9)	3,166,044		2,683,289	
Virginia Hills(4)	2,444,770		2,673,103	
Acheson(2)	2,555,059		2,541,976	
Kaybob(10)	2,409,558		2,482,893	
Harmattan-Elkton(6)	2,184,331		2,292,967	
Harmattan-East(6)	1,912,139		2,273,505	
Willesden Green(1)	1,558,142		2,204,980	
Crossfield(6)	1,476,387		2,022,772	
Westerose(2)	1,453,808		1,947,638	

Table 1 (cont'd)

	1961		1962	
	bbls	$	bbls	$
Alberta (cont'd)				
Stettler(8)	1,755,254		1,559,554	
Gilby(5)	1,456,869		1,537,429	
Carson Creek North(4)	897,977		1,424,652	
Sundre(6)	1,247,749		1,334,025	
Turner Valley(11)	1,147,974		1,151,406	
West Drumheller(8)	1,271,025		1,040,236	
Other fields and pools	15,862,159		17,017,164	
Total*	157,811,712	355,530,845	165,124,967	379,830,363
Saskatchewan				
Weyburn(13)	11,741,155		13,180,600	
Steelman(14)	8,456,932		8,817,125	
Midale(13)	4,593,817		5,689,236	
Dollard(18)	4,029,599		4,580,944	
Nottingham(15)	2,742,165		2,985,880	
Fosterton(19)	1,986,983		2,754,444	
Instow(18)	1,842,969		2,365,138	
Parkman(16)	2,160,383		1,887,446	
Coleville-Smiley(17)	2,008,897		1,837,846	
Success(19)	1,421,789		1,797,899	
Hastings(15)	1,475,957		1,777,752	
Carnduff(14)	1,385,881		1,631,694	
Dodsland(17)	879,294		1,334,920	
Queensdale(15)	1,350,838		1,302,618	

Table 1 (cont'd)

	1961		1962	
	bbls	$	bbls	$
Saskatchewan (cont'd)				
Alida(15)	1,335,385		1,137,407	
Workman(14)	609,290		1,129,893	
Battrum(19)	789,403		1,035,224	
Other fields and pools	7,049,367		9,186,345	
Total	55,860,104	115,719,791	64,432,411	141,783,520
Manitoba				
Virden-Roselea(20)	1,333,986		1,152,610	
North Virden-Scallion(20)	1,538,308		1,343,361	
Other fields and pools	1,608,054		1,430,712	
Total	4,480,348	10,156,000	3,926,683	9,435,819
Ontario	1,149,087	3,546,740	1,134,534	3,661,174
British Columbia(12)	1,017,826	1,859,873	8,914,220	16,872,122
Northwest Territories	516,979**	730,160	572,004**	755,045
New Brunswick	12,024	16,833	10,333	14,466
Total, Canada	220,848,080	487,560,242	244,115,152	552,352,509

Sources: Dominion Bureau of Statistics and provincial reports. * Excludes field condensate which in 1961 amounted to 3,277,622 barrels valued at $7,721,343, and in 1962 amounted to 6,986,606 barrels valued at $16,625,319
** Excludes base stock reinjected into the reservoir.

Table 2

PRODUCTION OF NATURAL GAS LIQUIDS BY PROVINCE

(barrels)

	1961	1962
Alberta		
Natural gasoline	1,649,042	1,734,366
Field condensate	3,277,622	6,986,606
Plant condensate	2,755,309	7,764,776
Propane	2,288,129	2,954,395
Butane	1,596,768	2,069,861
Propane-butane mix*	84,657	-
Total	11,651,527	21,510,004
Saskatchewan		
Natural gasoline	225,959	266,576
Propane	432,981	517,015
Butane	241,310	290,859
Total	900,250	1,074,450
British Columbia		
Plant condensate	813,724	845,885
Propane	154,717	200,273
Butane	319,231	383,324
Total	1,287,672	1,429,482
Total, Canada	13,839,449	24,013,936

Sources: IDBS and provincial government reports.
* 1962 propane-butane mix is included in propane and butane production according to the proportions of each in the mix.
Symbol: - Nil.

Table 3

VALUE OF SHIPMENTS OF NATURAL GAS LIQUIDS, BY PROVINCES
(dollars)

	1961	1962
Alberta	23,059,867	46,190,893
Saskatchewan	1,476,478	1,878,643
British Columbia	2,756,614	2,708,970
Total, Canada	27,292,959	50,778,506

Sources: DBS.

Alberta remained the leading producer of crude oil and natural gas liquids supplying 69.6 per cent of the Canadian output; Saskatchewan fields yielded 24.4 per cent. British Columbia displaced Manitoba as third-largest producer, providing 3.9 per cent compared with Manitoba's 1.5 per cent of total production. Ontario, Northwest Territories and New Brunswick accounted for the remaining 0.6 per cent.

RESERVES

A slower rate of increase in Canada's reserves of liquid hydrocarbons - crude oil plus natural gas liquids - was evident in 1962. The net increase in reserves was 9.0 per cent compared with 12.6 per cent in 1961. At the end of 1962, recoverable reserves of liquid hydrocarbons in Canada, as compiled by the Canadian Petroleum Association, were 5,176,052,000 barrels. Most of the 426,824,000-barrel net increase (gross recoverable increase minus production) resulted from revisions in previous estimates and extensions to known oil pools; only a minor part of the increase was due to newly discovered oil accumulations. At the 1962 rate of production, Canada has a 19.3 year supply of liquid hydrocarbons. Recoverable reserves, however, will be increased substantially by a series of waterflood pressure maintenance programs instituted in 1962, particularly in fields of the Swan Hills region of Alberta, thus reversing a decline in the reserves-to-production ratio evident since 1958. New discoveries would further improve the reserves-to-production ratio.

In 1962 additions to liquid hydrocarbon reserves in Alberta and British Columbia increased these provinces' proportion of total Canadian reserves. In Saskatchewan there was a decline in year-end reserves as a result of a revision in reserve estimates and a continuing high rate of production. The estimated oil reserves of Manitoba have been declining since 1955. In Ontario, some important recent oil discoveries north of Lake Erie added to the province's small but valuable petroleum reserves.

Table 4

CRUDE OIL - PRODUCTION, TRADE AND CONSUMPTION, 1948-62
(barrels)

	Production(a)	Imports(b)	Exports(b)	Consumption(c)		
				Domestic(d)	Imported(g)	Total
1948	12,286,660	75,535,943	-	11,941,677	75,463,113	87,404,790
1949	21,305,348	73,934,543	-	20,032,098	76,186,071	96,218,169
1950	29,043,788	78,648,571	-	26,666,376	82,476,476	109,142,852
1951	47,615,534	83,283,171	341,780	47,185,925	83,139,573	130,325,498
1952	61,237,322	81,199,086	1,424,456	58,894,631	82,467,322	141,361,953
1953	80,898,897	79,477,343	2,507,314	69,345,587	81,406,110	150,751,697
1954	96,080,345	78,771,914	2,344,948	92,679,819	76,773,031	169,452,850
1955	129,440,247	86,678,057	14,833,971	105,050,563	86,751,128	191,801,691
1956	171,981,413	106,469,685	42,908,086	125,592,074	106,305,532	231,897,606
1957	181,848,004	111,905,371	55,674,228	126,914,237	111,905,372	238,819,609
1958	165,496,196	104,038,800	31,679,429	134,513,998	107,444,741	241,958,739
1959	184,778,497	115,288,643	33,362,234	151,507,774	116,342,270	267,850,044
1960	189,534,221	125,559,631	42,234,937	149,259,745	126,824,208	276,083,953
1961	220,848,080	133,249,113	65,222,523	157,182,263	133,225,748	290,408,011
1962	244,139,057	134,517,707	91,580,232	173,606,596	135,364,821	308,971,417

Source: Dominion Bureau of Statistics. (a) Crude Petroleum and Natural Gas Production (DBS). Alberta field condensate is excluded from the statistics for 1960, 1961,and 1962. (b) Trade of Canada (DBS). (c) For 1948-50 inclusive - as reported in Petroleum Products Industry (DBS); for 1951-62 inclusive - receipts at refineries as reported in Refined Petroleum Products (DBS). (d) Domestic includes crude naphtha and absorption gasoline to 1950 only. (g) Imported includes partly processed crude for all years.
Symbol: - Nil.

Table 5

RESERVES OF CRUDE OIL

Province or Region	At End of 1962 ('000 barrels)	Per cent of Total 1961	Per cent of Total 1962	Net Change Since 1961 ('000 barrels)
Alberta..................	3,807,009	84.2	85.0	+294,200
Saskatchewan	462,372	12.1	10.3	- 41,905
British Columbia	136,577	1.9	3.1	+ 56,195
Northwest Territories.....	50,412	1.2	1.1	- 590
Manitoba	14,928	0.4	0.3	- 2,617
Eastern Canada	9,404	0.2	0.2	1,850
Total	4,480,702	100.0	100.0	+307,133

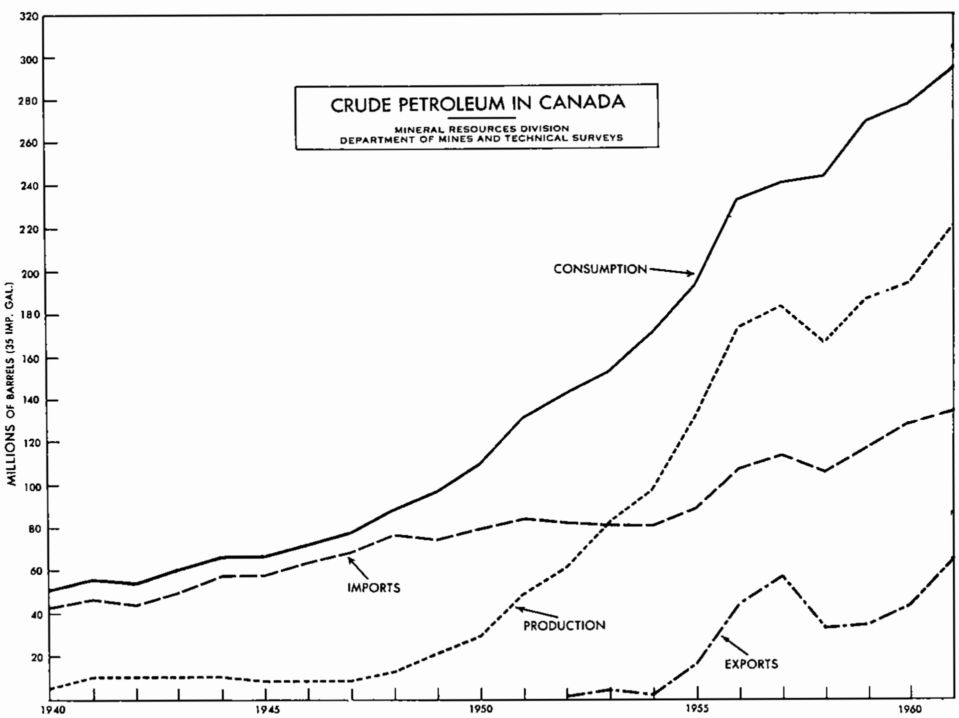
Source: Canadian Petroleum Association.

Table 6

RESERVES OF LIQUID HYDROCARBONS AT END OF 1962

	Natural-gas Liquids (N.G.L.) ('000 barrels)	Crude Oil Plus N.G.L. ('000 barrels)	Per cent of Total
Alberta.................	648,031	4,455,040	86.1
Saskatchewan	11,540	473,912	9.2
British Columbia	35,779	172,356	3.3
Other areas.............	-	74,744	1.4
Total	695,350	5,176,052	100.0

Source: Canadian Petroleum Association.
Symbol: - Nil.



EXPLORATION AND DEVELOPMENT

The long decline in geophysical activity, from 1953 until 1961, halted in the past year. On a month-by-month comparison of the number of crews working, seismic activity in western Canada in 1962 was slightly greater than in 1961. As many as 89 seismic crews were at work in the winter months and as few as 34 in the spring break-up period. Seismic work increased in Alberta and Saskatchewan and decreased in British Columbia, Manitoba and the Northwest Territories. In terms of crew-months, seismic-survey work in the western provinces was as follows: Alberta, 429; British Columbia, 109; Saskatchewan, 44; Manitoba, 0; Yukon Territory and the Northwest Territories, 43. The relatively minor amount of gravity survey work carried out in 1962 was a decline from the previous year.

Drilling decreased moderately in 1962, a sharp decrease in development drilling being partly offset by an increase in exploratory drilling. Exploratory drilling increased by 558,992 feet to 4,683,595 feet, 34.8 per cent of the total drilling; in 1961, exploratory drilling made up only 29.8 per cent of all drilling. Development drilling totalled 8,762,887 feet, a decrease of nearly a million feet from the preceding year. In western Canada, the percentage of dry holes drilled increased considerably: 36.3 per cent of all wells were dry compared to 27.7 per cent in 1961. The smaller success ratio was the result of a higher proportion of exploratory drilling with a consequent greater risk of failure. The average depth of all wells drilled, approximately 5,200 feet, was about 200 feet less than in 1961, thus reversing the trend evident in previous years towards greater average depths of wells. New land regulations for the southeastern quadrant of Alberta had the effect of increasing the amount of drilling carried out in this region, where potentially productive strata are generally shallower than in the western half of the province. The decreased amount of development drilling in the comparatively deep pools of the Swan Hills region of Alberta was also a factor in the shallower average well-depth. Several significant oil and gas discoveries late in the year brought about an increase in the pace of exploratory activities in all of the four western provinces.

Petroleum and natural-gas land-holdings in western Canada at the end of the year totalled about 246 million acres, about 10 million acres less than a year earlier. The main reason for the decrease was the discarding of substantial holdings in British Columbia and in the mainland of the territories. This loss was not made up by the six-million-acre increase of land holdings in the Arctic Islands, where the independent petroleum companies were particularly active in acquiring potentially productive areas. Discoveries in Alberta resulted in interesting 'land plays' in the Snipe Lake and Edson regions where prices rose above those normally paid for unproven land.

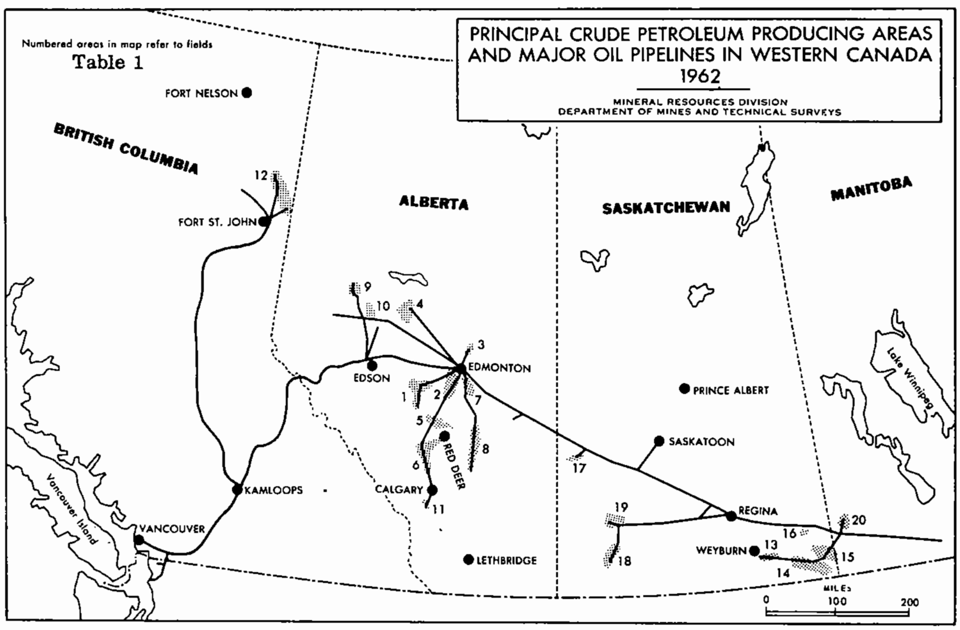


Table 7

WELLS* DRILLED TO COMPLETION - WESTERN CANADA

	Oil Wells		Gas Wells		Dry Holes		Total	
	1961	1962	1961	1962	1961	1962	1961	1962
Alberta..........	783	688	344	272	445	584	1,572	1,544
Saskatchewan	484	397	7	11	152	212	643	620
Manitoba	10	12	-	-	18	10	28	24
British Columbia ..	88	159	64	65	55	96	207	320
Northwest Territories & Yukon..........	-	-	1	-	14	8	15	8
Total	1,365	1,258	416	348	684	910	2,465	2,516

Sources: Provincial-government reports and Department of Northern Affairs and National Resources.
* Service wells are excluded. Symbol: - Nil.

Table 8

OIL WELLS IN WESTERN CANADA AT END OF YEAR

	Producing Wells		Wells Capable of Production	
	1961	1962	1961	1962
Alberta...............	8,938	9,183	10,529	10,809
Saskatchewan	3,906	4,248	4,826	4,935
Manitoba	729	730	874	852
British Columbia	114	326	193	352
Northwest Territories..	31	31	60	60
Total	13,718	14,518	16,482	17,008

Sources: Provincial-government reports and Department of Northern Affairs and National Resources.

DEVELOPMENT, BY AREAS

Alberta

The total amount drilled, 9,106,679 feet, represented an 8.4 per cent decrease from the total of the previous year. A 14.9 per cent decrease in development drilling was partly offset by a 7.0 per cent increase in exploratory drilling. Exploratory drilling constituted 34.7 per cent of the total footage drilled. Several significant oil discoveries were made in 1962, but none have been fully assessed with sufficient follow-up drilling. Late in the year, an important oil discovery was made at Snipe Lake 35 miles southwest of Lesser Slave Lake. The discovery well, SOBC Snipe Lake 10-21, produced from the Beaverhill Lake reef near a depth of 8,700 feet. Subsequently, a series of wells have partly delimited an oil pool at least 12 miles long. Two other significant Beaverhill Lake oil discoveries were made west of Swan Hills: Hudson's Bay-Union-Home Virginia Hills 2-1, located 4 miles northeast of the Virginia Hills oil field; and Atlantic Ante Creek 4-7, 15 miles northeast of the Simonette field. The Hudson's Bay-Union Kaybob 11-21 well, located 6 miles southwest of the Kaybob field led to the discovery of a Triassic oil pool which has been partly outlined by several more wells. In March 1962 a very productive oil well was drilled in the Granite Wash at Loon Lake near the Red Earth oil field 80 miles north of Lesser Slave Lake, but soft ground conditions prevented further drilling in the ensuing months. Productive Cardium sand was found far to the northwest of the Pembina and other Cardium oil fields at an oil discovery 10 miles northwest of Edson. In southern Alberta, one of the better oil discoveries was Home Manyberries 7-14 four miles east of Manyberries.

The decline in field-development drilling continued for two main reasons: the lack of large oil discoveries in the past few years, and the recent trend toward wider well-spacing in oil fields. Despite a notable decrease in drilling in the Pembina and Swan Hills fields, these were still the most important development areas. Only 78 oil wells were added to the Swan Hills field and 62 to the Pembina, to bring their respective oil well totals to 440 and 2,960 Other areas of fairly active development were the Judy Creek, Willesden Green and Medicine River fields. The Gilby field, whose main pool is in the Viking formation of the Lower Cretaceous age, was enlarged by the addition of 29 oil wells in a formation of Jurassic age. The province's first large-scale oil-field-abandonment program was well advanced by the end of the year. This project was in the Joffre field where more than half of the 273 oil wells in the Viking pool were abandoned.

As previously mentioned, Alberta's recoverable oil reserves will be increased considerably by the pressure-maintenance projects begun in 1962. Pilot waterflood schemes were started in the Swan Hills, Judy Creek, and Virginia Hills, and full-scale projects are now being prepared. The huge water-injection program of the Pembina field was expanded, especially in the Cynthia district of the western sector. Waterflood programs in the Gilby, Willesden Green, Crossfield and Wainwright fields were enlarged, as were the gas-injection pressure-maintenance schemes in the Windfall and Harmattan-Elkton fields.

In September the Alberta Oil and Gas Conservation Board issued a permit to Great Canadian Oil Sands Limited for the extraction of 31,500 barrels of oil a day from the Athabasca bituminous sands. Three more applications for production from the oil sands were before the Board early in 1963. The planned combined output of the three schemes is 240,000 barrels a day.

British Columbia

British Columbia was the only province that recorded a large increase in drilling in 1962. The total drilled was 1,554,408 feet, 44.7 per cent more than in 1961. Both development and exploratory drilling increased, especially development drilling. As in 1961, the increased development was largely the result of the new availability of West Coast markets for British Columbia crude oil, the result of the completion of the pipeline of Western Pacific Products & Crude Oil Pipelines Ltd. Much of the development was in the Boundary Lake field where 120 new oil wells were completed bringing the field total to 250. Development of the oil field was nearly completed. The other most important areas of development drilling were the Peejay, Wildmint, and Milligan Creek fields.

While most of the successful development holes were oil wells, nearly all the exploratory successes were gas wells. Three oil discoveries were made, the most important being Pacific-Scurry West Peejay d-54-G, which located a new oil pool six miles west of the Peejay field. The 561,327 feet drilled for exploratory purposes was 36.1 per cent of the total drilling in this province.

Saskatchewan

A continuing strong demand for Saskatchewan crude in Ontario and the United States Great Lakes region was probably a factor in maintaining the amount of Saskatchewan drilling near the 1961 level despite the lack of important oil discoveries in recent years. The amount drilled, 2,297,888 feet, was less than one per cent below the 1961 total. Exploratory drilling increased by 60 per cent to 731,383 feet. Several recent deep oil discoveries in the Williston Basin in Montana and North Dakota gave oil companies new encouragement to explore lower Paleozoic rocks in the part of the basin underlying Saskatchewan. Though several deep stratigraphic tests were drilled, probably the most important oil discovery was one made in the prolific Mississippian beds of southeastern Saskatchewan. The well, Francona-Imperial East Willmar 10-35, although within the Willmar field's boundaries, was three miles southeast of the previous Willmar producing area. Six follow-up wells near the discovery were also successful.

Development drilling decreased by nearly 16 per cent; the most active area once again being the Dodsland field where 76 oil wells were added to the field total. Thirty-seven new wells were added to the comparatively new Workman field. In the Steelman field, where water output is high, more than 150 wells were removed from the 'capable of production' category, leaving the field with about 700 oil wells. A major water-injection project instituted in the Midale field is expected to extend the life of the field by more than twenty years.

Manitoba

In the period 1954 to 1957, when oil exploration was at its peak in Manitoba, more than 200 wells were drilled annually; however, a steady decline in drilling has occurred since that period. In 1962, for example, only 22 wells were drilled totalling 60,214 feet compared with 61,628 in 1961. In November 1962, a significant oil discovery, Texaco Souris 8-17, was made near Hartney, 32 miles southwest of Brandon. The oil pool is one of the most easterly in the western Canada sedimentary basin, and is situated on the eastern edge of the Mississippian system.

Yukon and Northwest Territories

No important oil discoveries were made in the eight exploratory wells completed during the year. Their combined depth was 52,701 feet. The well-known deep well on the south coast of Melville Island, Dome et al., Winter Harbour No. 1, was abandoned as a dry hole early in 1962 at a depth of 12,543 feet. Surface exploration was more successful and significant quantities of oil were found on the northwestern shore of Melville Island in outcrops of oil-saturated sand. These showings confirm the existence of oil-forming conditions during the geological history of the Arctic Islands region.

Eastern Canada

In Ontario the discovery of the Gobles oil field in Cambrian strata in 1960 has led to more testing of the lowest Paleozoic strata. In February 1962, a Cambrian oil pool was found near Clearville, ten miles south of the Rodney field. The Clearville discovery is by far the most important of the year and oil production from the field has been increasing rapidly concurrent with development. The oil trap seems to be structural rather than a stratigraphic pinchout as is the Gobles field.

The total footage drilled in Ontario in 1962 was 370,675 feet, slightly more than in the previous year. Exploratory drilling amounted to 167,367 feet. In Lake Erie eight exploratory wells and 39 development wells were drilled. The Rodney field, the province's biggest producer, is now fully developed and a pilot waterflood project has been started.

In Quebec, activity declined in the region around the Pointe du Lac gas field but ten shallow tests were completed. A diamond drill hole was drilled to 4,172 feet on the Gaspé Peninsula in search of oil or gas and a shallow test was put down near Lake St. John. In New Brunswick, equipment was ordered in preparation for a waterflood scheme in the aging Stony Creek oil and gas field.

TRANSPORTATION

No major crude-oil pipelines were constructed in Canada in 1962. This contrasts sharply with pipeline construction in 1961 when 1,119 miles of oil pipeline were laid, including several important trunk lines. In 1962 less than half this much oil pipeline was constructed, a large part of which was small-diameter gathering line. At the year-end approximately 10,000 miles of oil pipeline was in operation, mainly crude-oil lines.

In northeastern British Columbia, Trans-Prairie Pipelines, Ltd., added a parallel 25-mile 8-inch line to its Boundary Lake to Taylor system to take care of the sharply increased demand for Boundary Lake oil following commencement in January of operations of the pipeline of Western Pacific Products & Crude Oil Pipelines Ltd. The latter company doubled the capacity of its line to 45,000 barrels a day by installing new pumping units.

In Alberta, most of the new pipelines were field gathering lines. Pembina Pipe Line Ltd. added 59 miles of gathering-line extensions in the Pembina, Willesden Green and adjacent fields. Federated Pipe Lines Ltd. installed 21 miles of extensions to the Swan Hills gathering system. Thirty miles of small-diameter trunk line were completed by Twining Pipeline Ltd. to join the Twining and Twining North fields to the Britamoil pipeline, south of the Fenn-Big Valley field. Some important pipelines for transporting natural-gas liquids (NGL) were completed in Alberta. Hudson's Bay Oil and Gas Company Limited, through its Rangeland Division, built a 66-mile 8-inch NGL pipeline from Sundre to the Westerose South field. The Cremona Pipe Line Division of Home Oil Company Limited completed 14 miles of 6-inch pipe for NGL from Harmattan to Sundre, and 28 miles of 6-inch from Madden to Calgary. Peace River Oil Pipe Line Co. Ltd. constructed 15 miles of NGL line from the new Carson Creek gas plant to Whitecourt.

In Saskatchewan, Producers Pipelines Ltd. added 127 miles of extensions to its systems in the Willmar, Gapview, and Oungre areas. In Minnesota and Wisconsin, the Lakehead Pipe Line Co. Inc., Interprovincial Pipe Line Company's wholly-owned United States subsidiary, added 38 miles

Table 9

MILEAGE IN CANADA OF PIPELINES FOR CRUDE OIL, NATURAL-GAS LIQUIDS AND PRODUCTS

Year-end	Miles	Year-end	Miles
1950...............	1,423	1956	6,051
1951...............	1,577	1957	6,873
1952...............	2,500	1958	7,148
1953...............	3,794	1959	7,945
1954...............	4,656	1960	8,435
1955...............	5,079	1961	9,554
		1962	10,037

Source: Dominion Bureau of Statistics.

Table 10

DELIVERIES OF CRUDE OIL

Company	Destination	(millions of barrels) 1960	1961	1962
Interprovincial........	Western Canada............	34.2	32.3	32.7
	United States	23.0	33.3	39.0
	Superior (for tankers)	0.9	1.2	-
	Ontario....................	69.8	79.1	86.1
	Total	127.9	145.9	157.8
Trans Mountain.......	British Columbia...........	23.3	23.9	26.2
	State of Washington.........	18.1	33.2	46.2
	Total	41.4	57.1	72.4

Source: Annual reports of Interprovincial Pipe Line Company and Trans Mountain Oil Pipe Line Company.

of 34-inch loop beside its 18- and 24-inch lines. This is the largest pipe yet used in the Interprovincial-Lakehead system and is the first stage in another long-term expansion of the system.

In October 1962 United States presidential approval was granted two Canadian pipeline companies to construct pipeline facilities across the international boundary. As a result, the Interprovincial Pipe Line Company started building a lateral line to Buffalo, capable of moving 20,000 barrels a day of crude oil, and the Aurora Pipe Line Company commenced exporting natural-gas liquids across the Alberta-Montana boundary.

PETROLEUM REFINING

The largest individual increase in Canadian oil-refinery capacity was made by Regent Refining (Canada) Limited at its Port Credit, Ontario, refinery, where crude oil capacity was increased from 26,000 to 35,000 barrels a day. The capacity of the plant of BP Refinery Canada Limited at Montreal was increased from 26,000 to 31,500 barrels daily. The net effect of these and other plant expansions was to increase Canada's crude-oil refining capacity from 961,760 barrels a day in 1961 to approximately 989,000. In addition, two other refineries were under construction and should be completed in 1963. One is a 30,500 barrel-a-day plant near Oakville, Ontario, owned by Shell Oil Company of Canada, Limited; the other is a 13,500 barrel-a-day refinery near Dartmouth, Nova Scotia, being constructed by Texaco Canada Limited.

Table 11

CRUDE-OIL-REFINING CAPACITY, BY REGIONS

	1955		1961		1962	
	bbl/day	%	bbl/day	%	bbl/day	%
Maritimes	18,300	3.0	106,300	11.1	103,800	10.5
Quebec	210,000	34.0	297,000	30.9	304,500	30.8
Ontario	148,800	24.0	260,820	27.1	279,170	28.2
Prairies & Northwest Territories	174,850	28.3	200,340	20.8	203,200	20.6
British Columbia	66,500	10.7	97,300	10.1	97,800	9.9
Total, Canada	618,450	100.0	961,760	100.0	988,470	100.0

Source: Department of Mines and Technical Surveys, Petroleum Refineries in Canada (Operators List 5) January 1963.

Table 12

CANADIAN CRUDE OIL AS PERCENTAGE
OF REFINERY RECEIPTS, BY REGIONS

	1940	1945	1950	1955	1959	1960	1961	1962
Maritimes	-	-	-	-	-	-	-	-
Quebec	-	-	-	-	-	-	-	-
Ontario	1.2	0.5	1	78.8	93.6	95.2	97.1	99.4
Prairies & North-west Territories	92.3	58.2	99	100	100	100	100	100
British Columbia	-	-	-	100	100	100	100	100
Average	16.4	11.7	24.4	54.7	55.6	54.1	54.1	56.2

Source: Calculations based on statistics published by the Dominion Bureau of Statistics, Refined Petroleum Products 1962.
Symbol: - Nil.

Table 13

CRUDE OIL RECEIVED AT CANADIAN REFINERIES, 1962
(barrels)

Location of Refineries	Country of Origin				Total Received
	Canada	Middle East	Trinidad	Venezuela	
Atlantic Provinces	-	11,930,991	-	19,795,741	31,726,732
Quebec	-	33,396,238	4,063,219	65,650,794	103,110,251
Ontario	84,729,390	-	-	527,838	85,257,228
Prairies & North-west Territories	60,749,389	-	-	-	60,749,389
British Columbia & Yukon	28,127,817	-	-	-	28,127,817
Total	173,606,596	45,327,229	4,063,219	85,974,373	308,971,417

Source: Dominion Bureau of Statistics, Refined Petroleum Products 1962.
Symbol: - Nil.

Table 14

REGIONAL CONSUMPTION OF PETROLEUM PRODUCTS - NET SALES, 1962
('000 barrels)

	Motor Gasoline	Kerosene, Stove Oil, Tractor Fuel	Diesel Oil	Light Fuel Oils No. 2 and 3	Heavy Fuel Oils No. 4, 5 and 6
Newfoundland	1,236,722	894,490	1,218,905	1,064,639	1,814,358
Maritimes	6,771,514	2,537,965	2,188,668	5,492,725	7,985,452
Quebec	23,926,701	6,025,332	6,030,366	20,688,539	21,732,311
Ontario	40,904,095	4,057,102	5,195,988	30,327,274	15,330,711
Manitoba	5,884,055	616,493	1,536,113	2,614,358	1,484,073
Saskatchewan	8,170,268	1,069,204	2,711,927	1,702,513	1,093,751
Alberta & North-west Territories	11,429,451	321,722	4,066,373	1,184,018	696,980
British Columbia & Yukon Territory	10,069,862	1,941,472	4,259,863	4,339,821	6,240,447
Total	108,392,668	17,463,780	27,208,203	67,413,887	56,378,083

Source: Dominion Bureau of Statistics, Refined Petroleum Products 1962.

Table 15

IMPORTS OF REFINED-PETROLEUM PRODUCTS
(millions of barrels)

	1961	1962
Heavy fuel oil	10.47	13.50
Light fuel oil	7.36	5.62
Stove oil	2.50	2.20
Motor gasoline	0.74	0.79
Aviation gasoline	1.04	0.68
Diesel fuel	2.38	2.73
Lubricating oil	1.10	1.08
Petroleum coke	1.76	1.62

Source: Dominion Bureau of Statistics, refined petroleum products.

MARKETING AND TRADE

Consumption of crude oil in Canada, as measured by receipts at refineries, increased by 18.56 million barrels, or 6.4 per cent, in 1962. Canadian crude-oil producers gained the benefit of most of this increase since the refineries took 16.42 million barrels more of Canadian crude than in 1961. Domestic crude made up 56.2 per cent of the 308.97 million barrels received at refineries. Refinery consumption increased in all provinces, but the demand was particularly strong in the four western provinces where the combined refinery receipts were 16 per cent more than in the previous year. In Ontario, growth in demand for Canadian crude was 5.2 per cent in 1962 compared with 11.7 per cent in 1961.

Refiners in the Atlantic Provinces and Quebec continued to use only imported crude. Ontario refiners reduced their intake of foreign crude to less than one per cent of total 1962 receipts. The amount of imported crude received at Canadian refineries increased by 2.13 million barrels, or 1.6 per cent - considerably less than the rate of increase in the preceding two years. Venezuela supplied 63.5 per cent of the imported crude and Middle East countries (Saudi Arabia, Iran, Kuwait and Quatar) supplied 34.3 per cent.

Imports of petroleum products increased slightly, in contrast to the sharp decrease of imports in 1961. Products imported totalled 30.06 million barrels, an increase of 0.38 million. Transfers of refined products into Ontario from Quebec and the Atlantic provinces decreased slightly, but a further reduction is expected when refining facilities presently under construction in Ontario come on stream in 1963. Heavy fuel oil accounted for 45 per cent of petroleum-products imports. The Netherlands Antilles, the United States, and Venezuela are the main suppliers of products imports, but small quantities are received from other countries in Latin America and from Europe.

The effects of the national oil policy were very evident in the crude-oil export sector. Exports of crude oil, including some natural gas liquids mixed in the pipeline stream, increased by 40.4 per cent to 91.6 million barrels. The United States Puget Sound region took 54 per cent of Canada's exported crude, and the Great Lakes region took the remainder. In the last quarter, pipeline exports of natural-gas liquids commenced at the Alberta-Montana boundary, although the quantities moved were small. A significant 99 per cent increase in exports of petroleum products took place in 1962, but products imports still remain well above the 4.4-million-barrel level of exports. Motor gasoline, heavy fuel oil, and natural gas liquids - a large part of the product exports - are shipped mainly to the United States.

Despite substantial increases in crude-oil output in 1962, factors such as gasoline 'price wars' and low product prices adversely affected the highly competitive marketing segment of the petroleum industry. The major integrated Canadian oil companies, important producers of crude oil, benefited at the production end through higher domestic crude-oil prices and greater output. Nevertheless these gains were offset by decreased profit margins at the consumer level. A highlight of the year was the unusually large number of corporate takeovers of independent Canadian companies by integrated oil companies with international affiliations. Shell Oil Company of Canada Limited acquired Canadian Oil Companies Limited; The British American Oil Company Limited took over Royalite Oil Company, Limited, Anglo American Exploration Limited and Superior Propane Limited. Substantial share interests were acquired in Bailey Selburn Oil & Gas Ltd. by Pacific Petroleums, Ltd. and in The Calgary & Edmonton Corporation Ltd. by Superior Oil Company of California.

Table 16

SUPPLY AND DEMAND - ALL OILS
(barrels)

	1961	1962
SUPPLY		
Production		
Crude oil (excluding field condensate)	220,848,080	244,115,152
Natural-gas liquids (including field condensate)	13,839,445	24,204,769
Total	234,687,525	268,319,921
Average barrels per day	642,980	735,123

Table 16 (cont'd)

	1961	1962
Imports		
Crude oil	133,225,748	135,364,821
Refined-petroleum products	29,673,607	30,055,174
Total	162,899,355	165,419,995
Change in stock		
Crude oil	-252,148	-210,845
Refined-petroleum products	-5,747,322	+528,295
Net changes in stock	-5,999,470	+317,450
Oils not accounted for	+613,381	+3,466,055
Total supply	392,200,791	437,840,871
DEMAND		
Exports		
Crude oil	65,222,523	91,580,232
Products	2,195,214	4,358,776
Total	67,417,737	95,939,008
Domestic sales		
Motor gasoline	102,801,766	108,392,668
Middle distillates	111,986,460	119,128,090
Heavy fuel oil	51,355,784	56,378,083
Other products	32,281,461	31,272,347
Total	298,425,471	315,171,188
Uses and losses		
Refinery	23,961,120	23,990,757
Field and pipeline	2,396,463	2,739,918
Total	26,357,583	26,730,675
Total demand	392,200,791	437,840,871

Sources: Dominion Bureau of Statistics and provincial government reports.

Phosphate

J.E. Reeves*

Phosphate, although not produced in Canada, has become an increasingly important mineral raw material in the last few years. Imports rose to about 1.2 million short tons in 1962, an increase of about 9.4 per cent over 1961 and of more than 100 per cent since 1956.

About 95 per cent of the imports in 1962 consisted of low-valued phosphate rock from Montana and Florida for use in the manufacture of phosphate fertilizers and phosphorus. The average value is probably about $7.25 a short ton. Most of the remainder is much higher-priced, low-fluorine materials used as stock- and poultry-feed supplements. Defluorinated phosphate rock and dicalcium phosphate were imported from the United States and similar low-fluorine compounds from Belgium and Japan. Values are in the range of $50 to $75 a short ton. Curacao in The Netherlands Antilles supplied naturally low-fluorine phosphate rock worth a little more than $30 a short ton.

Total imports of phosphate fertilizers in 1962, mostly into eastern Canada, further declined mainly because of increased production capacity for triple superphosphate. Imports of higher-priced, high-analysis phosphate fertilizers from the United States increased sharply in 1962.

The value of exported ammonium phosphate from western Canada was a little lower than in 1961, although overseas shipments apparently increased.

Late in the year, Cyanamid of Canada Limited began operating its new plant for the production of triple superphosphate and diammonium phosphate at Port Robinson, Ontario. Phosphate rock and phosphoric acid are being imported from the parent company's operations in Florida.

The Consolidated Mining and Smelting Company of Canada Limited began construction of a new ammonium-phosphate plant at Kimberley, British Columbia, that will double the present production capacity, raising it to 170,000 tons a year. Near year-end, it was announced that the company's mining subsidiary, Montana Phosphate Products Company, will start a new mining operation - the Douglas Mine - near Phillipsburg in western Montana. Capacity of the operation will be 300,000 tons a year of flotation-concentrated phosphate rock. Both should be in production in early 1964, with a resulting sharp increase in imports of phosphate rock in that year.

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*Mineral Processing Division, Mines Branch.

Table 1

PHOSPHATE - TRADE AND CONSUMPTION

	1961		1962	
	Short Tons	$	Short Tons	$
IMPORTS				
Phosphate rock(a)				
United States	1,039,910	9,043,670	1,134,905	10,336,232
Morocco	-	-	13,230	164,712
Netherlands Antilles ...	12,833	402,842	3,819	121,825
Belgium and Luxembourg	2,563	123,456	3,351	169,120
Japan	1,546	108,376	661	50,620
Britain	33	300	-	-
Total	1,056,885	9,678,644	1,155,966	10,842,509
Phosphate fertilizers				
Triple superphosphate				
United States	67,435	3,392,272	55,494	2,768,599
Superphosphate, not otherwise provided for				
United States	119,748	2,171,850	104,084	1,954,852
Venezuela	4,816	60,263	5,724	71,589
Total	124,564	2,232,113	109,808	2,026,441
Phosphate fertilizer, not otherwise provided for				
United States	6,679	567,193	21,540	1,843,805
Morocco	50	2,132	-	-
Total	6,729	569,325	21,540	1,843,805
Total, phosphate fertilizers	198,728	6,193,710	186,842	6,638,845
Phosphoric acid and phosphorous compounds	6,991	1,491,283	7,965	1,774,775

Table 1 (cont'd)

	1961		1962	
	Short Tons	$	Short Tons	$
EXPORTS				
Phosphate-nitrogen fertilizers				
United States.........		19,625,313		19,162,706
Australia		-		105,055
Philippines		46,481		61,255
Thailand.............		4,863		15,450
Guatemala		8,699		7,220
Total		19,685,356		19,351,686

	1960	1961	1962
	Short Tons		
CONSUMPTION of phosphate rock (available data)			
Fertilizers(b)	731,102	826,192	957,195
Chemicals(c)	160,792	150,447	159,412
Total................	891,894	976,639	1,116,607

Source: Dominion Bureau of Statistics. (a)Includes some defluorinated phosphate rock and dicalcium phosphate for use as animal-feed supplements. (b)Includes small amount used for animal-feed supplements. (c)Includes small amount used in production of pig iron.
Symbol: - Nil.

Table 2

PHOSPHATE ROCK - IMPORTS AND CONSUMPTION, 1953-62
(short tons)

	Imports	Consumption
1953	576,500	512,090
1954	644,860	628,061
1955	588,209	585,326
1956	627,648	552,646
1957	723,220	772,715
1958	744,164	728,906
1959	797,063	786,044
1960	941,998	891,894
1961	1,056,885	976,639
1962	1,155,966	1,116,607

Source: Dominion Bureau of Statistics.

75807—30½

PRODUCTION AND OCCURRENCES

There has been no significant domestic production of phosphatic raw material since low-cost Florida sedimentary phosphate rock became readily available during the early 1890's. For a few years before that period, a flourishing apatite-mining industry existed, particularly in the Buckingham area of Quebec. The source of this production was a number of relatively small, irregular, coarse-grained deposits of a type that is common in southwestern Quebec and southeastern Ontario. Typically the deposits also contain phlogopite and pink calcite and are found in association with pyroxenite.

Apatite is relatively abundant in some of the alkaline-rock complexes that occur in parts of Ontario and Quebec. Near Nemegos, about 150 miles northwest of Sudbury, extensive zones contain about 20 per cent apatite, large quantities of titaniferous magnetite and minor amounts of the niobium mineral pyrochlore. The niobium-mineral deposits in the Oka area, near Montreal, contain small amounts of apatite, which may prove to be recoverable as a byproduct of the niobium-mineral production.

Some of the ilmenite-magnetite deposits associated with anorthosite in eastern Quebec contain sufficient apatite to make them potential sources of byproduct apatite.

Sedimentary phosphate rock occurs between Banff, Alberta, and the Crowsnest-Fernie area of southeastern British Columbia, but is probably too low-grade to be currently commercial.

WORLD PRODUCTION

About 88 per cent of the world's requirements of phosphate is supplied by sedimentary phosphate rock. The remainder comes from apatite and, to a minor extent, guano.

World production of phosphate in 1962 was in excess of 51 million short tons. The United States produced about 42 per cent of the total, principally in Florida, but also in Montana and neighboring states and in Tennessee. The United States, Southern Morocco, Tunisia, the U.S.S.R., the island of Nauru in the southern Pacific and Christmas Island in the Indian Ocean market sedimentary phosphate rock. The U.S.S.R., North Viet Nam and Brazil are the main producers of apatite concentrate. Peru is the chief source of guano. The Netherlands Antilles markets a naturally low-fluorine phosphate rock that is valuable as an additive to stock and poultry feeds.

Table 3 is a partial list of phosphate producers in 1962.

TECHNOLOGY

Phosphorus, an essential constituent of life, is mainly derived from sedimentary phosphate rock or apatite, which are essentially calcium phosphate. These raw materials are graded chemically in terms of the $Ca_3(PO_4)_2$ (bone phosphate of lime or B.P.L.) content or the P_2O_5 content - 1.0 B.P.L. = 0.458 P_2O_5.

Table 3

WORLD PRODUCTION OF PHOSPHATE, 1962
('000 short tons)

United States	21,708
Southern Morocco	8,997
U.S.S.R.	9,598
Tunisia	2,312
Nauru	1,698
Christmas Island	575
Other countries	6,677
Total	51,565

Source: U.S. Bureau of Mines, Phosphate Rock Preprint 1962.

The phosphorus can be made readily available to plants by converting the raw material to a fertilizer. Normal superphosphate, with an 18- to 22-per-cent content of available P_2O_5, is manufactured by treating phosphate rock with sulphuric acid. Triple superphosphate contains 45 to 48 per cent available P_2O_5 and is produced by treating phosphate rock with phosphoric acid. These fertilizers are used mostly with compounds of nitrogen and potassium to produce mixed fertilizers, but are also applied directly to the soil.

Monoammonium and diammonium phosphate are manufactured by reacting ammonia with phosphoric acid, and provide relatively high contents of nitrogen and phosphorus. In Canada, wet-process acid, produced by acidulating phosphate rock with sulphuric acid, is used.

There is a well-developed trend toward the use of fertilizers with a higher content of plant food, the availability of phosphorus being as high as 61 per cent P_2O_5.

Almost all phosphate rock contains about three to four per cent fluorine, which must be reduced significantly before a supplement for stock and poultry feed can be produced. This is accomplished by calcining the rock, which substantially defluorinates it, or by manufacturing wet-process phosphoric acid and reacting this with limestone to produce dicalcium phosphate, which contains less than 0.2 per cent fluorine.

Elemental phosphorus is manufactured by fusing a mixture of phosphate rock, silica and coke in an electric furnace. The phosphorus is converted to high-purity phosphoric acid and numerous industrial chemicals.

USES AND SPECIFICATIONS

A large part of the phosphate rock used in Canada goes into the manufacture of fertilizers (a minor amount is fine-ground and applied directly to the soil). Smaller amounts are used for making phosphorus and phosphorous chemicals, and feed supplements for livestock and poultry.

Phosphorous chemicals are consumed by a wide variety of industries. The main application is in the manufacture of soaps and detergents. The food-processing industry uses considerable amounts as a leavening agent in baking powders, cake mixes, etc., and in food preservatives. They are also used in water-conditioning, metal treatment, plastic- and paper-manufacturing, the synthesis of organic phosphates, and the manufacture of chemical reagents and pharmaceutical preparations, as well as in paints, stock-feed supplements, munitions and fireworks, and many other products.

For fertilizers, phosphate rock should contain about 74 to 75 per cent B.P.L. For electric-furnace use, a lower B.P.L. content is acceptable, but the rock must have no excess calcium and a maximum of three per cent Fe_2O_3 plus Al_2O_3, and be mostly coarser than five mesh.

PRICES

According to E & M J Metal and Mineral Markets of December 31, 1962, the United States prices of Florida land-pebble phosphate rock per long ton were as follows:

% B.P.L.	f.o.b. Mine or Mill	f.o.b. Vessel
77 to 76	$8.21	$10.50
75 " 74	$7.21	$ 9.50
72 " 70	$6.21	$ 8.30
70 " 68	$5.56	$ 7.75
68 " 66	$5.16	$ 7.10

Phosphate rock enters Canada duty-free.

Platinum Metals

C. C. Allen*

Production of platinum metals in Canada during 1962 was 470,787 ounces valued at about $29 million. This was 12.5 per cent greater than the 1961 production of 418,278 ounces valued at about $24.5 million.

The platinum metals comprise platinum, palladium, rhodium, ruthenium, iridium and osmium. All except osmium are produced in Canada as byproducts of the treatment of nickel-copper ores.

The market for platinum metals during 1962 was, like 1961, very quiet. Consumption of platinum metals was up slightly from 1961. Major demand was for platinum in fabricated form as supplied by the two principal Free World refiners and manufacturers, Engelhard Industries, Inc.,Newark, N.J., and Johnson , Matthey & Co., Limited, London, England. Russian platinum metals were available at prices slightly lower than those of the two principal refiners. Current demand is dependent on general business activity and not on any particular industry.

Canada continues to be one of the three leading producers. The other two, the Republic of South Africa and the U.S.S.R., do not publish statistics. Platinum metals in South Africa are a primary product with nickel and copper as byproducts. In Russia, platinum metals are obtained from the placer deposits of the Urals and as byproducts of the nickel-copper operations at Norilsk, Nikel and Monchegorsk.

MINE PRODUCTION

Canadian platinum metals production is obtained from the treatment of nickel-copper ores though occasionally there are a few ounces of placer production from British Columbia or the Yukon. Canada's entire production just prior to 1961 came from Sudbury, Ontario, but additional production in 1961-62 has come from Thompson, Manitoba. Two nickel-copper mines commenced production in 1962 - Marbridge Mines Limited in LaMotte Township, Quebec, and Nickel Mining & Smelting Corporation at Gordon Lake, north of Kenora, Ontario. Marbridge concentrates are trucked to Falconbridge Nickel Mines, Limited in the Sudbury area, for smelting. Production is at a minimum of 300

*Mineral Resources Division

Table 1

WORLD PRODUCTION, 1960-61

(troy ounces)	1961	1962
Canada	418,278	470,787
U.S.S.R.	350,000e	375,000e
Republic of South Africa	357,000e	306,000e
United States	43,248	28,742
Colombia	29,844	22,052
Other countries	6,630	4,419
Total, world	1,205,000	1,207,000

Sources: U.S. Bureau of Mines, Platinum Group Metals Preprint, 1962; for Canada: Dominion Bureau of Statistics.
eEstimate.

Table 2

PLATINUM METALS - PRODUCTION AND TRADE

	1961		1962	
	Troy Ounces	$	Troy Ounces	$
PRODUCTION				
Platinum, palladium, rhodium, ruthenium, iridium	418,278	24,534,349	470,787	28,848,637
EXPORTS				
Domestic origin				
Platinum metals in ores and concentrates				
Britain	596,356	24,773,501	517,737	21,676,156
Norway	21,249	979,358	16,540	805,474
United States	9,271	156,579	8,708	227,008
Total	626,876	25,909,438	542,985	22,708,638

Table 2 (cont'd)

	1961		1962	
EXPORTS (cont'd)	Troy Ounces	$	Troy Ounces	$
Platinum metals				
United States	385	16,487	24,248	1,246,091
Britain	1,856	188,640	2,013	195,392
Japan	1,603	151,211	1,926	182,832
Jamaica	-	-	75	7,222
Cuba	666	61,406	-	-
Venezuela	109	3,919	-	-
Total	4,619	421,663	28,262	1,631,537
Foreign origin*				
Platinum metals refined and semi-processed				
United States	346,590	9,820,374	390,018	8,644,781
IMPORTS				
Platinum metals, semiprocessed and manufactured				
Britain**		10,973,779		12,456,562
United States		268,549		468,904
Total		11,242,328		12,925,466
Platinum crucibles				
United States		1,304,278		1,890,880
Britain		53,398		87,514
Total		1,357,676		1,978,394
Catalysts for refining petroleum				
United States		2,288,329		1,889,170
Britain		9,040		12,385
Total		2,297,369		1,901,555

Source: Dominion Bureau of Statistics.
*Exports from Canada to the United States of platinum metals in a refined or semiprocessed state. Re-exports of imports from Britain (see following note).
**Derived from Canadian concentrates refined and processed in Britain.
Symbol: - Nil.

Table 3

PLATINUM METALS - PRODUCTION AND TRADE, 1953-62

	Production(a)			Exports			Imports(d)
	Platinum (troy oz)	Other Platinum Metals (troy oz)	Total (troy oz)	Domestic(b) ($)	Foreign(c) ($)	Total ($)	($)
1953	137,545	166,018	303,563	15,357,335	10,921,621	26,278,956	16,517,392
1954	154,356	189,350	343,706	16,693,716	10,936,039	27,629,755	17,784,372
1955	170,494	214,252	384,746	14,605,539	11,697,861	26,303,400	15,723,099
1956	151,357	163,451	314,808	20,571,623	14,814,488	35,386,111	19,579,826
1957	199,565	216,582	416,147	17,638,093	10,081,412	27,719,505	15,430,931
1958	146,092	154,366	300,458	15,014,321	4,893,616	19,907,937	8,641,360
1959	150,382	177,713	328,095	12,497,221	8,676,998	21,174,219	6,466,280
1960	na	na	483,604	16,068,728	8,404,563	24,473,291	12,951,420
1961	na	na	418,278	26,331,101	9,820,374	36,151,475	11,242,328
1962	na	na	470,787	24,340,175	8,644,781	32,984,956	12,925,466

Source: Dominion Bureau of Statistics.

(a) Platinum metals, content of residues, concentrates and matte shipped to Britain and Norway for treatment.

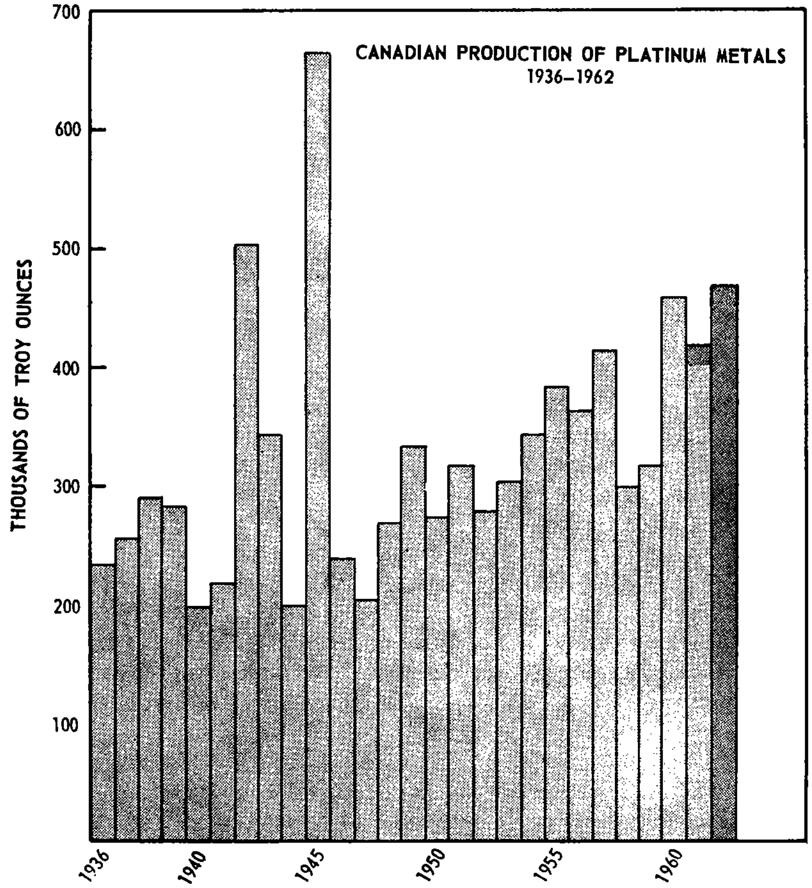
(b) Value of platinum metals in concentrates exported for treatment.

(c) Exports of platinum metals refined and semiprocessed. Re-exports of platinum metals from Britain; considered exports of foreign produce.

(d) Imports from Britain of refined and semiprocessed platinum metals derived from Canadian concentrates and residues shipped to Britain for treatment.

Symbols: na Not available for publication.

tons of ore a day; information on the platinum metals content has not been released. Nickel Mining & Smelting Corporation mines and concentrates 500 tons of ore a day. Bulk nickel-copper concentrates are trucked to Lac du Bonnet, Manitoba, and shipped by rail to The International Nickel Company of Canada, Limited, at Copper Cliff, for smelting. Precious-metal content, consisting chiefly of platinum, has been estimated at $3.00 a ton.



Most Canadian production of platinum metals continues to come from the Sudbury area of Ontario. The platinum metals content of the nickel-copper ore is about 0.025 ounce per ton. In 1962, International Nickel operated five underground mines - Creighton, Frood-Stobie, Garson, Levack, and Murray; and two new open-pit mines - the Clarabelle and Ellen. The Ellen was subsequently closed and the Crean Hill mine, ready for production, was maintained on a standby basis. Ore production from mines in Ontario and from Thompson, Manitoba, amounted to 13,794,000 tons compared to 17,489,000 tons in 1961. At Dec. 31, 1962, ore reserves in Ontario and Manitoba totalled 299,416,000 tons with a nickel-copper content of 9,006,300 tons. Comparable reserves in 1961 were 297,419,000 tons containing 8,937,000 tons of nickel and copper. In September, International Nickel announced a fourth-quarter cutback from 92 million to 80 million pounds of nickel.

Falconbridge Nickel Mines, Limited, operated the Falconbridge and East mines in the Falconbridge, Ontario, area, and the Hardy, Onaping and Fecunis on the north rim of the Sudbury basin. At the Strathcona deposit, shaft sinking was completed to the 3,205-foot horizon and lateral development was under way at the year-end. At the East mine, a contract was let for sinking a winze from the 4,025-foot level to the 6,050-foot level. When additional work was done at Norduna Mines Limited to extract a small quantity of ore below the 700-foot level the mine closed.

Falconbridge nickel deliveries during the year amounted to 61,061,000 pounds compared to 65,546,000 pounds in 1961. Ore delivered to treatment plants was 2,407,520 tons. Ore reserves at the year-end were slightly greater than in 1961 - developed ore, 21,096,850 tons at 1.62% nickel and 0.84% copper; indicated ore, 27,166,150 tons at 1.32% nickel and 0.77% copper. Total reserves amounted to 48,263,000 tons at 1.45% nickel and 0.80% copper.

In Manitoba, the Thompson property of International Nickel experienced its first full year of production. Surface preparations were made for the sinking of a second production shaft that will go to the 2,400-foot level. Nickel production capacity was increased to over 90 million pounds from 75 million.

Platinum metal concentrates from International Nickel's Copper Cliff plant are sent to the refinery of The International Nickel Company (Mond) Limited, at Acton, England. The platinum metals in Falconbridge ore are in matte shipped to the refinery at Kristiansand, Norway. The platinum-metal slimes from the electrolytic cells are refined by Engelhard Industries Incorporated at Newark, New Jersey.

EXPLORATION AND DEVELOPMENT

Exploration for new nickel deposits in Canada during 1962 was active and some encouraging results were obtained. Because of the general association of platinum metals with nickel, this exploration is of direct interest to the platinum industry.

Raglan Nickel Mines Limited, operating in the Ungava area of far northern New Quebec, increased its estimated reserves by mid-year to 6.4 million tons averaging 1.60 per cent nickel and 0.80 per cent copper.

The nickel-copper prospect of Cochenour Willans Gold Mines, Limited, on Pipestone Bay at the west end of Red Lake in northern Ontario, was optioned to Falconbridge Nickel and subsequently dropped. McIntyre-Porcupine Mines, Limited, optioned a nickel-copper prospect in the Belleterre area of northern Quebec near the boundary of Blondeau and Gaboury townships, about 13 miles southwest of Belleterre. At last report the sulphide lens being drilled was limited to about 250 feet in length but open at depth; two diamond drills continued operating. The property adjoins, on the northwest, that of Consolidated Regcourt Mines Limited on which exploration was done prior to 1962.

Marmal Nickel Mines Limited, with property in the Cross Lake area of northern Manitoba, was formed from the holdings of Consolidated Marbenor Mines Limited and Rio Tinto Canadian Exploration Limited. Falconbridge subsequently optioned the Marmal holdings for further exploration and development.

In eastern Ontario, diamond drilling on the Bicroft nickel property of Macassa Gold Mines Limited indicated 2,200 tons of potential ore per vertical foot, to a one thousand foot depth, averaging one per cent nickel and 0.25 per cent copper. Metallurgical and feasibility studies were continuing.

USES

The platinum metals are valuable to industry because of their many special properties, the chief of which are: catalytic activity, resistance to corrosion, resistance to oxidation at elevated temperatures, high melting points, high strength and high ductility. Platinum and palladium are the principal platinum metals consumed. Iridium, osmium, ruthenium and rhodium are used mainly as alloying elements to modify properties of platinum and palladium. Rhodium is also used extensively in rhodium plating.

The uses of platinum metals in industry became more diverse and that, coupled with further research, will create a greater demand. Palladium-silver alloys were used as membranes in diffusion cells in hydrogen purification. Members of the platinum group are being increasingly used in or on the electrodes of fuel cells on research bases. Platinum metals, either as catalysts or in or on electrodes, are being considered in many automobile smog-control units. The lesser known platinum metals, rhodium, ruthenium, and osmium, show added desirability as polymerization and hydrogenation catalysts. Platinum was used in part of the framework of the Telstar satellite.

The displacement plating of palladium by chemical reduction of palladium salt solutions is becoming increasingly important. Irregular shapes and printed circuits can be readily plated in this manner. Electrolytic plating of palladium will continue for the decorative plating of smooth surfaces.

PRICES

E & M J Metal and Mineral Markets of December 31, 1962, gives the United States prices of platinum metals per troy ounce as follows:

Platinum..................	\$ 80 to \$ 85
Palladium	24 to 26
Osmium.................	60 to 70
Iridium	70 to 75
Rhodium	137 to 140
Ruthenium	55 to 60

TARIFFS

Canada	British Preferential	Most Favored Nation	General
Platinum wire and platinum bars, strips, sheets, plates; platinum, palladium, iridium, osmium, ruthenium, and rhodium, in lumps, ingots, powder, sponge or scrap.....	free	free	free
Platinum crucibles	free	free	free
Platinum retorts, pans, condensers, tubing and pipe, and preparations of platinum for use in manufacture of sulphuric acid	free	free	free
Platinum and black oxide of copper for use in manufacture of chlorates and colors............................	free	10%	10%

United States	
Ores of platinum metals..............	free
Platinum, unmanufactured or in bars, ingots, plates or sheets not less than 1/8 in. thick, scrap and sponge......	free
Iridium-osmium, palladium-rhodium and ruthenium and native combinations thereof with one another or with platinum	free
Chemical compounds, mixtures and salts of which gold, platinum, rhodium or silver constitute element of chief value	11%

Potash

C.M Bartley*

DEPARTMENT OF MINES AND TECHNICAL SURVEYS, OTTAWA

A new mineral industry was added to the impressive Canadian list when the large-scale potash mining and processing operation of International Minerals & Chemical Corporation (Canada) Limited (IMC) at Esterhazy, Saskatchewan, was successfully brought into production in August 1962. Energy, unusual engineering skill and persistence have been necessary to solve the problems of sinking a shaft to the potash deposits. United States management and finances combined with West German shaft "tubbing" techniques and a Canadian staff to make the project an international success. At year-end the plant was operating at near capacity and shipments were being made to Canadian and foreign purchasers. Output in 1963 is expected to be about one million tons, nearly one tenth of world potash production.

The rehabilitated mine and mill of Potash Company of America (PCA) near Saskatoon will be in operation in 1964 and the total annual capacity of these two plants, about 1,800,000 tons of end-product, will make Canada one of the world's major producers of potash.

In early 1963, three companies made formal announcement regarding the construction of additional potash mining and processing facilities in Saskatchewan. These were: International Minerals & Chemical Corporation (Canada) Limited, Kalium Chemicals Limited, and Alwinsal Potash of Canada Limited.

Several other companies are interested in potash development in this province and additional shaft-mining and solution-mining operations are expected.

World wide potash consumption has increased appreciably in recent years and, although potash production capacity is being expanded in several countries, only the new projects in Canada and the United States add significant quantities to the total supply. Canada alone appears able to meet the expected steadily rising demands of the future.

PRODUCTION AND TRADE

Potash was first produced in Canada in late 1958 at the Potash Company of America plant near Saskatoon. Water leaks in the shaft wall made it necessary to cease production early in 1959 and rehabilitate the shaft. Unofficial estimates of production in 1959 by the U.S. Bureau of Mines were 300,000 tons of ore mined with a content 42,184 tons of potash (K_2O).

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*Mineral Processing Division, Mines Branch.

Table 1

POTASH - PRODUCTION AND IMPORTS

	1961		1962	
	Short tons	$	Short tons	$
PRODUCTION				
K_2O content	-	-	na	na
IMPORTS				
Potash fertilizers				
Muriate of potash				
United States	107,267	2,540,186	88,295	2,455,578
West Germany	32,750	943,991	25,009	775,568
France	24,310	729,801	22,080	709,648
U.S.S.R.	5,450	187,555	12,589	426,565
Total	169,777	4,401,533	147,973	4,367,359
Sulphate of potash				
United States	17,324	665,888	15,130	623,208
France	9,054	352,949	8,341	312,296
West Germany	100	4,073	510	21,682
Total	26,478	1,022,910	23,981	957,186
Sulphate of potash magnesia				
United States	4,880	76,133	4,967	87,232
West Germany	300	7,877	775	22,681
Total	5,180	84,010	5,742	109,913
Total, potash fertilizers	201,435	5,508,453	177,696	5,434,458
Potash chemicals and compounds	9,837	1,981,589	9,262	2,031,767

Source: Dominion Bureau of Statistics.
Symbols: - Nil; na Not available.

Table 2

POTASH CONSUMPTION
(short tons)

	1960	1961	1962
Muriate of potash			
Fertilizers and chemicals	132,747	135,606	158,608
Other	240	243	947
Total	132,987	135,849	159,555

Continuous production of potash in Canada started in August 1962 at the Esterhazy plant of International Minerals & Chemical. Company officers have stated that more than one million tons of ore were mined from August 1962 to the end of March 1963. Production figures for 1962 are not available but, if it is assumed that 400,000 tons of ore were mined in 1962, product output from the refinery, assuming an average of 25 per cent K_2O grade in the ore, would have been about 100,000 tons.

Evidence given to the Canadian Senate Standing Committee on Transport and Communication contained an estimate that about 50 per cent of Canadian potash production will normally move to export markets overseas, about 30 per cent will move to United States markets, and the balance will be sold to Canadian purchasers. Statistics on Canadian potash exports in 1962 were not released but the United States reported the import of 76,236 tons of Canadian potash valued at $1,629,906 in that year, and it is believed that some Canadian potash was shipped to overseas buyers through the port of Vancouver.

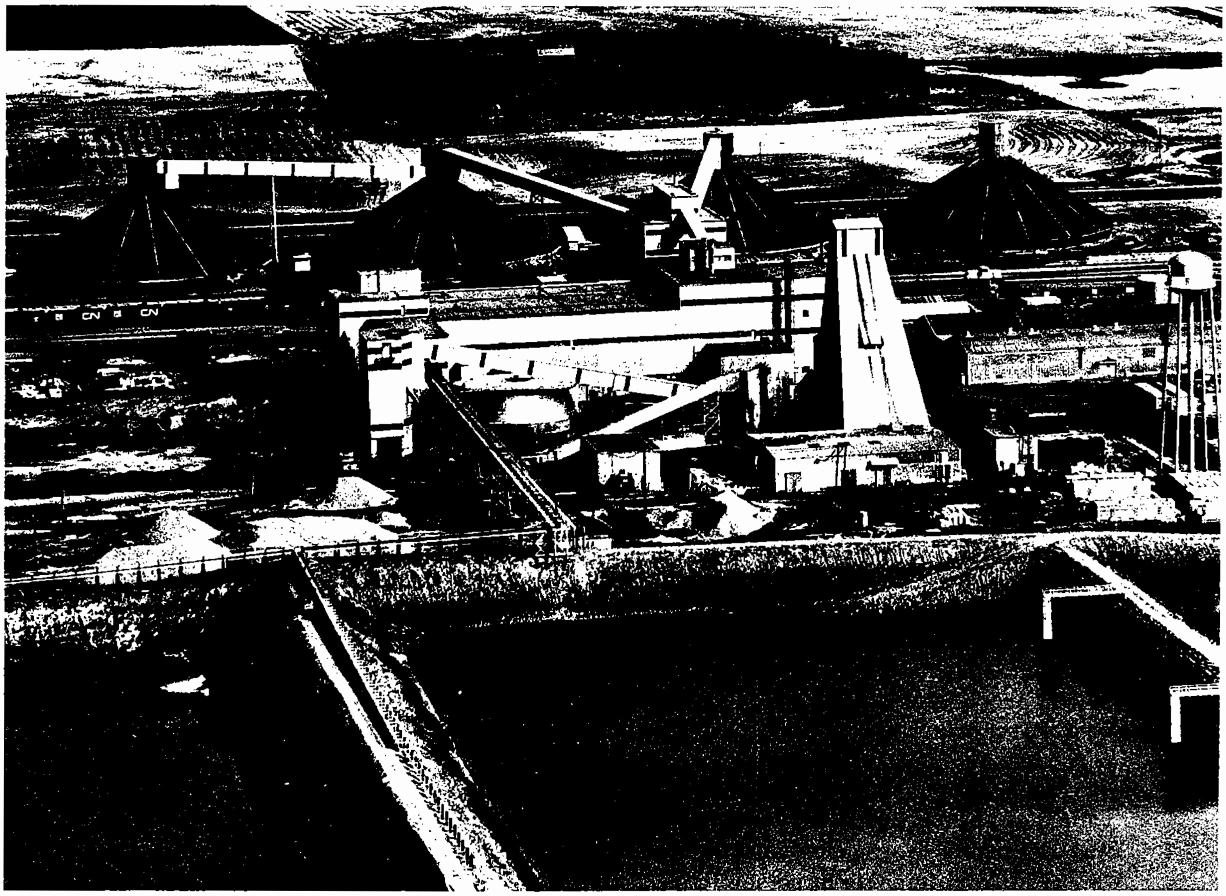
Total imports of potash into Canada for fertilizer, at 177,696 tons, were lower than in 1961. The availability of Canadian potash in late 1962 probably accounts for the lower rate of imports.

Consumption of muriate of potash totalled 159,555 tons in 1962 - up from 135,849 tons in 1961. Almost all is used in the manufacture of chemical fertilizers.

Trade in potash is world wide. The main producing areas are western Europe and the United States; in the Soviet Bloc they are: East Germany and the U.S.S.R. Europe is the main producer and consumer. United States production is nearly in balance with total North American consumption. Some potash is exported from the west coast of United States and some is imported to the east coast of Canada and the United States.

In 1960-61, world production of potash totalled 8,670,000 tons of K_2O. Trade for 1962, by continents, is indicated in Table 3.*

*Source: F.A.O. Fertilizers, 1961.



Potash plant of International Minerals & Chemical Corporation (Canada) Limited at Esterhazy, Saskatchewan. Waste brine reserves are shown in the foreground and four storage warehouses are in the background.

Table 3

POTASH PRODUCTION AND CONSUMPTION

	Output %	Consumption %
Europe	63.1	52.2
U.S.S.R.	12.0	9.0
North and Central America	23.6	25.8
South America	0.2	1.9
Asia	1.1	8.8
Africa	-	1.1
Oceania	-	1.2
	100.0	100.0

Symbol: - Nil

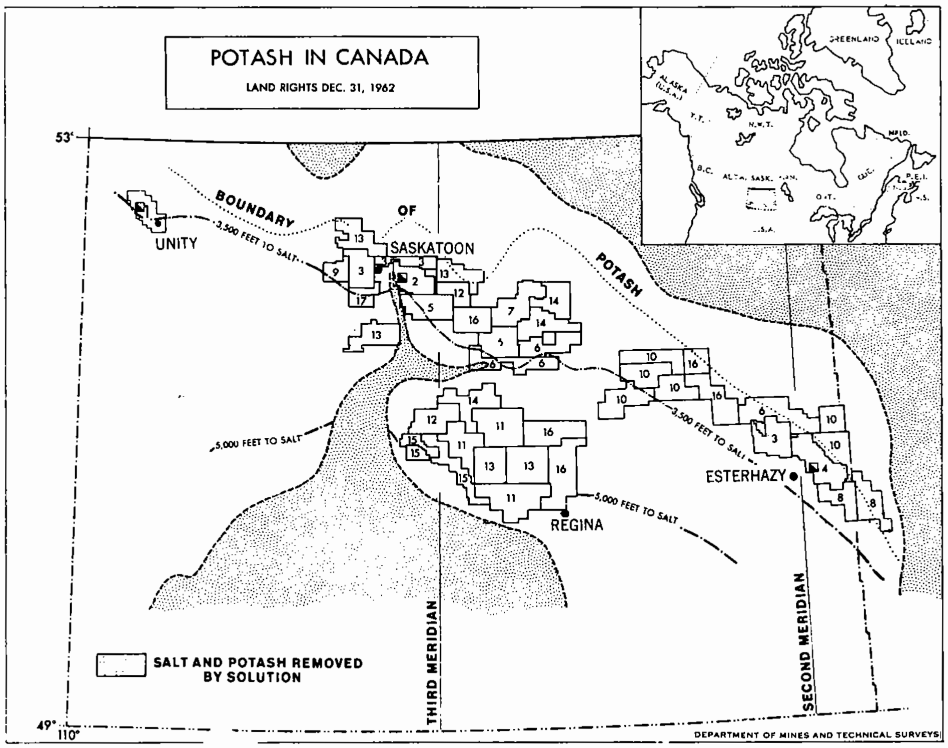
POTASH MINERALS AND THEIR SOURCES

The term "potash", applied to materials containing potassium in useful amounts, is derived from "pot ashes". In the early days, solutions leached from wood ashes in iron pots served as a source of potassium. Soluble potash minerals found in German salt deposits were recognized as valuable for fertilizer in 1857, and minerals have since been the source for fertilizer and for chemical use. The potassium content of the minerals is stated in terms of K_2O because it was originally thought that potassium was effective as fertilizer only in this form. The present trend to high-analysis fertilizers makes traditional practice cumbersome in that plant nutrient values sometimes total more than 100 per cent.

The common and most useful potassium-bearing minerals, with chemical formulae and potassium content expressed as percentages of K_2O and K, are as follows:

Mineral	Formula	Percentages Equivalent K_2O	K
Sylvite	KCl	63.3	52
Carnallite	$KCl.MgCl_2.6H_2O$	17.0	14
Langbeinite	$K_2SO_42MgSO_4$	22.0	19
Kainite	$KCl.MgSO_43H_2O$	18.9	13
Nitre	KNO_3	46.5	39

Minerals valued for their potassium content occur almost entirely as bedded evaporite deposits associated with salt (NaCl) or as natural brines (as in the Dead Sea) where soluble salts are being concentrated by high rates of evaporation. The main sources of potash are evaporites that after deposition have been buried by overlying sediments and thus protected from solution by surface water. Major deposits of potash minerals have been found in Germany, France, the U.S.S.R., Spain and the United States and, more recently, in Saskatchewan.



Potash Land Rights, December 31, 1962*

1. Continental Potash Corporation Limited, 1951
2. Potash Company of America, 1952
3. Duval Sulphur & Potash Company, 1954
4. International Minerals & Chemical Corporation (Canada) Limited, 1955
5. United States Borax & Chemical Corporation, 1955
6. Southwest Potash Corporation, 1956
7. Alwinsal Potash of Canada Limited, 1958
8. Tombill Mines Limited, 1957
9. National Potash Company, 1957
10. Canberra Oil Company Ltd., 1959
11. Kalium Chemicals Limited, 1960
12. Consolidated Morrison Explorations Limited, 1960
13. Imperial Oil Limited, 1961
14. Kerr-McGee Oil Industries, Inc., 1961
15. Domtar Chemicals Limited, Sifto Salt Division, 1961
16. Shell Oil Company of Canada, Limited, 1962
17. Gibbs, G.H., 1962

*This map shows the location of potash rights held in Saskatchewan and Manitoba by various companies. The approximate date of the first acquisition of land rights is given although company names and property locations may have changed since that time.

Potash is recovered from Searles Lake in California. It is also recovered by Israel from brines drawn from the Dead Sea. Similar recovery is planned by Jordan at the Dead Sea and by Midepsa Industries Limited, a Canadian company, from brine occurrences in Peru.

THE SASKATCHEWAN DEPOSITS

In Saskatchewan, potash was first noted in the early 1940's in cores from oil-well drilling. Additional discoveries indicated the extent and richness of the occurrences and attracted wide interest in their development. Attempts to recover potash from these occurrences began in 1951 near Unity and have since continued.

Potash is found in three or more fairly continuous and consistent layers in the upper part of the vast Prairie Evaporites formation of Devonian age. The formation has the shape of a huge platter underlying southern Saskatchewan and adjacent parts of Manitoba and Alberta. It is tilted slightly to the southwest, and the shallow northern edge lies at depths from 3,000 to 3,500 feet below the surface. Southward the depth increases to 5,000 feet at Regina and 7,000 feet at the International Boundary. The Prairie Evaporites consist largely of salt concentrated by the evaporation of an ancient sea; the potash zones represent the final precipitation of the most soluble materials. Thus, the potash occurs with salt and is overlain by various sedimentary rocks ranging from glacial drift to limestone.

CANADIAN ACTIVITIES IN POTASH

Since 1951 five companies have made six attempts in Saskatchewan to produce potash by solution mining or by mining through shafts. These projects, together with the drilling of some 200 exploration holes, technical studies and various kinds of surveys and test work, have resulted in the expenditure of more than $100 million to date. For comparison, it has been estimated that capital investment for potash production in New Mexico during the past thirty years totals about $150 million. The Saskatchewan expenditures, in an industry which is just starting, indicate not only the technical difficulties and the high cost of potash development in Canada, but also the conviction that profitable operation can be based on these rich deposits in spite of the high costs.

The accompanying map shows the properties held by 17 companies on December 31, 1962, and the general features of the potash area. It is assumed that the companies along the shallow northern edge of the potash area will produce through shafts and that those farther south, in the central region north of Moose Jaw and Regina, will operate by solution mining.

During 1962 several companies were active in Saskatchewan, drilling a total of 28 holes and carrying on technical work and financial and marketing negotiations. Much of the development interest during the year appeared to be concentrated on solution mining, but at least two companies were considering shaft mines. Potash land holdings increased considerably in 1962 both along the mining belt and in the presumed solution mining area.

The start of production at Esterhazy, and the rehabilitation of the shaft at Saskatoon have probably diverted attention from the fact that several strong companies have become interested in the possibilities of solution mining. It is evident that potash can be produced by shaft mining and additional shafts will undoubtedly be sunk in Saskatchewan. However, the high cost and lengthy

Table 4

SUMMARY OF POTASH PROJECTS IN SASKATCHEWAN

Date	Company	Location	Type of Mining	Present Status
1951	Western Potash Corporation Limited	Unity	Solution	Test abandoned
1953	Same (named changed 1955 to Continental Potash Corporation Limited)	Unity	Shaft	Shaft to 1,800', inactive 1962
1952	Potash Company of America	Saskatoon	Shaft	Shaft repaired, production 1964
1957	International Minerals & Chemical Corporation (Canada) Limited	Esterhazy	Shaft	Production started August 1962
1957	General Petroleum of Canada Limited	Nokomis	Solution	Test abandoned
1960	Kalium Chemicals Limited	Moose Jaw	Solution	Full scale production to start 1964
1962	Duval Sulphur & Potash Company	Saskatoon	Solution	Test conducted summer 1962
1962	Imperial Oil Limited	North of Moose Jaw	Solution	Test conducted summer 1962
1963	Alwinsal Potash of Canada Limited	Lanigan	Shaft	Production 1968 Shaft to start 1964

development period of shafts have encouraged interest in solution mining. As a result three test projects were being conducted during the summer of 1962. Comparison of the efficiency and economics of shaft mining and solution mining is not yet possible although each method appears to have advantages and disadvantages. Generally speaking, the industry will be stronger by being capable of production by the two methods because solution mining could exploit deposits too deep for shaft mines. The two methods would not be operated in the same area.

International Minerals & Chemical Corporation (Canada) Limited (IMC)

The IMC shaft reached the potash horizon on June 8, 1962. Following the successful penetration of the Blairmore formation by deep-freezing and cast iron "tubbing" techniques in 1961 and 1962, the remainder of the shaft excavation was completed slowly by repeated cycles of careful pre-grouting and sinking in short sections. Production was started in August on a small scale but the rate was increased rapidly as underground development opened new mining areas. At year-end, production was at near capacity - possibly 400,000 tons of ore having been mined. Processed potash was being shipped to Canadian and several foreign purchasers including the United States and Japan.

The mine and mill operate with the most modern and efficient equipment and processes known. The orebody, accessible from the present shaft, contains many millions of tons estimated to average about 30 per cent K_2O equivalent.

The present plant has a rated capacity of about 1,200,000 tons of end product (KCl concentrate) or 750,000 tons K_2O equivalent annually, and with additional equipment might produce 20 per cent more.

To insure ground stability, only 40 per cent of the ore in place will be mined initially, and a rapid lateral expansion of workings can therefore be expected. The rising cost of transporting ore great distances underground, and the hazard to both personnel and investment in a one-shaft operation at this depth, and the requirement for increased ventilation as workings are extended, emphasize the need for a second shaft. The second shaft, announced early in 1963, will be similar to the first and will be sunk within six miles of the present mine. The two shafts will provide sufficient mining capacity for four million tons of product annually.

Potash occurrences at the IMC mine, and in the Esterhazy sub-basin generally, show fairly coarse crystallization (average one-half inch) and a faint pinkish to cream color, in contrast to the usual pinkish color and finer crystallization (average one-quarter inch) of most potash occurrences. Because of the color difference of the ore, the granular concentrate produced at Esterhazy is whiter in color than normal. This color difference will probably make Esterhazy area potash recognizable throughout the world.

The first export warehouse for potash in North America is being built by IMC in Vancouver to provide storage for potash en route to overseas customers. The automated handling equipment used in the warehouse for loading and unloading, has a capacity of 35,000 tons of potash and is estimated to cost $600,000. Japan has been the main overseas customer since the mine opened in August 1962.

Potash Company of America (PCA)

The Potash Company of America's shaft near Saskatoon was pronounced sound and capable of use in mid 1962, and the company reported that, following some changes in equipment, operations would start in 1964. A friction hoist will be installed, and changes will be made in underground mining machines and ventilation. Some alteration in milling equipment is planned to improve recovery. The nature of these changes rules out an immediate resumption of production. Once these changes are complete, output should increase rapidly using mining areas developed in 1958 and 1959.

The PCA plant has a rated capacity of about 600,000 tons of end-product per year (360,000 tons K_2O). The ore body has a mining thickness of about 12 feet and has been estimated to grade about 27 per cent K_2O. In the United States this company is the largest single producer of potash and is a merchant producer only rather than a manufacturer of fertilizers.

Continental Potash Corporation Limited (CPL)

In 1961, at Unity, Continental Potash Corporation Limited cleared its flooded shaft of Blairmore sand. In 1962 CPL completed the removel of water and repaired damaged timbers and guides. A thick concrete plug was poured at the shaft bottom. In mid 1962 the property was inactive while plans were made to complete the shaft and while financing was being negotiated.

Kalium Chemicals Limited (KCL)

During 1962, Standard Chemical Limited continued the operation of its solution mining test project, located at Belle Plaine just northeast of Moose Jaw. Early in 1963 the company announced a change of name to Kalium Chemicals Limited. Although no details regarding the operation have been released, the company has stated that satisfactory progress has been made and, in April 1963, announced the immediate start of construction of a multimillion dollar commercial solution mining operation. Cost is expected to be about $30 million and capacity, although not officially reported, is estimated at 500,000 tons per year.

This is the first operation of its kind in the world. Water will be introduced into thick potash beds through drill holes, and, after dissolving the potash, will be returned to surface where the contained potash will be recovered by evaporation and recrystallization. The product will be similar in character to that produced by shaft mining and will serve the same markets, although it will be purer and white rather than pink.

The methods of recovering the raw material and processing it to a finished product are different from the methods used in shaft mining operations. Because these methods have been developed specifically to suit Saskatchewan conditions, they may not be readily applicable to potash deposits in other areas.

Alwinsal Potash of Canada Limited (APC)

Alwinsal Potash obtained additional land rights in the Lanigan area of Saskatchewan and continued studies and investigations in preparation for the development of large potash shaft mining operation. In June 1963, the company, formed by two West German and one French potash-producing companies, announced the start of construction on a deep potash mine and refinery with a capacity of one million tons of product annually. The plant will be located near Lanigan, about 75 miles east of Saskatoon. The cost has been estimated at about $50 million. Shaft sinking will start in 1964 and production is expected in 1968.

Other Companies

Duval Sulphur & Potash Company drilled two holes for a solution mining test and built a small test plant on its property just west of Saskatoon. Tests on solution rate and potash recovery were conducted. A considerable thickness of potash is reported to underlie the property.

Tombill Mines Limited, Steep Rock Iron Mines Limited and Premium Iron Ores Limited entered an agreement whereby the latter two companies would provide finances to bring the Tombill property to production when certain product-marketing negotiations were completed. The agreement was cancelled early in 1963, although the companies indicated continued interest in potash development. During 1962, Tombill Mines obtained a lease on an additional 4,617 acres in Manitoba for potash development.

Imperial Oil Limited and Southwest Potash Corporation conducted solution mining drilling tests during the summer of 1962 and plan further work in the future. Shell Oil Company of Canada, Limited and Sifto Salt Division of Domtar Chemicals Limited are considering solution mining tests. Drilling was conducted by Consolidated Morrison Explorations Limited and Canberra Oil Company Ltd., and possibly by others late in the year.

United States Borax & Chemical Corporation considered joint development of its property southeast of Saskatoon with Homestake Mining Company. In mid 1962 this agreement was cancelled and construction plans were deferred. The property is being held for possible future development.

OUTLOOK

At the start of 1963 the outlook for Canadian potash is highly favorable. The birth problems of the industry appear to have been solved and it appears certain that potash will be an important item in Canadian mineral production and exports.

Statistics on production, consumption and trade in potash fertilizers published by the Food and Agricultural Organization of the United Nations show a strong growth trend. This is due to the rising food needs of the expanding world population, both as the minimum amount to feed more people and also because everywhere efforts are being made to produce a wider variety of foodstuffs and to raise the standards of nutrition. In addition, there is a definite trend toward the use of fertilizers with a higher concentration of nutritional ingredients. For example, the consumption of 60 per cent K_2O potash is increasing and the consumption of 20 to 45 per cent K_2O potash salt is falling. The combined effect of these factors, and the appreciable consumption for non-food uses such as lawns in parks and recreational areas (golf courses etc.),may result in a higher rate of fertilizer use in the future than is predicted by the current statistics.

Against the potential demands of the future it is of interest to compare the estimated reserves of the various current sources of potash and to consider their ability to expand output. Table 5 lists the main sources of potash, estimated reserves, estimated average grade, and production in 1962. The strong position of Canada's new industry is clear. The technical problems and high capital costs of Saskatchewan potash projects effectively restrict development to strong and capable companies and will undoubtedly result in highly efficient plants with low unit costs. During the next seven years, up to 1970, it is expected that five or six large projects will be in operation involving a total capital outlay of possibly $275 million and capable of producing annually six million tons of end-product valued at $120 million. The combination of large rich deposits, strong aggressive producers and increasing demand for the product forecast a healthy and important potash industry for Canada.

In Saskatchewan, the development of several large mining and refining operations, widely spaced and superimposed on a thinly populated rural area may exert considerable strain on the companies and the municipalities involved. Unlike the potash-producing areas in the United States, Germany and France, there are few communities in Saskatchewan large enough to act as adequate service centres for operation of the required scale. In some cases it may be necessary to plan and build new communities to provide the industrial and social facilities, such as power and communication, and education and medical care, as well as modern homes, at the same time that the companies are concentrating on difficult shaft and refinery construction. The need for adequate industrial facilities is obvious but the necessity for satisfactory residential and social services may be fully as important in providing a community capable of attracting and retaining the technical staff necessary for efficient operation. Careful planning will be necessary to insure adequate facilities and efficient service over the long term.

Table 5

Country	Estimated* potash reserves in millions tons K_2O	Estimated grade in per cent K_2O	Estimated production 1962 million metric tons
United States	250	18	2.225
West Germany	2-20,000	12	1.938
East Germany	270-500	20	1.725
France	300-400	18	1.722
U.S.S.R.	700-18,400	10	1.500
Spain			.235
Italy	155	13.5	.135e
Canada	17,700	25	.135
Israel (in brines)	600-700	1	.091e
Chile (as potassium nitrate)	na	na	.018
Poland	165	8	
Ethiopia	na	20	production planned 1964
Morocco	na	12	production planned
Jordan (in brines)	600-700	1	production planned 1964
Peru (in brines)	na	na	deposits under investigation
Britain	350	16	under investigation
Gabon	na	na	under investigation
Libya	na	na	under investigation
Total	34,750-73,000	15	9.700

*Sources: U.S.B.M., Phosphorus and Potassium, and many others.
Note: 1,000 kilograms = 1 metric ton, 1 metric ton x 1.023 = 1 short ton.
Symbols: e Estimate; na Not available.

WORLD REVIEW

Although the successful developments in Saskatchewan were the most significant items of potash news in 1962, potash exploration and development was in progress throughout the world. Additional producing capacity was under construction or about to start in the Carlsbad area of New Mexico by several companies including: Kermac Potash Company, Duval Sulphur & Potash Company, International Minerals and Chemical Corporation, National Potash Company, and Potash Company of America. Texas Gulf Sulphur Company was completing a large new potash project near Moab in Utah. Capacity will be about one million tons of product per year; production is expected to start late in 1963. Bonneville Ltd. in Utah is increasing production capacity. Estimates are that these projects will increase United States productive capacity from 2.9 million tons of K_2O per year to 3.5 million tons per year in 1964 and possibly to 4.5 million tons by 1968.

Midepsa Industries Limited, a Canadian company based in Montreal, optioned its Peru potash brine property to Homestake Mining Company for development. The agreement was terminated by Homestake early in 1963 and other efforts are being made to bring the property into production. The operation would be somewhat similar to recovery from the Dead Sea and from Searles Lake. In addition to potassium chloride, a considerable amount of magnesium chloride is present in the brines.

In Europe expansion of potash production facilities is taking place in Italy, Spain, West Germany, East Germany and the U.S.S.R. In the U.S.S.R., new potash deposits have been discovered recently near Chelkar Lake in Kazakhstan. The most important production increases appear to be in Italy and Spain. Efforts in Germany and France are being concentrated on improving the efficiency of present mines. Saunderhousen in East Germany is to become the centre for all Soviet Bloc potash research.

Potash production from the Dead Sea brines will increase considerably in the next few years. Israeli capacity will expand from 190,000 to 590,000 tons of product annually by a $25 million project. Construction of a plant with a 250,000-ton capacity is under way in Jordan.

In Ethiopia 330,000 tons of potash annually is expected to be available by 1965. Near-surface deposits of bedded sylvite, kainite and carnallite are being developed by the Ralph M. Parsons Company of Los Angeles on a 3,500-square-mile mineral concession in the Dallal Depression. Profits from the operation will be shared equally by the company and the Ethiopian government.

French potash companies are investigating carnallite deposits in Morocco near Khemisset, and sylvite deposits near Pointe Noire in Gabon, western Africa.

The government of Libya is planning to develop potash occurrences found in the Marada salt marsh area about 100 miles south of El Agheila.

Deep potash deposits in Yorkshire, England, are being investigated by Armour Agricultural Chemical Company to determine whether potash could be produced by solution mining methods.

USES AND SPECIFICATIONS

Potash is one of the three basic ingredients in mixed chemical fertilizers, the others being phosphorus and nitrogen. The familiar grade notations on packaged fertilizers, such as 5-10-15, indicate the percentage content of nitrogen, phosphate and potash in that order. As fertilizer, potash contributes to healthy plant growth and assures the maximum of balanced development by regulating the intake of other fertilizer ingredients.

About 95 per cent of the potash produced is used as fertilizer, five per cent is used in the form of various chemicals of which potassium hydroxide has the widest application. Most fertilizer potash is used as concentrates of muriate (KCl) in various strengths, mixed with other ingredients. Smaller amounts are used as potassium sulphate for particular soils and crops.

PRICES

Canadian Prices

International Minerals & Chemical on June 7, 1963 issued the following schedule of Canadian potash prices on materials contracted for prior to July 1,

1963. Contracts subsequent to June 30, 1963 are five per cent higher.

POTASH PRICES, July - August 1963
in Canadian funds f.o.b. mine

	Bulk ¢ per unit	Bagged $ per net ton
Standard muriate, min. 60% K_2O	37.5	28.35
Coarse muriate, min. 60% K_2O	38.5	29.00
Granular muriate, min. 60% K_2O	39.6	29.65
Sulphate of potash, min. 50% K_2O	71.7	43.70
Sul-Po - Mag, 22% K_2O, 18% MgO	$16.75 (per net ton)	23.55

U.S. Prices

The Oil, Paint and Drug Reporter of December 31, 1962, quotes the following U.S. prices:

Potassium muriate	
Standard	
Bulk, car lots, works, unit-ton	$ 0.37
Bagged, 60% min. K_2O, same basis, ton	27.70
Granular	
Bulk, car lots, works, unit-ton	0.40
Bagged, 60% min. K_2O, same basis, ton	29.50
Potassium sulphate, 50% min. K_2O agricultural, bulk, car lots, works, unit-ton	0.67

Note: Add 2¢ per unit-ton for material contracted for after July 1, 1962.

TARIFFS

Canada

German potash salts, muriate and sulphate of potash, crude, saltpetre or potash nitrate	free

United States

Crude potash salts, muriate of potash, and potassium sulphate	"

Roofing Granules

F. E. Hanes

The value of roofing granules consumed in 1962 was $3.5 million, an increase of 5.8 per cent over 1961. This is 77.1 per cent of the record $4.5 million achieved in 1958.

Because smaller amounts of higher-cost granules were imported compared with an increased consumption of lower-cost domestic granules, cost increases calculated on a value-per-ton basis are not significant. The imported products show a higher cost partly because of tariff charges.

The consumption of roofing granules, amounting to 125,463 short tons, exceeded that of 1961 by 1,977 tons for an increase of 1.6 per cent. Canadian production in 1962 accounted for 59 per cent of Canadian consumption; it was 35.8 per cent in 1961. This increase in volume - only 84.8 per cent of the record consumption of 1955 - indicates a continued improvement over the last two years.

Residential construction in 1962 increased by $149 million or 7.6 per cent over 1961. Housing starts, according to the Dominion Bureau of Statistics, increased to 130,095 units from the 125,577 of 1961; this is a substantial recovery from the 1960 low of 108,858 starts but is still considerably short of the record 141,345 housing starts in 1959. Completions of houses were about 3,000 units higher than in 1960. On December 31, 1962 there were 76,153 housing units under construction. However, despite the increase in consumption this year, the growth of the granule industry will be slowed if the trend develops toward more apartment buildings and fewer houses.

PRICES

The average price of the various types and colors of granules has increased from a low of $26.03 in 1960 to $26.62 in 1961 and $27.71 in 1962.

The price of imported rock and slag, natural color, in 1962 was $23.10 or $1.58 more than in 1961. Most of this increase was due to an increase in the price of the popular black slag. A Canadian black slag granule produced by Industrial Granules Ltd. was marketed for the first time in 1962 and is successfully competing with the imported granules. The use of black slag granules in Canada during 1962 increased 6.9 per cent in volume to 30,295 short tons. The value of slag granules increased by $74,186 to approximately $700,000, an increase of about 12 per cent over the previous year.

The price of imported artificially colored granules increased almost $7.00 (average) a ton in 1962. This was probably the reason that imports, 28,779 short tons, were lower by 34 per cent in volume and 21 per cent in value.

Table 1

ROOFING GRANULES - CONSUMPTION AND IMPORTS*

	1961		1962	
	Short Tons	$	Short Tons	$
CONSUMPTION				
By kind				
Naturally colored	47,441	954,657	52,115	1,091,070
Artificially colored.........	76,045	2,332,013	73,348	2,385,805
Total	123,486	3,286,670	125,463	3,476,875
By color				
Black and grey black	41,353	916,134	46,045	1,046,433
Green	23,430	670,839	21,835	674,838
Red	9,122	242,303	7,457	215,113
Blue	4,784	185,701	4,070	165,424
White.....................	19,702	697,458	19,631	743,918
Grey	19,180	383,086	19,158	374,102
Buff	674	24,702	799	29,526
Brown and tan	4,205	122,974	4,674	156,192
Coral, cream and yellow ...	641	25,729	1,073	42,711
Turquoise.................	395	17,744	438	20,976
Not classified	-	-	283	7,642
Total	123,486	3,286,670	125,463	3,476,875
IMPORTS				
United States				
Naturally colored	35,421	762,164	22,074	509,841
Artificially colored	43,882	1,438,647	28,779	1,133,110
Total	79,303	2,200,811	50,853	1,642,951

*Compiled from figures supplied to the Mines Branch by consumers.
Symbol: - Nil.

Competition met by imported granules was stiffer as consumption of Canadian granules increased 39 per cent in volume and 40 per cent in value despite the fractionally higher prices of the Canadian product over previous years.

The popular granule colors: black, buff, brown and tan, coral, cream and yellow, and turquoise, showed increased consumption; white and grey gained slightly in consumption, but were down in production. Green, red and blue were not as popular as in previous years.

CANADIAN PRODUCERS

Manufacturers of granules in Canada are located at Havelock, Ontario; Montreal, Quebec; and Vancouver, British Columbia.

Minnesota Minerals Limited at Havelock is building a large modern plant which it hopes will be ready for production in mid-1963. After a fire in

July 1962, which razed the coloring plant and other nearby buildings, plans were implemented to replace the buildings lost in the fire. The existing crushing and screening sections of the old plant are also being rebuilt and modernized. The company will continue to manufacture granules from the fine-grained, dark-colored basalt - a quality trap rock deposit. The rock is also crushed in sizes suitable for use in concrete and road building.

Waste slag from a steam generating plant in Halifax, Nova Scotia, is the present source of raw material used by Industrial Granules Ltd. of Montreal, the black-slag granule manufacturer. Controlled methods of cooling are required to produce a satisfactory granule. Poorly shaped particles that make uniform coverage difficult on the felt are kept to a minimum by proper quenching procedures. The low-iron slags are preferred, as iron staining dulls the glistening black slag granule.

Crushed slate for roofing granules is produced by G.W. Richmond of Vancouver, British Columbia; the company is known as the Richmix Clay Products Ltd.

Table 2

AVERAGE PRICES OF ARTIFICIALLY COLORED GRANULES

($ per short ton)

Granule Color	Imported		Canadian	
	1961	1962	1961	1962
Red	27.94	35.70	25.04	24.72
Green	30.96	37.91	29.69	28.82
Black	27.13	31.95	21.12	20.72
Blue	39.04	45.23	37.14	37.86
White	36.32	41.23	33.13	34.25
Grey	27.18	30.68	25.79	25.51
Buff	32.36	41.01	39.18	35.28
Brown and tan	29.58	46.99	25.35	24.66
Coral, cream, yellow	40.69	45.53	28.89	27.89
Turquoise	44.99	49.68	39.30	41.15
Not differentiated	-	-	-	26.08
Average price	32.79	39.37	27.78	28.11

ROOFING AND SIDING PLANTS

The process of imbedding roofing granules on an asphalt-saturated felt backing material for the manufacture of roofing shingles and wall siding is carried on by seven companies in 17 plants across Canada. During the year, Sidney Roofing & Paper Company, Limited was taken over by Domtar Construction Materials Ltd. The seven companies and their plants are listed on the following page:

Company	Location
The Barrett Company, Limited	Montreal, Que. Vancouver, B. C. St. Boniface, Man.
Building Products Limited	Montreal, Que. Hamilton, Ont. Winnipeg, Man. Edmonton, Alta.
Canadian Gypsum Company Limited	Mount Dennis, Ont.
Canadian Johns-Manville Company, Limited	Asbestos, Que.
Iko Asphalt Roofing Products Limited	Calgary, Alta. Brampton, Ontario
Domtar Construction Materials Ltd.	Brantford, Ont. Saint John, N.B. Lachine, Que. Lloydminster, Alta.* Burnaby, B.C.*
The Philip Carey Company Ltd.	Lennoxville, Que.

*Previously belonged to Sidney Roofing & Paper Company, Limited.

COMPARISON OF PRICES FOR ARTIFICIALLY COLORED GRANULES

The 1962 prices of imported granules not only showed a large increase over 1961 prices, but also over the average price of the corresponding Canadian granule (Table 2). Granules imported into Canada generally carry higher operating and transportation costs as well as tariff costs.

Trends that develop in the American industry one year are often reflected in the Canadian market the following year. This might indicate that Canadian prices may trend higher in 1963; however, as yet there is no sign of this swing in our average price scale. Canadian produced blue, white and turquoise granules are the only ones to show price increases; all other color types are definitely lower: a maximum decrease of $3.90 per ton for buff granules illustrates this point.

Salt

R.K. Collings*

In 1962 there were several important developments in the Canadian salt industry, not the least of which was a record production of over 3.6 million tons. Active expansion programs were undertaken by the two principal producers. The Canadian Salt Company Limited completed an evaporator plant at Pugwash, Nova Scotia, the site of its eastern rock salt mine, and announced plans for construction of a second shaft at Pugwash. This shaft, which is to be 850 feet deep, was started early in 1963. Domtar Chemical Limited's second shaft at its Goderich, Ontario, rock salt mine was at 1,400 feet at year-end. The ultimate depth will be about 1,800 feet. This latter company also began rebuilding its Goderich evaporator plant. The new plant is expected to be completed early in 1963. Domtar Chemical Limited's evaporator operation at Unity, Saskatchewan, was expanded by the addition of a salt fusion plant - the third of its kind in Canada. The other two plants, operated by The Canadian Salt Company Limited, are at Sandwich, Ontario, and Lindbergh, Alberta. Interprovincial Co-Operatives Limited, a Winnipeg company, is currently investigating the feasibility of producing brine from salt beds that underlie a caustic soda-chlorine plant under construction north of Saskatoon, Saskatchewan.

Canada's production of salt in 1962, at 3,638,778 tons, was 12 per cent greater than the previous year. Over one-half of this amount was rock salt; 37 per cent was salt recovered in chemical operations and salt brine for direct use by the chemical industry; the remainder (approximately 13 per cent) was fine evaporator salt. Value of production was $21,927,135, an increase of 12.1 per cent. This relatively large increase in value was due to increased production of higher-value rock salt coupled with reduced production of lower-value salt in brine form.

Imports totalled 245,836 tons valued at $1,120,630. Most of the imports came from Mexico, Spain and the United States.

Exports for the year were valued at $3,987,668, up 41 per cent from 1961. Over 98 per cent of this value can be accounted for by exports of salt from southern Ontario to the United States; however, there is a trend toward increased export of salt from Nova Scotia to the West Indies, Central America and to points as distant as New Zealand and the Republic of the Congo.

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*Mineral Processing Division, Mines Branch.

Table 1

PRODUCTION AND TRADE

	1961		1962	
	Short Tons	$	Short Tons	$
PRODUCTION (shipments)				
By type				
Fine vacuum salt.........	446,712	9,649,614	463,093	9,651,016
Mined rock salt	1,294,988	7,714,077	1,845,393	10,391,050
Salt recovered in chemical operations	24,966	110,242	25,926	118,606
Salt content of brines used and shipped........	1,479,861	2,078,073	1,304,366	1,766,463
Total................	3,246,527	19,552,006	3,638,778	21,927,135
By province				
Ontario	2,861,705	13,586,373	3,155,589	15,387,911
Nova Scotia.............	225,875	2,659,119	312,519	3,112,753
Alberta	83,880	1,355,074	90,729	1,454,462
Saskatchewan	51,964	1,322,311	54,931	1,337,471
Manitoba	23,103	629,129	25,010	634,538
Total................	3,246,527	19,552,006	3,638,778	21,927,135
IMPORTS (by type)				
Table				
United States	1,353	121,753	1,178	97,590
Britain.................	20	352	10	175
Total................	1,373	122,105	1,188	97,765
For fisheries				
Spain	55,361	227,725	36,376	132,264
Bahamas	3,808	18,945	3,920	20,580
Jamaica.................	550	2,145	4,521	15,346
United States	550	2,054	2,793	11,221
Netherlands	68	1,267	40	760
Britain.................	22	729	22	798
St. Pierre..............	106	2,063	-	-
Denmark	50	616	-	-
Total................	60,515	255,544	47,672	180,969

Table 1 (cont'd)

	1961		1962	
	Short Tons	$	Short Tons	$
Other, in bulk				
Mexico..................	64,194	79,444	100,091	123,042
United States	62,291	357,220	85,870	485,030
Total.................	126,485	436,664	185,961	608,072
Other, in bags, barrels and other covering				
United States	10,641	222,187	10,677	226,698
Britain..................	351	6,721	338	7,126
Total.................	10,992	228,908	11,015	233,824
Total imported........	199,365	1,043,221	245,836	1,120,630
EXPORTS*				
United States		2,695,429		3,919,662
New Zealand.............		93		22,461
Jamaica.................		1,551		11,409
Republic of the Congo.....		-		6,781
Leeward and Windward islands		815		6,612
Bermuda		1,630		5,773
Bahamas		-		3,578
British Honduras.........		-		3,052
Other countries		129,620		8,340
Total.................		2,829,138		3,987,668

Source: Dominion Bureau of Statistics.
Symbol: - Nil.
*Table salt included in 1962 but not in 1961.

Table 2

PRODUCTION AND TRADE, 1952-62
(short tons except where noted)

	Production(a)	Imports	Exports(c)	
			Short Tons	$
1952	971,903	288,125	2,844	
1953	954,928	307,333	2,354	
1954	969,887	370,412	1,199	
1955	1,244,761	365,255	146,472	
1956	1,590,804	319,124	333,935	
1957	1,771,559	367,483	457,888	
1958	2,375,192	340,887	906,707b	
1959	3,289,976	369,967	1,274,077	4,639,522
1960	3,314,920	191,940		3,461,366
1961	3,246,527	199,365		2,829,138
1962	3,638,778	245,836		3,987,668

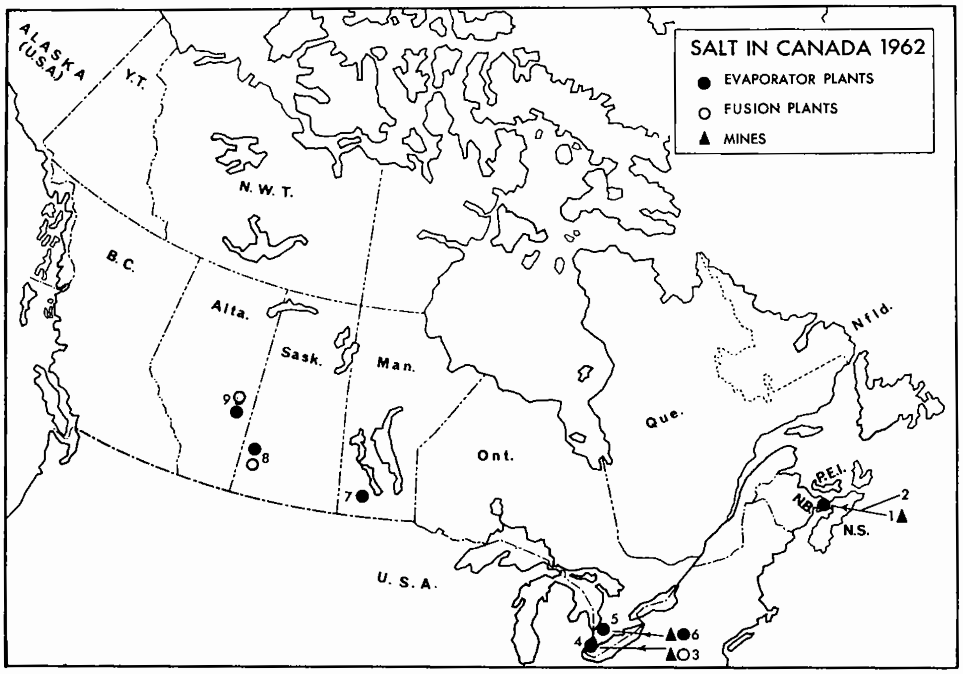
Source: Dominion Bureau of Statistics.
(a)Producers' shipments.
(b)This has been adjusted to include the salt content of brine, estimated at 500,000 tons, exported to the United States during 1958.
(c)Export tonnage not available for years following 1959.

Table 3

WORLD PRODUCTION, 1962
('000 short tons)

United States	28,807
China	13,200
U.S.S.R.	9,000
Britain	6,704
West Germany	5,428
France	4,200
India	4,247
Canada	3,639
Other countries	25,275
Total	100,500

Source: U.S. Bureau of Mines, <u>Salt Preprint, 1962.</u>



DEPARTMENT OF MINES AND TECHNICAL SURVEYS

EVAPORATOR PLANTS

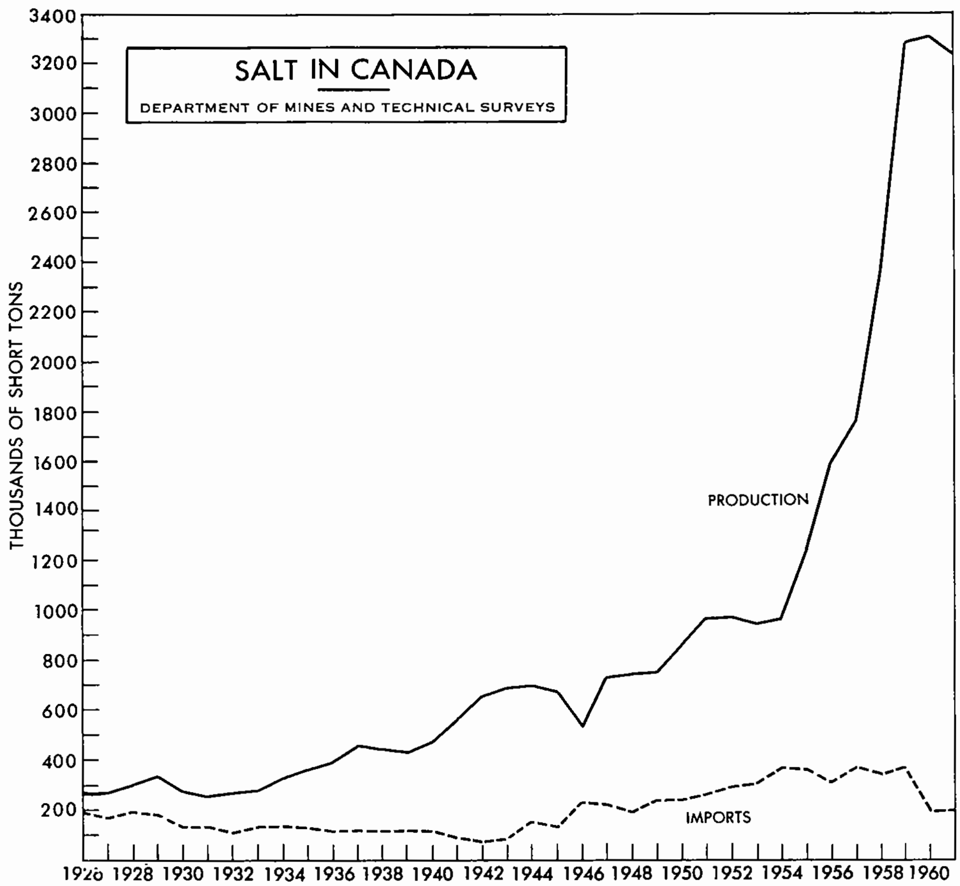
1. Domtar Chemicals Limited, Sifto Salt Division, Nappan, N.S.
2. The Canadian Rock Salt Company Limited, Pugwash, N.S.
3. The Canadian Salt Company Limited, Sandwich, Ont.
4. Brunner Mond Canada, Limited, Amherstburg, Ont.
5. Domtar Chemicals Limited, Sifto Salt Division, Sarnia, Ont.
6. Domtar Chemicals Limited, Sifto Salt Division, Goderich, Ont.
7. The Canadian Salt Company Limited, Neepawa, Man.
8. Domtar Chemicals Limited, Sifto Salt Division, Unity, Sask.
9. The Canadian Salt Company Limited, Lindbergh, Alta.

FUSION PLANTS

3. The Canadian Salt Company Limited, Sandwich, Ont.
8. Domtar Chemicals Limited, Sifto Salt Division, Unity, Sask.
9. The Canadian Salt Company Limited, Lindbergh, Alta.

MINES

2. The Canadian Rock Salt Company Limited, Pugwash, N.S.
3. The Canadian Rock Salt Company Limited, Ojibway, Ont.
6. Domtar Chemicals Limited, Sifto Salt Division, Goderich, Ont.



PRODUCERS

Ontario

Ontario, the chief producer, accounted for over 86 per cent of the total in 1962. This salt is obtained from beds that are 800 to 1,800 feet below the surface in the area between Goderich and Amherstburg in the southwestern section of the province.

Rock salt is produced by The Canadian Rock Salt Company Limited at Ojibway, and by the Sifto Salt Division of Domtar Chemicals Limited at Goderich. At Ojibway an 18-foot section of salt is mined at a depth of 980 feet; at Goderich a 45-foot section is mined at 1,760 feet.

Fine salt, obtained by evaporation of artificial brine from local wells, is produced by Domtar Chemicals Limited at Goderich and Sarnia and by The Canadian Salt Company Limited at Sandwich. The latter company also operates a salt-fusion plant at Sandwich.

Salt brine for use by the chemical industry is produced at Amherstburg, Sandwich and Sarnia. Brunner Mond Canada, Limited, produces industrial salt, soda ash, calcium chloride, and other chemicals at Amherstburg; Canadian Brine Limited, a subsidiary of The Canadian Salt Company Limited, supplies a chemical plant in Detroit with brine produced at Sandwich; and Dow Chemical of Canada, Limited, uses brine from wells at Sarnia for the production of caustic soda and chlorine.

Nova Scotia

At Pugwash, The Canadian Rock Salt Company Limited obtains rock salt from a 20-foot section at a depth of 630 feet. A newly-constructed evaporator plant is now in operation at the mine site. This plant uses salt fines from the rock salt operation for production of refined salt.

Domtar Chemicals Limited produces fine evaporator salt at Nappan using brine obtained from salt beds occurring at depths between 1,100 and 1,800 feet.

Prairie Provinces

The Canadian Salt Company Limited produces fine salt at Neepawa, Manitoba, using natural brine that occurs at a depth of 1,400 feet, and at Lindbergh, Alberta, using artificial brine from salt beds that are 3,600 feet below the surface. Domtar Chemicals Limited produces fine salt at Unity, Saskatchewan, using brine from salt beds at 3,000 feet. Fusion plants for the production of high-purity coarse salt are operated at Lindbergh and Unity.

Western Chemicals Ltd. of Calgary, Alberta, uses brine from underground salt beds for the manufacture of caustic soda, chlorine, and hydrochloric acid near Duvernay, Alberta.

OTHER OCCURRENCES

Salt beds occur at depth on the west coast of Cape Breton Island; under Hillsborough Bay, Prince Edward Island; and in the area south of Moncton, New Brunswick.

Beds of salt varying from a few feet to several hundred feet in thickness underlie large sections of the Prairie Provinces. The beds occur in a huge basin that extends from northeastern Alberta southeasterly through central Saskatchewan and thence into southwestern Manitoba. The depths of these beds vary from less than 400 feet below the surface in northern Alberta to 6,000 feet or more in southern Saskatchewan.

USES

Salt is important chiefly as a raw material for the chemical industry. This industry uses salt brine for the production of sodium hydroxide, chlorine and hydrochloric acid. These, in turn, are employed in the manufacture of soda ash and a variety of other chemicals.

Evaporator salt is used in food- and leather-processing, in the curing of meats and fish, in textile-dyeing and chemical manufacture, in dairying and in animal feed.

Salt is also used as a soil stabilizer, a glazing agent in the manufacture of sewer pipes and drain tile, and as a drilling-mud ingredient when drilling in salt.

The coarser grades of salt are generally preferred for fish-curing, ice and dust control on highways, in the dairy and food-processing industries and for the regeneration of calcium and magnesium zeolites in water softeners, as well as for refrigeration, meat-packing and the curing and tanning of hides and skins.

TECHNOLOGY

In Canada, salt is produced by underground mining and brining. Brining usually is followed by vacuum-pan evaporation, the product of which is much finer than rock salt and very pure.

Salt brine is obtained from underground deposits of rock salt by the use of wells that extend from the surface to the salt horizon. These wells are 8 to 10 inches in diameter and contain two concentric pipes - an 8- to 10-inch casing pipe that lines the hole to the top of the salt horizon, and an inner, 3- to 4-inch pipe extending to the bottom of the salt. Fresh water is pumped down the annulus between the pipes and, upon contact with the salt, forms artificial brine which is brought to the surface through the inner pipe. Sometimes the water is pumped down the centre pipe and the brine brought up through the annulus. Occasionally the salt occurs in solution as natural brine.

The practice of using two or more interconnected wells is becoming increasingly common as it results in rapid brine saturation and a notable increase in the recovery of salt from a particular area. Adjacent wells are connected by "hydrofracturing". This process consists of pumping water into one well under enough pressure to fracture the salt formation from this well to the next. When fracture is complete, the salt-saturated water rises to the surface and is recovered. In developing a brine field, holes or wells are usually laid out in a straight line on the surface at distances of 300 to 400 feet to form a gallery. Adjacent galleries are laid out parallel to the first at intervals of about 600 feet. The direction of fracturing cannot always be positively controlled; hence fractures may occur between holes in different galleries rather than between adjacent holes in the same gallery.

The coarser grades of salt are divided into four standard sizes as follows: No. 2, -5/8 + 1/2 inch; No. 1, -1/2 + 1/4 inch; C.C., -1/4 + 1/8 inch; F.C., -1/8 inch. Coarse salt is produced from mined rock salt by crushing and sizing, and, from fine evaporator salt by briquetting or fusion followed by crushing and sizing. Rock salt fines are also made into the coarser grades of salt by briquetting, or by being formed into a thin ribbon of salt by pressure, prior to crushing.

Mined rock salt, although usually of high purity, sometimes contains gypsum, anhydrite, limestone and dolomite. These impurities may be partly reduced by crushing followed by selective screening; by electronic scanning devices that are able to differentiate between translucent grains of salt and the opaque and darker mineral impurity; and by the use of the "thermoadhesive" beneficiation method developed by International Salt Company, of Cleveland, Ohio. This last technique is based on the fact that pure salt crystals transmit infrared rays whereas the gangue minerals absorb the rays and become heated. Separation is accomplished on a conveyor belt coated with a heat-sensitive polystyrene resin.

Table 4

AVAILABLE DATA ON CONSUMPTION OF SALT IN SPECIFIC CANADIAN INDUSTRIES, 1960*
(short tons)

Chemical products (dry salt and salt content of brine)	1,226,825
Food preparation and stock and poultry feed	64,937
Slaughtering and meat-packing	54,680
Pulp and paper mills	42,965
Fish-processing	29,700
Leather tanneries	6,544
Soap and cleaning preparations	1,884
Dyeing and finishing textiles	1,019
Breweries	1,525

Source: Dominion Bureau of Statistics.
*The latest year for which all data are available.

TARIFFS

	British Preferential	Most Favored Nation	General
Canada			
Fishery salt	free	free	free
Bulk salt	free	3¢ per 100 lb	5¢ per 100 lb
Salt in bags, barrels, etc.	free	3.5¢ per 100 lb	7.5¢ per 100 lb
Table salt	5%	10%	15%
United States			
Bulk salt		1.7¢ per 100 lb	
Salt in bags, barrels, etc.		3.5¢ per 100 lb	

Sand, Gravel and Crushed Stone

F.E. Hanes*

The estimated[a] production of sand, gravel and crushed stone in 1962 was 203.4 million short tons valued at $163 million - an increase of about one million short tons and $13.6 million over the 1961 figures of 202.5 million short tons and $149 million.

SAND AND GRAVEL

Production of sand and gravel[b] in Canada increased in 1962 by 2.4 per cent to 162.1 million short tons. Increases were reported by Manitoba, Prince Edward Island, New Brunswick, British Columbia and Quebec. All other provinces except Nova Scotia produced about the same amount as in 1961. Nova Scotia's production dropped drastically, 41 per cent, from 5.56 to 3.29 million short tons in 1962.

Ontario and Quebec production totalled 106 million short tons of sand and gravel - more than 65 per cent of the national total, with Ontario producing 47.6 per cent more than Quebec. British Columbia, Alberta and Manitoba, respectively, produced about 9.5, 7.4 and 6 per cent of the total; the other five provinces produced the remaining 12 per cent. Prince Edward Island produced less than 0.5 per cent of the total.

The value of sand and gravel produced in Canada increased by over 17 per cent to about $115.5 million in 1962. Increases in values were reported by New Brunswick, 64 per cent; Pronce Edward Island, 52 per cent; British Columbia, 47 per cent; Manitoba, 35 per cent; Ontario, 23 per cent; and Quebec 16.5 per cent.

Ontario and Quebec together produced 60.3 per cent of the total value. They are followed by British Columbia which produced 11 per cent, Alberta with 9.5 per cent and Manitoba with about 6.7 per cent. The remaining five provinces produced the remaining 12 per cent.

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* Mineral Processing Division, Mines Branch

(a) All 1962 quantities and values of sand, gravel and crushed stone are estimates obtained by using 1962 preliminary figures and applying averages of previous years.

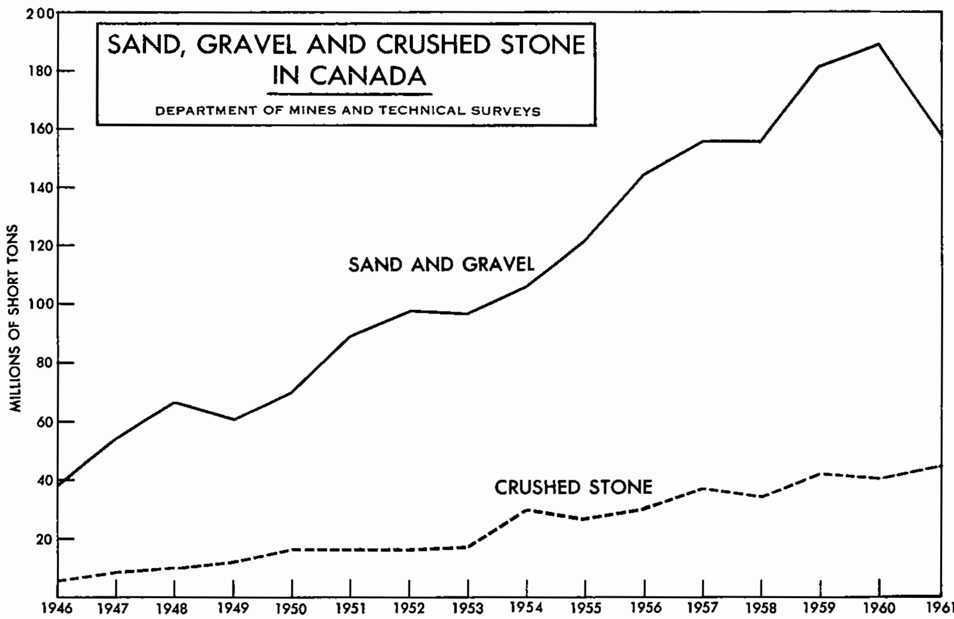
(b) Differs from the official sand and gravel production total used in the compilation Mineral Production of Canada in that certain types are not included.

Table 1

PRODUCTION OF SAND, GRAVEL AND CRUSHED STONE

	1961		1962e	
	Short Tons	$	Short Tons	$
BY PROVINCE				
Sand and Gravel				
Newfoundland	3,200,192	2,670,495	2,953,000	2,449,000
Prince Edward Island	530,322	373,559	691,000	567,000
Nova Scotia	5,560,665	6,506,346	3,289,000	3,842,000
New Brunswick	4,942,685	2,713,614	5,896,000	4,453,000
Quebec	40,820,686	20,116,438	42,800,000	23,431,000
Ontario	63,878,383	37,414,463	63,183,000	46,198,000
Manitoba	7,239,800	5,674,422	9,741,000	7,679,000
Saskatchewan	6,662,161	3,751,426	6,294,000	3,341,000
Alberta	12,153,275	10,723,637	12,017,000	11,025,000
British Columbia	13,309,567	8,489,372	15,231,000	12,463,000
Total	158,297,736	98,433,772	162,095,000	115,448,000
Crushed Stone				
Newfoundland	36,451	75,166	13,000	33,000
Prince Edward Island	225,000	225,000	225,000	225,000
Nova Scotia	917,860	1,147,886	566,000	870,000
New Brunswick	2,860,256	2,667,091	2,396,000	2,303,000
Quebec	21,308,283	24,871,333	20,659,000	23,287,000
Ontario	16,489,703	19,524,550	15,569,000	18,330,000
Manitoba	244,803	196,303	400,000	297,000
Saskatchewan	-	-	-	-
Alberta	19,584	58,664	48,000	148,000
British Columbia	2,134,886	2,222,575	1,453,000	2,084,000
Total	44,236,826	50,988,568	41,329,000	47,577,000
BY TYPE				
Sand and Gravel				
For roads (roadbed surface)	104,434,450	53,170,128	106,940,000	62,360,000
Concrete aggregate	18,130,383	16,006,815	18,565,000	18,774,000
Asphalt aggregate	3,625,413	3,440,788	3,712,000	4,036,000
Railroad ballast	4,630,635	2,013,606	4,742,000	2,362,000
Mortar sand	1,446,397	1,176,187	1,481,000	1,379,000
Total	132,267,278	75,807,524	135,440,000	88,911,000
Crushed Gravel				
For roads (roadbed surface)	18,729,659	15,082,171	19,179,000	17,689,000
Concrete aggregate	4,652,023	5,330,108	4,764,000	6,251,000
Railroad ballast	1,651,958	1,293,849	1,691,000	1,518,000
Other uses	996,818	920,120	1,021,000	1,079,000
Total	26,030,458	22,626,248	26,655,000	26,537,000
Total, sand, gravel and crushed gravel	158,297,736	98,433,772	162,095,000	115,448,000
Crushed Stone				
Concrete aggregate	11,495,107	14,377,121	10,762,000	13,789,000
Railway ballast	1,874,678	2,041,619	1,857,000	1,979,000
Road metal	24,966,426	27,485,722	22,323,000	24,225,000
Rubble and riprap	2,731,721	3,033,932	2,652,000	3,084,000
Terrazzo, stucco and artifical stone	48,259	587,403	58,000	564,000
Other uses	3,120,635	3,462,771	3,677,000	3,936,000
Total	44,236,826	50,988,568	41,329,000	47,577,000

e Estimate



CRUSHED STONE

Estimates of the production of crushed stone in Canada show decreases in both volume and value. The estimated 1962 volume, 41.3 million short tons, is 6.6 per cent less than in 1961; the value, $47.6 million, is 6.7 per cent less. However, despite apparent decreases, the level of activity in the building construction and cement industries, which use large quantities of stone, indicates that final figures may show an increase rather than a decrease.

In 1962, building construction in Canada increased 9.2 per cent to a value of $4,525 million. This gain was also shown in total (engineering and building) construction which increased 5.1 per cent in 1962.

In 1962, as in many other years, a gain in building construction in Canada is a reflection of a similar trend in the same industry in the United States. In that country, crushed and broken stone used in building construction and general construction increased seven per cent in volume and nine per cent in value compared with 1961. The commodities showing marked increases in the United States were stone used for construction of roads and concrete structures (seven per cent increase in volume and nine per cent in value) and for the production of riprap.

The small increase, 2.4 per cent, in natural sand and gravel aggregates despite large increases in industries that use these raw materials indicates that the demand has been supplied with crushed stone aggregates.

In Canada, the amount of shipments of cement is a fairly reliable basis for estimating the consumption of aggregate raw materials. An increased use of cement usually means increased construction requiring increased amounts of natural and crushed stone products.

In 1962, cement shipments were 11 per cent higher than in 1961 and nine per cent higher than in the previous record year 1959.

Ready-mixed concrete increased by almost 14 per cent over the 1961 volume of 8.3 million cu yd and the production of cement drain pipe, sewer pipe and culvert tile (all employing aggregate) increased by 26.7 per cent. An increase of 11.4 per cent is reported for the production of concrete brick and concrete block, and a 19 per cent increase is reported for other lightweight aggregates and slag, all of which also use crushed stone.

Because of the increases in the building construction and cement industries, it can be assumed that crushed stone production has also increased.

Table 2

SAND, GRAVEL AND CRUSHED STONE
IMPORTS - EXPORTS

	1961		1962	
	Short Tons	$	Short Tons	$
IMPORTS				
Sand and gravel	537,972	495,609	838,894	556,873
Crushed stone	790,482	1,185,454	731,999	1,263,879
Total	1,328,454	1,681,063	1,570,893	1,820,752
EXPORTS				
Sand	337,421	461,188	305,404	401,777
Gravel	52,074	49,734	48,703	46,031
Crushed limestone and refuse*			788,790	966,152
Total	389,495	510,922	1,142,897	1,413,960

Source: Dominion Bureau of Statistics. *Not available prior to 1962.

CONSTRUCTION AND DEVELOPMENT

As previously mentioned, building construction increased 9.2 per cent in value over 1961. This increase is made up of gains in three of the segments of this industry: residential construction 7.6 per cent, industrial 19.9 per cent and institutional 25.1 per cent. Of the building construction total, residential construction accounted for 46.4 per cent, industrial for 10.9 per cent and institutional 17.9 per cent. The commercial segment of the building construction industry, accounting for 16.2 per cent of the total, decreased three per cent over 1961.

Inducements such as the availability of loan money, subsidies for winter development, the easing of restrictions on raw material classifications and specifications, and active building construction and highway development programs all have shared in the expansion in the construction industry. Also affecting the expansion is the relatively low price of cement, an essential component in the industry.

Prospects for a continuing high rate of consumption of aggregate in Canada are bright due to large projects under construction or planned for the near future. The Manicouagan power project in Quebec, the Grand Rapids dam in Manitoba, the Peace and Columbia River projects in British Columbia, the Montreal subway and many major building and road construction projects in the various provinces are examples.

The concrete industry is making an effort to expand its production in prestressed and precast concrete, mass-produced curbs and sidewalk slabs, brick and block products, pipe and reinforced steel products for concrete; they are capturing local and foreign markets by developing new designs and products. They are also adapting successful machines and techniques from foreign countries for use in Canada.

IMPORTS AND EXPORTS

A total volume of 1.6 million short tons, made up of approximately 53 per cent sand and gravel and 47 per cent crushed stone, was imported in 1962. This is an increase of 18.2 per cent in volume over the 1.3 million short tons imported in 1961. The only significant change is a shift from a 60/40 ratio in 1961, crushed stone to sand and gravel, to a 47/53 ratio in 1962.

Exports are about double in volume and in value compared with 1961; the amount and value of Canadian exports is about 78 per cent of the volume and value of imports.

Selenium and Tellurium

A.F. Killin*

SELENIUM

All of the 487,066 pounds of selenium produced in Canada in 1962 was recovered as a byproduct from the treatment of tank muds in the electrolytic refining of copper anodes. The year's production was valued at $2,800,630.

Selenium is a grayish semimetal with a semimetallic lustre and electrical properties characteristic of the semiconductor group of metalloid elements. Although selenium is widely distributed in the earth's crust in the native state and in the selenides of copper, silver, lead, mercury, bismuth and thallium, it has never been found in deposits worth working for the selenium content alone.

Canada has two selenium refineries. At Copper Cliff, Ontario, The International Nickel Company of Canada, Limited, operates a selenium- and tellurium-recovery plant where it processes slimes from its Copper Cliff electrolytic copper refinery and Port Colborne, Ontario, nickel refinery. The plant has the capacity to produce 240,000 pounds of minus 200 mesh, 99.7 per cent selenium powder a year.

Canadian Copper Refiners Limited at Montreal East, Quebec, operates Canada's largest selenium plant at its copper refinery. The Montreal East refinery treats copper anodes from the Noranda, Quebec, smelter of Noranda Mines, Limited, and the Murdochville, Quebec, smelter of Gaspé Copper Mines, Limited, and blister copper from the smelter of Hudson Bay Mining and Smelting Co., Limited, at Flin Flon, Manitoba. The selenium plant has an annual capacity of 450,000 pounds of selenium metal and salts. In addition to commercial-grade selenium metal (99.5% Se) and high-purity (H.P.) selenium metal (99.9% Se), the refinery can produce a great variety of metallic and organic selenium compounds.

CONSUMPTION AND USES

The consumption of selenium in the electronics industry for the manufacture of dry-plate rectifiers has been declining because of the substitution of silicon and germanium for selenium. Some increase has been noted in the use of high-purity selenium in the manufacture of modules for thermoelectric devices.

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*Mineral Resources Division.

Table 1

SELENIUM - PRODUCTION, EXPORTS AND CONSUMPTION
(pounds of contained selenium)

	1961		1962	
	Pounds	$	Pounds	$
PRODUCTION				
All forms(a)				
Quebec............	214,998	1,397,487	276,409	1,589,352
Ontario	164,800	1,071,200	142,915	821,761
Saskatchewan	41,270	268,255	56,265	323,524
Manitoba	9,544	62,036	11,477	65,993
Total	430,612	2,798,978	487,066	2,800,630
Refined(b)	422,955		466,629	
EXPORTS				
Metal and salts				
Britain............	212,500	1,413,520	161,100	1,009,056
United States	100,100	618,945	142,300	889,740
Brazil	2,000	12,149	5,200	30,924
France............	7,100	53,156	3,200	23,420
Argentina	3,000	18,401	3,100	16,949
India..............	300	402	1,700	7,364
Spain	100	664	1,700	11,294
Italy	1,500	9,885	1,600	11,300
Australia..........	1,100	8,400	1,200	8,442
Venezuela	-	-	1,200	8,012
Other countries	18,100	115,980	3,300	17,477
Total	345,800	2,251,502	325,600	2,033,978
CONSUMPTION(c)	13,160		12,587	

Source: Dominion Bureau of Statistics. (a)Recoverable selenium content of the blister copper produced from domestic ores, plus refined selenium from stockpiled sludge. (b)Includes production from scrap. (c)As reported by consumers.
Symbol: - Nil.

Selenium and its compounds are used by the glass, rubber and alloy-steel industries. A small amount of selenium added to copper forms a free-machining alloy.

Table 2

SELENIUM - PRODUCTION, EXPORTS AND CONSUMPTION, 1953-62
(pounds of contained selenium)

	Production		Exports	Consumption(c)
	All Forms(a)	Refined(b)	Metals and Salts	
1953	262,346	307,903	253,620	14,465
1954	323,529	297,479	344,292	21,141
1955	427,109	422,588	334,215	34,854
1956	330,389	355,024	409,729	31,669
1957	321,392	332,011	228,051	15,572
1958	306,990	342,141	250,351	16,600
1959	368,107	372,410	325,712	22,156
1960	521,638	524,659	404,410	14,461
1961	430,612	422,955	345,800	13,160
1962	487,066	466,629	325,600	12,587

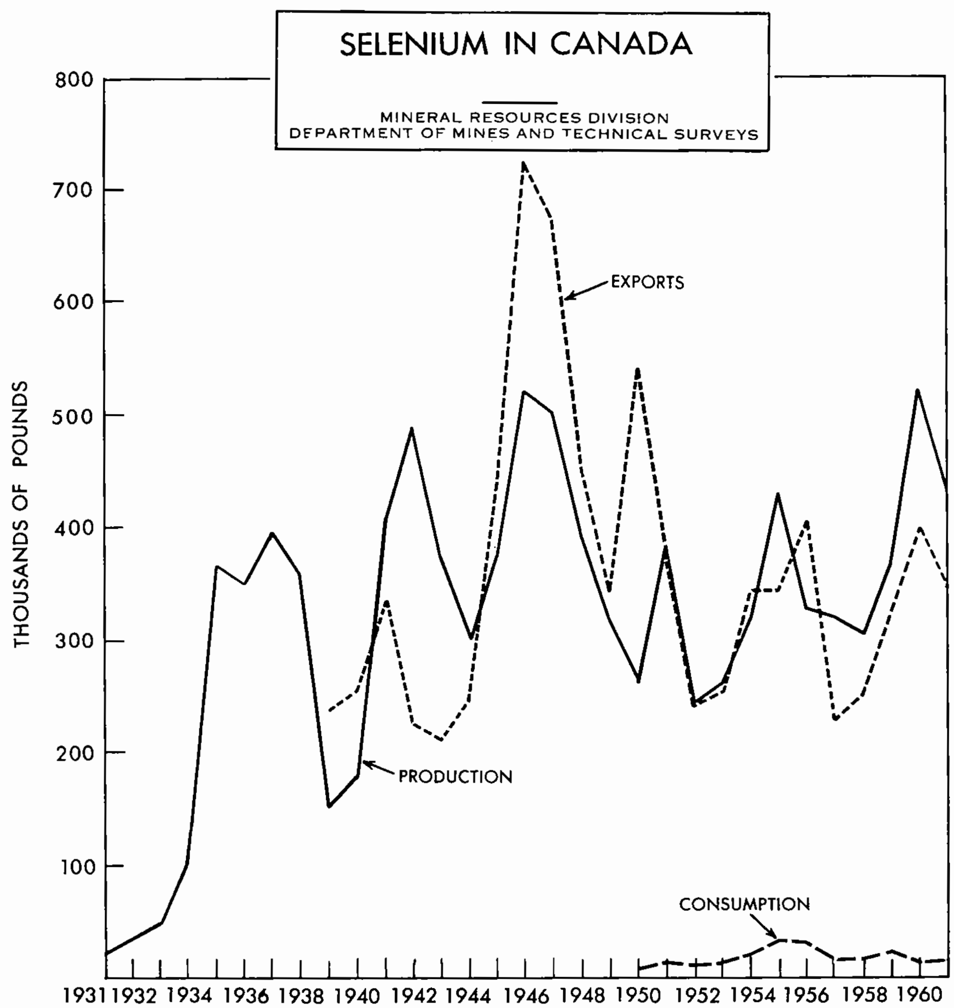
Source: Dominion Bureau of Statistics. (a)Recoverable selenium content of the blister copper produced from domestic ores, plus refined selenium from domestic primary material. (b)Includes production from scrap. (c)To 1958 inclusive, producers' domestic shipments of selenium and selenium salts (selenium content); for 1959 and the years following, consumption as reported by consumers.

Table 3

FREE WORLD PRODUCTION OF SELENIUM, 1961 and 1962
(pounds)

	1961	1962
United States	1,022,000	999,000
Canada	430,612	487,066
Japan	300,262	309,314
Sweden (exports)	213,471	200,000
Belgium and Luxembourg (exports)	52,910	30,900
Other countries	77,745	81,720
Total	2,097,000	2,108,000

Source: U.S. Bureau of Mines, Minor Metals and Minerals Preprint, 1962.



In glassmaking, selenium is used both as a de-colorizer and as a coloring agent. When added to the glass batch in small quantities, selenium helps to neutralize the green color imparted by iron in the glass sand. Larger amounts of selenium produce orange to ruby-red colors, according to the quantity added. Selenium ruby glass, which is a brilliant red, is used in stop lights, signal lights, automotive taillights, marine equipment and decorative tableware. The increasing use of plastics for automotive taillights has reduced the use of selenium ruby glass. The ceramics and paint industries use selenium as a pigment to obtain orange to dark-maroon colors and in the coloring of inks for printing glass containers.

The pharmaceutical industry uses selenium and selenium compounds in the preparation of various proprietary medicines for the control of dermatitis in humans and animals and the correction of dietary deficiencies in animals. The chemical industry uses selenium as a catalyst in the manufacture of cortisone and nicotinic acid.

Finely ground metallic selenium and selenium diethyldithiocarbamate (selenac) are used in natural and synthetic rubber to increase the rate of

Table 4

CANADIAN INDUSTRIAL USE OF SELENIUM, 1960-62
(pounds of contained selenium)

	1960	1961	1962
By end-use			
Electronics	3,822	1,465	1,634
Glass	5,761	6,643	5,347
Other*	4,878	5,052	5,606
Total	14,461	13,160	12,587
By type			
Ferroselenium	3,201	3,518	3,519
High purity	3,822	1,465	1,619
Metal powder	5,291	6,187	4,562
Other**	2,147	1,990	2,887
Total	14,461	13,160	12,587

Source: Consumers Reports. *Rubber, steel, pharmaceuticals.
**Selenium dioxide, sodium selenate, sodium selenite and selenium sulphide.

Table 5

CONSUMERS OF SELENIUM AND PRODUCTS

Quebec
- Abbot Laboratories, Limited, Montreal
- Canada Iron Foundries, Limited, Montreal
- Consumers Glass Company, Limited, Ville St. Pierre
- Dominion Glass Company, Limited, Montreal
- Dominion Rubber Company, Limited, Montreal
- Iroquois Glass Limited, Candiac
- Needco Frigistors Ltd., Montreal
- Shawinigan Chemicals Limited, Shawinigan

Ontario
- Atlas Steels Limited, Welland
- Fahralloy Canada Limited, Orillia
- Ferro Enamels (Canada) Limited, Oakville

British Columbia
- The Consolidated Mining and Smelting Company of Canada Limited, Trail

vulcanization and to improve the aging and mechanical properties of sulphurless and low-sulphur rubber stocks. Selenac acts as an accelerator in butyl rubber.

The porosity of stainless-steel castings is improved by the addition of selenium in proportions from 0.20 to 0.35 per cent. The machinability and other properties of stainless and leaded recarburized steels are improved by the addition of ferroselenium (55-57% Se). In high-speed machining operations production increases of up to 35 per cent have been achieved by the addition of selenium to leaded recarburized steel.

PRICES

In 1962, E & M J Metal and Mineral Markets quoted United States prices for a pound of selenium as follows:

Period	Commercial-grade Powder	High-purity Selenium
Jan. 1 to Dec. 31	$5.75	$6.75

TARIFFS

Canada	British Preferential	Most Favored Nation	General
In lump, powder, ingot etc.	free	15%	25%
In alloy, rod, sheet or process form	15%	20%	25%

United States	
Selenium and salts	free

TELLURIUM

Tellurium is recovered with selenium from the tankhouse slimes as a byproduct of the electrolytic refining of copper anodes at Canada's two copper refineries. Production in 1962 totalled 58,725 pounds valued at $352,350, a decrease of 18,884 pounds and $24,054 from 1961.

Tellurium, like selenium, is a semimetal and exhibits semiconductor properties. Tellurium forms compounds with other metals more readily than does selenium, and in the formation of minerals its affinity for metallic elements decreases according to the series:

Au-Ag-Hg-Bi-Ni-Pb-Cu
(Highest affinity) (Lowest affinity)

Although many telluride minerals are found in nature and gold tellurides are common in many Canadian gold mines, there is no commercial recovery of tellurium in Canada except from copper refinery muds. Not all of the tellurium content of these slimes is recovered as production tends to be on a batch basis governed by market demands. Unprocessed selenium- and tellurium-bearing slimes are stockpiled at the refineries.

The tellurium refinery of The International Nickel Company of Canada, Limited, at Copper Cliff, Ontario, processes slimes from the company's copper refinery at Copper Cliff and nickel refinery at Port Colborne, both in Ontario. Canadian Copper Refiners Limited at Montreal East, Quebec, treats slimes produced by the electrolysis of anodes from the Noranda and Murdochville smelters in Quebec and from blister copper of Hudson Bay Mining and Smelting Co., Limited's Flin Flon, Manitoba smelter.

Table 6

TELLURIUM - PRODUCTION AND CONSUMPTION
(pounds of contained tellurium)

	1961		1962	
	Pounds	$	Pounds	$
PRODUCTION				
All forms(a)				
Quebec	63,904	309,934	45,724	274,344
Saskatchewan	4,596	22,291	4,982	29,892
Ontario	8,050	39,043	7,011	42,066
Manitoba	1,059	5,136	1,008	6,048
Total	77,609	376,404	58,725	352,350
Refined(b)	81,050		57,630	
CONSUMPTION (refined)(c)	4,843		4,306	

Source: Dominion Bureau of Statistics. (a)Includes the recoverable tellurium content of the blister and anode copper treated plus refined tellurium from stockpiled sludge. (b)Refinery output from all sources. (c)As reported by consumers.

Table 7

PRODUCTION OF TELLURIUM 1953-62
(pounds)

	All Forms*	Refined**
1953	4,694	17,295
1954	8,171	7,990
1955	9,014	6,516
1956	7,867	15,915
1957	31,524	34,895
1958	38,250	42,337
1959	13,023	8,900
1960	44,682	41,756
1961	77,609	81,050
1962	58,725	57,630

Source: Dominion Bureau of Statistics. *Includes the recoverable tellurium content of blister copper, which was not necessarily recovered in the year designated. Also includes some refinery output from stockpiled sludge. **Refinery production from all sources.

Table 8

FREE WORLD PRODUCTION OF TELLURIUM, 1961 and 1962
(pounds)

	1961	1962
United States	205,000	264,000
Canada	77,609	58,725
Peru	76,279	50,742
Japan	16,486	22,297
Other countries	26	36
Total	375,400	395,800

Source: U.S. Bureau of Mines, Minor Metals and Minerals Preprint, 1962.

CONSUMPTION AND USES

Tellurium is nontoxic, but when absorbed into the body by direct contact or inhalation it imparts a strong odor of garlic to the breath and perspiration. Because of this adverse physiological effect, industry has used tellurium less than selenium.

Tellurium, as a component of alloys containing gallium, bismuth and lead, is used in thermoelectric devices for the direct conversion of heat into electricity and for cooling as a result of the Peltier effect. These devices have received increased attention in recent years and the amount of tellurium used in these applications has been rising.

Tellurium powder and tellurium diethyldithiocarbamate are used to improve the aging and mechanical properties of sulphurless and low-sulphur stocks of natural and GR-S (synthetic) rubber. Tellurium diethyldithiocarbamate reduces the porosity of thick rubber sections. Rubber containing tellurium is resistant to heat and abrasion and its principal use is for the jacketing of portable electric cables used in mining, dredging, welding, etc. Mercaptobenzothiazol plus tellurium diethyldithiocarbamate is one of the fastest known accelerators for butyl rubber.

Tellurium powder is added to molten iron to control the depth of chill in grey-iron castings. A 99.5 per cent copper and 0.5 per cent tellurium alloy has good hot-working properties and can also be extensively cold-worked and forged; it has good thermal and electrical conductivity, and is used in the manufacture of welding tips and in radio and communications equipment. Up to 0.1 per cent tellurium in lead forms a corrosion-resistant alloy used to sheath marine-cables and to line tanks subject to chemical corrosion.

Table 9

REFINED TELLURIUM USED IN CANADA, 1960-62
(pounds of contained tellurium)

	1960	1961	1962
By end-use			
Metal alloys	1,578	1,875	1,563
Other*	2,660	2,968	2,743
Total	4,238	4,843	4,306
By type			
Metal pellets	2,578	1,259	986
Other**	1,660	3,584	3,320
Total	4,238	4,843	4,306

Source: Consumers' reports. *Rubber, electronics. **Lump, powder and compounds.

The 1962 United States prices of tellurium powder and slab were $6 per pound, in hundred pound lots, as quoted by E & MJ Metal and Mineral Markets.

TARIFFS

Canada	British Preferential	Most Favored Nation	General
In lumps, powder, ingots, etc.	free	15%	25%
In alloys, rod, sheet or processed form	15%	20%	25%

United States

Tellurium compounds	11%
Other tellurium	9 1/2%

Silica

R. K. Collings*

Silica, or silicon dioxide (SiO_2), occurs in nature chiefly as quartz. It is found in many forms, such as sand, sandstone, quartzite and vein quartz. Deposits are widespread but only those having a high silica content are of commercial interest. Canada's production of silica is mostly lump quartzite, sandstone and natural sand for use as metallurgical flux. Production of flux represented 86 per cent of the total in 1961; the remainder was largely lump silica for ferro-silicon manufacture and sand for use by the foundry industry and in glass and silicon-carbide production.

Canada's 1962 production of silica, at slightly over two million tons, was 4.9 per cent lower than in the previous year. Value increased 21.1 per cent to $3.8 million, largely as a result of increased production in Ontario and British Columbia of moderately high value lump silica for export.

Imports, which mostly consisted of high-purity sand from the United States, increased 10 per cent over 1961 (firebrick excluded). This increase, in part, resulted from expansion at several glass plants in the Montreal and Toronto areas. Imports of high-purity sand should decline appreciably during the next few years with increased production from Canadian Silica Corporation Limited's expanded operation at St. Canut, Quebec, and from the Black Island, Lake Winnipeg, sand deposit operated by Selkirk Silica Co. Ltd. of Winnipeg. Canadian producers of high-purity sand currently supply 25 to 30 per cent of the domestic market.

Exports of silica, consisting largely of quartzite for use in ferrosilicon production in the United States, increased to 156,205 short tons, almost six times the 1961 total. These exports were valued at $489,999.

PRINCIPAL PRODUCERS

Nova Scotia

Dominion Steel and Coal Company, Limited, obtains quartzite as required from Chegoggin Point, Yarmouth County, for use in the manufacture of silica brick at Sydney.

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*Mineral Processing Division, Mines Branch.

Table 1

SILICA - PRODUCTION AND TRADE

	1961		1962	
	Short Tons	$	Short Tons	$
PRODUCTION, quartz and silica sand*				
By province				
Ontario	1,540,016	827,061	1,352,613	1,077,784
Quebec	302,432	1,717,502	392,395	2,037,944
Manitoba	165,247	339,730	120,541	322,806
Saskatchewan	144,348	90,940	172,219	137,775
British Columbia	40,967	171,877	45,350	196,100
Nova Scotia	1,044	5,772	2,502	45,036
Total	2,194,054	3,152,882	2,085,620	3,817,445
By use				
Flux	1,883,184	1,276,031	na	na
Ferrosilicon	91,344	392,870	na	na
Silicon carbide	74,122	521,207	na	na
Glass	50,073	322,930	na	na
Foundry	24,798	163,025	na	na
Other uses	70,533	476,819	na	na
Total	2,194,054	3,152,882	2,085,620	3,817,445
IMPORTS				
Silica sand for glass and carborundum manufacture and for use in steel foundries, filtration plants and sandblasting				
United States	691,928	2,470,753	761,890	2,883,401
Norway	544	5,412	2,899	36,391
Belgium and Luxembourg	279	4,345	575	41,287
Australia	459	10,178	67	1,547
Total	693,210	2,490,688	765,431	2,962,626
Quartz				
Silex, or crystallized quartz, ground or unground**	10,327	191,336	8,960	175,509
Piezoelectric quartz	5	185,777	5	222,169
Total	10,332	377,113	8,965	397,678

Table 1 (continued)

	1961		1962	
IMPORTS (continued)	Short Tons	$	Short Tons	$
Flint and ground flint stones				
United States	1,100	16,829	1,003	23,843
Denmark	145	6,492	190	5,853
France	94	7,632	-	-
Total	1,339	30,953	1,193	29,696
Firebrick containing not less than 90% silica				
United States		1,179,779		1,168,823
West Germany		26,426		34,427
Britain		8,183		62
Total		1,214,388		1,203,312
EXPORTS				
Quartzite				
United States	26,774	116,109	156,205	489,999

Source: Dominion Bureau of Statistics.
*Producers' shipments, including crude and crushed quartz, crushed sandstone and quartzite, and natural silica sands.
**Mostly from the United States.
Symbol: na Not available.

Table 2

AVAILABLE STATISTICS ON CONSUMPTION OF SILICA BY SPECIFIED INDUSTRIES, 1961

Industry	Short Tons
Smelter flux*	1,883,184
Glass manufacturing (including fibre glass)	323,136
Foundry sand	131,249
Artificial abrasives	130,882
Ferrosilicon	99,779
Fertilizer, stock and poultry feed	25,334
Silica brick	15,128
Chemicals	12,767
Ceramic	11,772
Asbestos products	2,622
Paints	1,782
Soaps	482
Other	10,148
Total	2,648,265

Source: Dominion Bureau of Statistics.
*Includes low-grade sand and gravel as well as crushed quartz.

Table 3

SILICA - PRODUCTION AND TRADE, 1953-62

	Production		Imports				Exports
	Quartz and Silica Sand (short tons)	Silica Brick ('000 bricks)	Silica Sand (short tons)	Silex, or Crystallized Quartz (short tons)	Flint and Ground Flint Stones (short tons)	Ganister (short tons)	Quartzite (short tons)
1953	1,785,574	3,720	703,221	30,534	1,106	286	200,169
1954	1,716,151	3,578	655,863	28,412	1,219	590	162,374
1955	1,869,913	4,763	735,458	24,517	803	456	87,622
1956	2,142,234	5,799	840,374	26,892	616	562	181,196
1957	2,139,246	4,308	744,867	13,718	528	667	232,299
1958	1,453,656	2,815	603,343	12,024	542	*	17,074
1959	2,163,546	1,926	792,129	13,815	786	*	147,412
1960	2,260,766	**	720,826	10,521	1,232	*	13,057
1961	2,194,054	**	693,210	10,327	1,339	*	26,774
1962	2,085,620	**	765,431	8,960	1,193	*	156,205

Source: Dominion Bureau of Statistics.
*Included with miscellaneous stone imports from Jan. 1, 1958.
**Not available. Beginning in 1960, silica used to make silica brick included in the production of quartz and silica.

Quebec

Union Carbide Exploration Ltd. quarries quartzitic sandstone at Melocheville, Beauharnois County, for use in ferrosilicon manufacture at Beauharnois. Fines from this operation are sized and used in foundry work, in cement manufacture and as metallurgical flux.

E. Montpetit et Fils Ltée also quarries sandstone in the Melocheville area. This is used by Chromium Mining & Smelting Corporation, Limited, for ferrosilicon production at Beauharnois.

Dominion Industrial Mineral Corporation obtains quartzite at St. Donat de Montcalm for use in the manufacture of silica sand and flour at Lachine. Production from Lachine is used in glass and silicon carbide manufacture and for other products requiring high-quality silica. This company is currently studying the feasibility of relocating its Lachine plant at St. Donat.

Canadian Silica Corporation Limited, Toronto, produces silica sand and flour at St. Canut, Two Mountains County, from a large deposit of Potsdam sandstone. The sand is used for glass and silicon carbide manufacture, and for foundry purposes. The flour is used by steel foundries as a filler in asbestos-cement products and in various cleaners. A $1 million plant expansion program, designed to provide a threefold increase in production, was completed at St. Canut during the year. The new plant, which incorporates wet treatment methods, initiated shipments in September.

The silica plant operated by Silica & Brick Mills Limited at Ste. Clothilde, south of Montreal, closed during the year.

Ontario

Canadian Silica Corporation Limited and Union Carbide Exploration Ltd. operate quarries in the Lorraine quartzite formation that extends along the northwest end of Georgian Bay. Canadian Silica has quarries at Sheguiandah on Manitoulin Island; Union Carbide's quarry is near Killarney on the mainland. Most of the production is exported to the United States; the remainder is used domestically for ferrosilicon manufacture. A small amount of the Sheguiandah production is used for silica flour manufacture at Whitby, Ontario.

Manitoba

Selkirk Silica Co. Ltd. of Winnipeg resumed operations at its Black Island, Lake Winnipeg, sand deposit during the latter part of the year. Sand from this deposit is shipped to Selkirk where it is washed, sized, dried and sold for foundry purposes and other uses.

British Columbia

Pacific Silica Limited quarries quartz near Oliver. This quartz is crushed, sized and sold as stucco-dash, roofing rock and poultry grit. Part of the production is exported to the United States for use in the manufacture of silicon carbide and ferrosilicon.

Other Areas

Silica for metallurgical flux is obtained near Noranda, Buckingham and Howick, in Quebec; Sudbury, Ontario; Thompson, Manitoba; west of Flin Flon in Saskatchewan; and near Trail, British Columbia.

SPECIFICATIONS AND USES

Lump Silica

Silica Flux - Quartz and quartzite, as well as sandstone and sand, are used as fluxes in smelting low-silica, base-metal ores. The amount of silica used depends on the composition of the ore, but the silica content should be high. Impurities such as iron and alumina are not objectionable in small amounts. Silica used as flux is generally minus one, plus 5/16 inch in size.

Silicon Alloys - Lump quartz, quartzite and well-cemented sandstone are used in the manufacture of silicon, ferrosilicon and other alloys of silicon. The silica content should be 98 per cent, the iron, expressed as Fe_2O_3, and alumina less than one per cent each and the total iron-and-alumina content less than 1 1/2 per cent. Lime and magnesia should each be less than 0.2 per cent. Phosphorus and arsenic are objectionable. The silica used is generally minus six, plus one inch in size.

Silica Brick - Quartz and quartzite, crushed to minus eight mesh, are used in the manufacture of silica brick for high-temperature refractory furnace linings. The iron and alumina should be less than one per cent each, and other impurities, such as lime and magnesia, should be low.

Other Uses - Lump quartz and quartzite are used as lining in ball and tube mills and as lining and packing for acid towers. Naturally occurring flint pebbles are used as grinding media for the reduction of various nonmetallic ores.

Silica Sand

Glass Manufacture - Naturally occurring sand and sand produced by crushing quartz, quartzite or sandstone are used in the manufacture of glass and fused silicaware. The silica content should be more than 99 per cent; that of iron should be uniform and less than 0.02 per cent. Other impurities such as alumina, lime and magnesia should be low. Uniformity of grain size is important; all sand preferably should be between 20 and 100 mesh.

Silicon Carbide - Sand used for silicon-carbide manufacture should have a silica content of 99 per cent. Iron and alumina should be less than 0.1 per cent each. Lime, magnesia and phosphorus are objectionable. A coarse-grained sand is preferred for silicon-carbide manufacture, but finer sands are sometimes used. All sand should be plus 100 mesh, with the bulk of it plus 35 mesh.

Hydraulic Fracturing - Sand used in the hydraulic fracturing of oil-bearing formations must be clean and dry, have a high compressive strength and a high silica content, and be free of all acid-consuming constituents. The grain size should be between 20 and 35 mesh. Grains should be well rounded to facilitate placement and to provide maximum permeability.

Foundry Use - Naturally occurring sand and sand produced by the reduction of sandstone are used extensively in the foundry industry for moulding. Sands for this purpose vary greatly in screen size and chemical composition. Grain size is usually between 20 and 200 mesh in closely sized ranges. A rounded grain is preferred.

Sodium Silicate and Other Chemicals - Sand for the manufacture of sodium silicate and other chemicals should contain more than 99 per cent silica, less than 0.25 per cent alumina, less than 0.05 per cent lime and magnesia combined, and less than 0.03 per cent iron. All sand should be between 20 and 100 mesh.

Other Uses - Coarsely ground, closely sized quartz, quartzite, sandstone and sand are used as abrasive grit in sandblasting operations and for the manufacture of sandpaper. Various grades of closely sized sand are used in water-treatment plants as filtering media. Silica is also used as an ingredient in the manufacture of portland cement.

Silica Flour

Silica flour, formed by grinding quartz, quartzite, sandstone or sand to a very fine powder, is used in the ceramic industry for enamel frits and pottery flint. It is also used as an inert filler in rubber and asbestos-cement products, as an extender in paint and as an abrasive ingredient in soaps and scouring powders. Silica flour is finding increasing application in concrete used in the fabrication of autoclave-cured products such as building blocks and panels.

Quartz Crystals

Quartz crystals with desirable piezoelectric properties are used in radio-frequency control apparatus, radar and other electronic devices. Crystals used for this purpose must be perfectly transparent and free of all impurities and flaws. The individual crystals should weigh 100 grams or more and measure at least two inches in length and one inch or more in diameter. Most of the world's crystal requirement is met by natural crystal from Brazil; however, natural crystal is being replaced, in part, by excellent quality synthetic crystal grown in the laboratory from quartz 'seed'.

There is little demand for quartz crystal in Canada, and virtually no production. In 1962 five tons valued at $222,169 were imported from Brazil, the United States and Britain. Quartz Crystals Mines Limited, Toronto, produced a small amount for test purposes from its mine near Lyndhurst, Ontario.

PRICES

The price of silica varies greatly depending upon the location of deposits, the purity of the product and the purpose for which it is required. High-quality silica sand from Ottawa, Illinois, in carload lots f.o.b. Montreal, sells for about $10 a ton.

TARIFFS

Canada	
Sand and ganister	free
Silex, or crystallized quartz, ground or unground	"
United States	
Sand containing 95% or more silica and not more than 0.6% oxide of iron and suitable for use in the manufacture of glass, per long ton	.50¢
Quartzite, sand, not specifically provided for	free
Silica, crude, not specifically provided for, per long ton	$1.75

Silver

J.W. Patterson*

Silver production in 1962 at 30,422,972 ounces was slightly below the 1961 production of 31,381,977 ounces. Gains in output in Quebec, Manitoba, Newfoundland, Nova Scotia and New Brunswick were more than offset by declines in the territories and the other provinces. The largest increase took place in Nova Scotia where, because of a new producer which completed its first full year of production in 1962, output increased 724,245 ounces. Most of the decline took place in British Columbia and was attributable, for the most part, to a drop in lead production with which silver is recovered as a byproduct. Production in British Columbia dropped 2,204,703 ounces to 6,186,937 ounces.

The principal sources of silver were the lead-zinc and silver-lead-zinc ores, most of which were mined in British Columbia. These ores accounted for 49 per cent of total production. Another important source was the copper, copper-nickel and copper-zinc ores of Canada from which about 33 per cent of production was derived. The remaining 18 per cent came from silver-cobalt ores in northern Ontario (16 per cent) and from lode- and placer-gold ores (2 per cent).

Canada's principal silver producers are listed in Table 3; the map shows their locations. Lead-zinc-silver ores mined by United Keno Hill Mines Limited in Yukon Territory and by The Consolidated Mining and Smelting Company of Canada Limited (COMINCO) in southeastern British Columbia were the source of 11,425,630 ounces or 38 per cent of Canada's total output. As in previous years most of the refined silver production came from the refinery at Trail, British Columbia, operated by COMINCO. At this refinery COMINCO treated its own concentrates as well as concentrates and ores from other companies from which it recovered 6,667,813 ounces or almost one half of the total refined production of 15,261,882 ounces. Other producers of refined silver were Canadian Copper Refiners Limited at Montreal East (from blister copper); The International Nickel Company of Canada, Limited at Copper Cliff, Ontario (from nickel-copper concentrates); Hollinger Consolidated Gold Mines, Limited at Timmins, Ontario (from gold precipitates); the Royal Canadian Mint at Ottawa (from gold bullion); and Cobalt Refinery Limited at Cobalt, Ontario (from silver concentrates). Most of the concentrates treated by the latter company were from mines operated near Cobalt by Glen Lake Silver Mines Limited and Langis Silver & Cobalt Mining Company Limited.

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*Mineral Resources Division.

Table 1

SILVER - PRODUCTION, TRADE AND CONSUMPTION

	1962		1961	
	Troy Ounces	$	Troy Ounces	$
PRODUCTION				
By provinces and territories				
Ontario	9,383,445	10,931,713	8,870,402	8,361,240
Yukon	6,482,244	7,551,814	6,937,086	6,538,897
British Columbia	6,186,937	7,207,782	8,391,640	7,909,960
Quebec	4,603,019	5,362,517	4,315,844	4,068,115
Manitoba and Saskatchewan	1,610,094	1,875,759	1,643,993	1,549,628
Newfoundland	1,181,648	1,376,620	1,145,105	1,079,376
Nova Scotia	724,245	843,745	-	-
New Brunswick	178,521	207,977	-	-
Northwest Territories	72,802	84,814	77,890	73,419
Alberta	17	20	17	16
Total	30,422,972	35,442,761	31,381,977	29,580,651
By sources				
Base-metal ores	25,046,109		26,041,639	
Gold ores	657,274		645,734	
Silver-cobalt and silver ores	4,707,590		4,680,536	
Placer-gold ores	11,999		14,068	
Total	30,422,972		31,381,977	
Refined silver	15,261,882		17,952,914	
EXPORTS				
In ores and concentrates				
United States	6,751,273	7,299,218	8,648,932	8,120,385
West Germany	975,465	891,183	316,764	220,707
Belgium and Luxembourg	821,112	696,611	1,377,351	1,104,378
Britain	270,594	240,074	-	-
Japan	43,414	42,702	9,653	8,819
Total	8,861,858	9,169,788	10,352,700	9,454,289

Table 1 (cont'd)

	1962		1961	
	Troy Ounces	$	Troy Ounces	$
EXPORTS (cont'd)				
Silver, refined metal				
United States.............	9,343,030	10,818,849	10,656,655	9,972,630
Brazil..................	97,296	115,110	121,258	114,168
Venezuela	4,342	5,374	5,344	5,839
Other countries	426	2,193	157	904
Total	9,445,094	10,941,526	10,783,414	10,093,541
IMPORTS				
Unmanufactured				
United States.............	8,054,180	9,540,562	10,785,630	10,225,999
Britain	3,306,537	3,722,924	3,020	2,946
Netherlands.............	2,097,102	2,309,190	-	-
Mexico	1,707,583	2,066,626	1,471,221	1,339,659
Other countries	16,934	18,767	18,598	17,344
Total	15,182,336	17,658,069	12,278,469	11,585,948
Manufactured articles of silver, including toilet articles of sterling silver				
Britain		313,280		369,218
United States..............		326,357		283,669
West Germany		117,069		90,373
Denmark		27,525		30,945
Other countries		38,235		36,855
Total		822,466		811,060
CONSUMPTION				
By use				
Coinage	10,883,035		5,141,894	
Silverware................	1,499,891		1,392,825	
Photography	1,618,650		1,558,576	
Wire and rod..............	18,536		42,390	
Silver alloys	275,844		229,834	
Miscellaneous(a)	1,377,557		1,248,564	
Total	15,673,513		9,614,083	

Source: Dominion Bureau of Statistics. (a)Includes sheet, anodes for electroplating, and silver used in the manufacture of electrical equipment and jewelry. Symbols: - Nil.

Table 2

SILVER - PRODUCTION, TRADE AND CONSUMPTION, 1952-62
(troy ounces)

	Production		Exports			Imports	Consumption**
	All Forms*	Refined Silver	In Ore and Concentrate	In Bullion	Total	Unmanufactured	
1952	25,222,227	21,045,592	3,546,448	14,928,515	18,474,963	145,898	8,031,873
1953	28,299,335	25,360,632	5,686,518	14,632,914	20,319,432	287,497	8,518,441
1954	31,117,949	19,424,154	8,672,340	14,467,015	23,139,355	60,165	5,996,563
1955	27,984,204	19,354,223	5,873,873	16,598,577	22,472,450	87,128	5,161,445
1956	28,431,847	21,599,798	6,924,414	14,341,753	21,266,167	1,010,180	7,710,925
1957	28,823,298	20,004,360	5,979,459	12,799,990	18,779,449	1,859,131	10,730,255
1958	31,163,470	24,620,142	5,098,788	16,026,550	21,125,338	2,701	9,299,809
1959	31,923,969	21,770,510	6,814,865	15,140,830	21,955,695	2,807,774	10,202,769
1960	34,016,829	21,932,773	8,897,402	12,761,063	21,658,465	3,849,115	11,742,064
1961	31,381,977	17,952,914	10,352,700	10,783,414	21,136,114	12,278,469	9,614,083
1962	30,422,972	15,261,882	8,861,858	9,445,094	18,306,952	15,182,336	15,673,513

Source: Dominion Bureau of Statistics. *Recoverable silver in ores, concentrates and matte shipped for export; in crude gold bullion produced; in blister and anode copper made at Canadian smelters; in base bullion made by The Consolidated Mining and Smelting Company of Canada Limited at Trail, B.C.; bullion produced from the treatment of cobalt-silver ores. **Includes consumption for coinage.

Mining community at the Hector Calumet mine, source of most of the silver-lead-zinc ore mined by United Keno Hill Mines Limited. Ore is carried 2.7 miles down hill to the company's mill at Elsa by an aerial tramway.

Little change took place in Canada's silver export pattern. Most of the exports, as in past years, went to Belgium-Luxembourg, West Germany and the United States with the greatest part (16,094,303 ounces out of 18,306,952) going to the United States. Reflecting the increasing silver requirements of the Royal Canadian Mint, Canada's imports of unmanufactured silver were at a high level in 1962. There was a substantial rise in imports from Britain and The Netherlands to 3,306,537 and 2,097,102 ounces respectively. Total imports were the highest on record rising to 15,182,336 ounces compared with 12,278,469 ounces in 1961. Because of increased demands for available supplies of silver in the United States, imports from there dropped by a large amount.

Due mainly to increased requirements for coinage and to slightly higher demand by industry, consumption of silver increased markedly from 9,614,083 ounces to a record 15,673,513 ounces.

DEVELOPMENTS

Yukon Territory

Most of the exploration activity was centred in the Mayo district not far from the mines of United Keno Hill Mines Limited. Peso Silver Mines Limited and Silver Titan Mines Limited carried out extensive underground programs. Exploration, both on the surface and underground, was done by Tintina Silver Mines Limited on its property about 140 miles northwest of Watson Lake. Unfortunately, the results of this exploration were discouraging.

During its fiscal year ending September 30, 1962, United Keno Hill continued to explore and develop a number of mines (notably the Keno and Silver King mines) which are in the same area as its main sources of ore - the Hector, Calumet and Elsa mines. Over $1,000,000 has been budgeted by the company for an extensive exploration program during its fiscal year ending September 30, 1963.

British Columbia

In the Slocan district, a number of former mines were re-examined and several shipments of hand-sorted ore were made to COMINCO's Trail plant. A few of the older producers in the district continued to make intermittent shipments of concentrate to Trail. Western Mines Limited reported encouraging exploration results on its Buttle Lake property on Vancouver Island. The principal ore metals there are zinc, lead and copper with silver present in substantial amounts. Dolly Varden Mines Ltd. announced its intention of commencing milling silver ores in 1963 from its properties near Alice Arm in the northwest section of the province. It will use the mill formerly operated by Torbrit Silver Mines, Limited. In the same general area, Silbak Premier Mines, Limited shipped several hundreds of tons of high-grade silver ore from its mine north of Stewart. High-grade ore was also shipped from the Silver Standard mine near Hazelton about midway between Prince Rupert and Prince George.

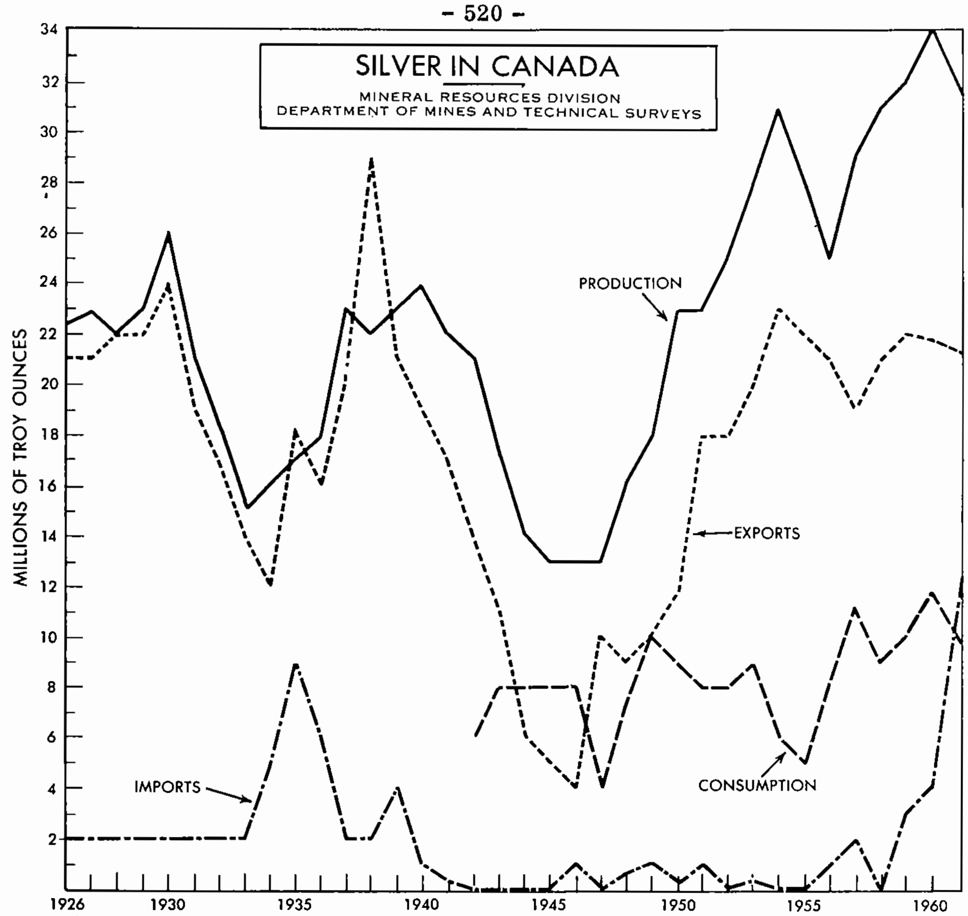
Table 3

PRINCIPAL SILVER PRODUCERS IN CANADA, 1962

Company	Mine	Location	Mill Capacity (tons/day)	Type of Ore Mined	Silver Content (oz/ton)	Ore Produced 1962 (short tons)	Ore Produced 1961 (short tons)	Silver Produced 1962 (ounces)
YUKON TERRITORY								
United Keno Hill Mines Limited(a)	Calumet	Mayo district						
	Elsa	Mayo district	500	Ag, Pb, Zn	40.55	184,123	186,116	7,000,837
	Hector	Mayo district						
BRITISH COLUMBIA								
Consolidated Mining and Smelting	Sullivan	Kimberley	10,000	Pb, Zn, Ag	na	2,583,068	2,461,695	4,070,666b
Company of Canada Limited, The	Bluebell	Riondel	700	Pb, Zn, Ag	na	237,742	252,821	294,097b
Mastodon-Highland Bell Mines Limited	Highland-Bell	Beaverdell	70	Ag, Pb, Zn	42.77	19,480	18,954	833,153
MANITOBA AND SASKATCHEWAN								
Hudson Bay Mining and Smelting	Flin Flon	Flin Flon district		Cu, Zn				
Co., Limited	Coronation	Flin Flon district	6,000	Cu	na	1,702,340	1,697,749	1,525,257
	Schist Lake	Flin Flon district		Cu, Zn				
	Chisel Lake	Snow Lake, Man.		Zn, Pb, Cu, Ag				
ONTARIO								
Geco Mines Limited	Geco	Manitouwadge	3,300	Cu, Zn, Pb, Ag	2.14	1,282,414	1,276,778	2,106,694
Willroy Mines Limited	Willroy	Manitouwadge	1,200	Cu, Zn, Pb, Ag	1.45	495,028	421,772	418,462
International Nickel Company of Canada, Limited, The	c	Sudbury district	c	Ni, Cu	na	13,794,000d	17,489,000d	1,741,000g
Agnico Mines Limited	Christopher	Cobalt district						
	Nipissing-O'Brien	Cobalt district	400	Ag, Co	na	na	97,135	502,341i
Deer Horn Mines Limited	Cross Lake-O'Brien	Cobalt district	90	Ag, Co	na	na	8,725	254,355i
Glen Lake Silver Mines Limited (h)	Bailey	Cobalt district	100	Ag, Co	na	na	h	268,849i
Langis Silver & Cobalt Mining Company Limited	Langis	Cobalt district	175	Ag, Co	na	na	29,434	451,962i
McIntyre-Porcupine Mines, Limited, Castle Division	Capitol	Gowganda district	125	Ag, Co	na	20,759	23,386	940,615
Siscoe Metals of Ontario Limited	Miller-Lake	Gowganda district	275	Ag, Co	na	na	67,215	1,471,665
	O'Brien			Ag, Co				

QUEBEC								
Coniagas Mines, Limited, The	Coniagas	Bachelor Lake	325	Ag, Zn, Pb	7.5	108,212	79,826	585,770
Gaspé Copper Mines, Limited	Gaspe	Murdochville	6,500	Cu	na	2,694,100	2,589,390	439,000
Manitou-Barvue Mines Limited	Golden Manitou	Val d'Or	1,300	Cu, Zn, Ag, Pb	5.03	169,140j	162,860d	708,668
New Calumet Mines Limited(a)	New Calumet	Grand Calumet Island	750	Pb, Zn, Ag	4.06	95,623	96,872	305,078
Noranda Mines, Limited	Horne	Noranda	3,200	Cu	0.30	901,500	961,502	na
Normetal Mining Corporation, Limited	Normetal	Normetal	1,000	Cu, Zn, Ag	1.88	354,751	355,001	511,571
Quemont Mining Corporation, Limited	Quemont	Noranda	2,300	Cu, Zn	0.86	804,600	822,275	426,000
Solbec Copper Mines, Ltd. (h)	Solbec	Eastern Townships	1,000	Cu, Zn, Pb, Ag	na	271,384	h	263,876
NEW BRUNSWICK								
Heath Steele Mines Limited(h)	Heath Steele	Bathurst area	1,500	Cu, Zn, Ag	na	na	h	na
NOVA SCOTIA								
Magnet Cove Barium Corporation	Magnet Cove	Walton	125	Ag, Pb, Zn	17.05	47,416	9,333	706,258
NEWFOUNDLAND								
American Smelting and Refining Company (Buchans Unit)	Buchans	Buchans	1,250	Zn, Pb, Cu, Ag	4.59	378,000	387,000	1,459,521

(a) Production for the fiscal year ending September 30, 1962.
(b) COMINCO's total silver production, including that from purchased ores and concentrates, was 6,667,813 ounces.
(c) INCO operates seven nickel-copper mines in the Sudbury district and the Thompson nickel-copper mine in northern Manitoba. The ores from the Sudbury district mines are treated in three mills having a combined daily capacity of 48,000 tons. The Thompson mill has a capacity of 6,000 tons.
(d) Ore production includes the output of the Thompson-Manitoba mine.
(g) Silver delivered to markets.
(h) Production commenced in 1962.
(i) Shipments via the Temiskaming Testing Laboratory.
(j) Production does not include copper ore milled in a separate circuit.
n a Not available.

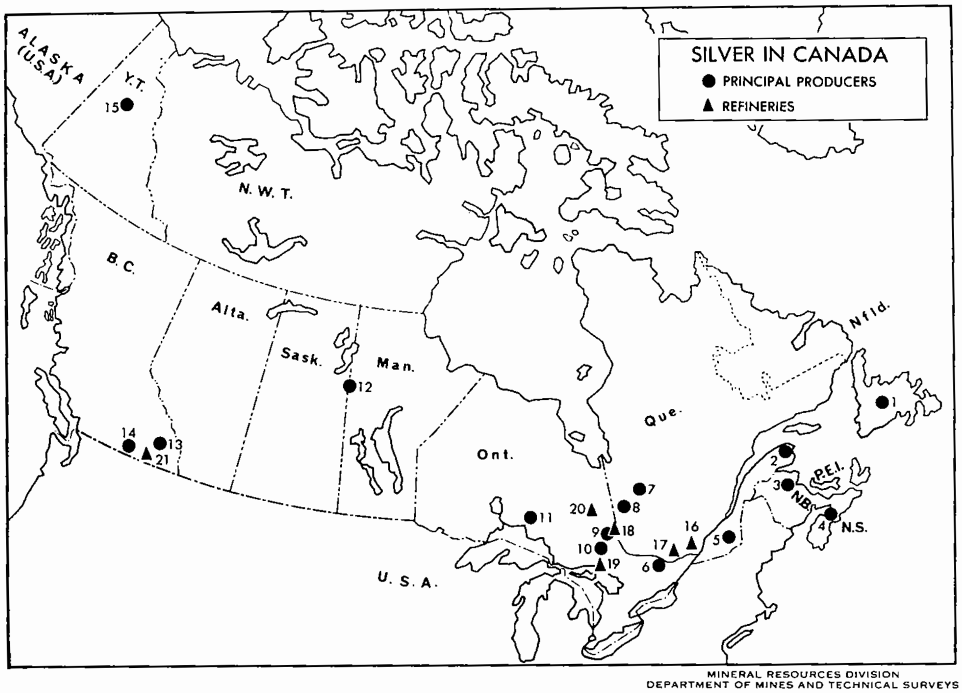


Ontario

Because of continuing favorable market conditions, exploration and development activity was given added impetus in the Cobalt and Gowganda areas of Ontario. Glen Lake Silver Mines Limited commenced production in July at its mine near Cobalt and Rix-Athabasca Uranium Mines Limited made several shipments from its mine in the same area. A third company, Keeley-Frontier Mines Limited, began to tune up its mill early in January 1963. Production by these companies in 1963 should more than offset the declining production of other companies in the Cobalt and Gowganda areas. At least 13 other companies were actively engaged in exploration in the two areas. One of them, Silver Summit Mines Limited, announced its intention to commence milling in the fall of 1963.

Quebec

Solbec Copper Mines, Ltd. became Quebec's only new producer of substantial amounts of silver when it commenced production of copper-zinc-silver ore early in February at its mine in the Aylmer Lake district of the Eastern Townships. Silver production from it is expected to be higher in 1963 than the



PRODUCERS*

1. American Smelting and Refining Company (Buchans Unit)
2. Gaspé Copper Mines, Limited
3. Heath Steele Mines Limited
4. Magnet Cove Barium Corporation
5. Solbec Copper Mines Ltd.
6. New Calumet Mines Limited
7. The Coniagas Mines, Limited
8. Manitou-Barvue Mines Limited
   Noranda Mines, Limited
   Normetal Mining Corporation, Limited
   Sullico Mines Limited
   Quemont Mining Corporation, Limited
9. Agnico Mines Limited
   Deer Horn Mines Limited
   Glen Lake Silver Mines Limited
   Langis Silver & Cobalt Mining Company Limited
   McIntyre-Porcupine Mines, Limited Castle Division
   Siscoe Metals of Ontario Limited
10. The International Nickel Company of Canada, Limited
11. Geco Mines Limited
    Willroy Mines Limited
12. Hudson Bay Mining and Smelting Co., Limited
13. The Consolidated Mining and Smelting Company of Canada Limited
    Bluebell mine
    Sullivan mine
14. Mastodon-Highland Bell Mines Limited
15. United Keno Hill Mines Limited

REFINERIES

16. Canadian Copper Refiners Limited
17. Royal Canadian Mint
18. Cobalt Refinery Limited
19. The International Nickel Company of Canada, Limited
20. Hollinger Consolidated Gold Mines, Limited
21. The Consolidated Mining and Smelting Company of Canada Limited

*Some small producers are omitted.

1962 production of 263,876 ounces because the mine was operated for only part of the year and because milling was below capacity. In northwestern Quebec, mill construction was commenced by Mattagami Lake Mines Limited and Orchan Mines Limited. Zinc-copper and copper ores will be concentrated in these mills - 3,000 tons a day at the Mattagami Lake mine and 1,900 tons at the Orchan mine - from which appreciable quantities of byproduct silver will be recovered. Part of the ore milled at the Orchan mine will be from the property of New Hosco Mines Limited about nine miles away.

New Brunswick

Heath Steele Mines Limited, which operated its 1,500-ton mill near Bathurst in 1957 and 1958, resumed milling zinc-lead-copper and copper ores in mid-year. The copper ore (750 tons a day) was from the nearby Wedge mine operated by COMINCO. Most of New Brunswick's silver production was derived from Heath Steele's mine.

Brunswick Mining and Smelting Corporation Limited announced plans to commence production of base-metal ore, late in 1963 or early in 1964, at 3,000 tons a day from its properties near Bathurst. As this ore contains over one ounce of silver a ton, it will be the source of more than 1,000,000 ounces annually when the proposed mill is operated at full capacity.

Nova Scotia

Ever since Magnet Cove Barium Corporation reported the discovery of a rich silver-lead-zinc orebody beneath its barite orebody at Walton, other companies have shown increasing interest in the Walton area and in other areas where geological conditions are similar. However, no major discoveries of silver-bearing ores were reported by any of them to the end of 1962. Gunnar Mining Limited and Talisman Mines Limited have been active in the area.

USES

Silver's greatest single use is for the manufacture of coinage. This is because it strongly resists corrosion, alloys well with copper, is relatively scarce and, perhaps most important of all, because it is attractive. Silver's well-known and popular use in jewelry, silverware and silverplate manufacture is attributable to the same properties that make it popular as a coinage metal as well as its high malleability, ductility and ability to take a fine finish. Increasing amounts of silver are being consumed by the photographic industry in which the use of silver is based on the light sensitivity and ease of reduction of certain silver compounds, all of which are made from silver nitrate. Silver's important use as a constituent of soldering alloys is due mainly to the low melting point of silver-copper and silver-copper-zinc alloys, to their resistance to corrosion, to their high tensile strength, and to their ability to join together nearly all non-ferrous metals and alloys as well as iron and silver. These solders are widely used in the manufacture of refrigeration, air-conditioning and automotive equipment.

Among the more recently developed uses for silver is in the manufacture of highly efficient batteries for jet aircraft, missiles, satellites and space capsules. In the Mercury space capsule , manned by Col. John Glenn during his epic journey around the earth, a packet of six zinc-silver oxide batteries was sufficient to supply all the electrical needs of the spacecraft. In the United States, silver-cadmium batteries are used by at least one manufacturer of battery-powered hand tools such as saws and drills, and another manufacturer has given a laboratory demonstration of a gas fuel cell which uses molten silver as an electrode.

PRICES

On October 19, the Canadian price reached its highest level ($1.3175 a troy ounce) in 43 years. At the beginning of the year, it was $1.1012; at year end it was $1.3037.

TARIFFS

Canada	British Preferential	Most Favored Nation	General
Silver ores or concentrates	free	free	free
Anodes of silver	5%	7 1/2%	10%
Silver in ingots, blocks, bars, drops, sheets or plates; sweepings, scrap, jewelry	free	free	free
Silver leaf	12 1/2%	25%	30%
Manufactures of silver, not otherwise provided for	17 1/2%	27 1/2%	45%

WORLD REVIEW

Consumption and Prices

While Free World production has for the past three years remained relatively constant, consumption has increased markedly. Consumption in 1961 was estimated at 352,400,000 ounces; in 1960 and 1959 it was 319,300,000 and 298,900,000 ounces. Silver's popularity as an industrial metal is increasing and because of the continual increase in the use of coin-operated machines in many countries more and more silver is going into coinage manufacture.

Prices on world markets during 1962 reflected the increasing demands for available silver. Following President Kennedy's announcement on November 28, 1961, that sales of silver to commercial buyers within the United States would no longer be made from the Treasury Department's free stocks, world prices increased rapidly. Since then, while there have been some declines, the price trend has been upward. Silver prices at the beginning and end of 1962 were $1.0475 and $1.2050 an ounce in the United States and 88.250 and 103.620 pence in Britain.

Production

On a mine-production basis, Mexico led the world for the forty-fourth consecutive year, with an output estimated at 41.2 million ounces. The three next largest producers were the United States, Peru and Canada. In 1962, as shown in Table 4, these four countries produced approximately 60 per cent of total world production. Free World production in 1962, as estimated by Handy and Harman, a large United States silver consumer, was 199 million ounces; in 1961 and 1960, it was 205.9 and 210.1 million ounces.

Table 4

WORLD PRODUCTION OF SILVER, 1962

	(troy ounces)
Mexico	41,249,402
United States	36,345,000*
Peru	36,016,676
Canada	30,422,972
Russia	27,000,000e
Australia	17,250,000
Japan	8,620,482
Other countries	45,249,468
Total	242,154,000

Source: U.S. Bureau of Mines, Silver in 1962. *Refinery production from domestic ores and concentrates; mine production was 36,798,000 ounces.
e Estimate.

Sodium Sulphate

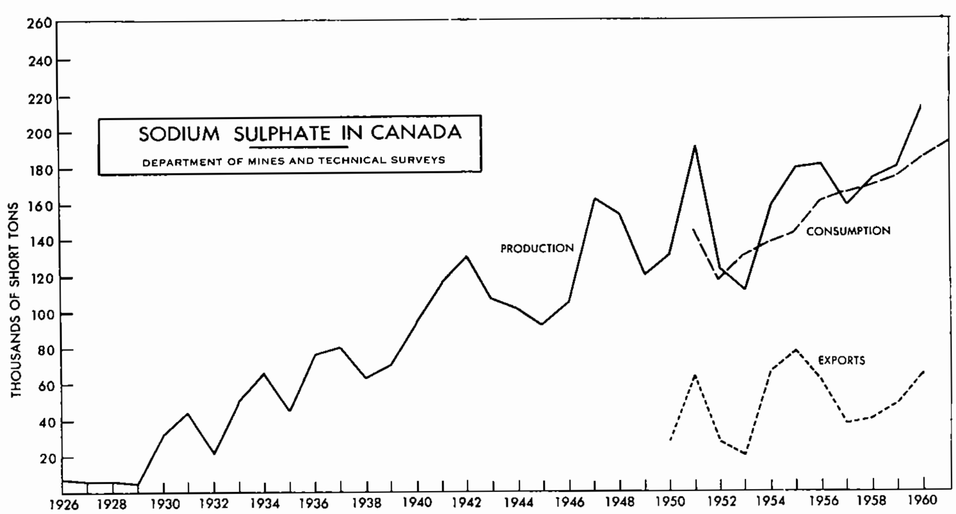
C.M. Bartley*

After rising consistently from 157,800 tons in 1957 to 250,996 tons in 1961, natural sodium sulphate production in Canada was fractionally lower in 1962 at 246,672 tons valued at $3,954,273. Production is obtained from five plants in Saskatchewan.

Exports, at 74,049 tons, were 15 per cent lower than in 1961; imports, at 31,347 tons, were slightly lower.

Consumption of sodium sulphate in Canada during 1961 increased substantially over that of 1960 to reach an estimated high of 200,096 tons. Of this amount, some 96 per cent was consumed by the pulp and paper industry.

During 1962 Saskatchewan companies investigated several sodium sulphate deposits and continued efforts to improve their processing methods and plant operations. Sifto Salt Division of Domtar Chemicals Limited continued work on the development of a process to produce sodium sulphate from the glauberite deposits in New Brunswick, and Western Minerals Ltd. of Edmonton investigated a sodium sulphate lake deposit in Alberta. Although current capacity in Saskatchewan is adequate to satisfy demand, these efforts indicate that increased demands are expected in the future.



*Mineral Processing Division, Mines Branch.

Chaplin Lake, Saskatchewan showing sodium sulphate crystals (white) along the lake shore and in low-lying ground. A stockpile of sodium sulphate, harvested from the reservoirs, is shown in the centre background beside the processing plant.

Table 1

SODIUM SULPHATE - PRODUCTION, TRADE AND CONSUMPTION

	1961		1962	
	Short Tons	$	Short Tons	$
PRODUCTION (shipments)	250,996	4,036,625	246,672	3,954,273
IMPORTS				
Crude sodium sulphate, or salt cake				
United States	22,643	373,364	22,272	398,948
Britain	9,651	201,149	9,075	210,010
West Germany	16	502	-	-
Total	32,310	575,015	31,347	608,958
Glauber's salt				
West Germany	124	7,830	129	4,791
United States	771	20,520	294	17,155
Britain	4	673	3	633
Total	899	29,023	426	22,579
EXPORTS				
Crude sodium sulphate				
United States	87,048*	1,320,928*	74,049	1,210,958

CONSUMPTION	1960	1961	1962
Pulp and paper	178,449	193,000	203,000e
Glass, including glass wool	2,813	2,845	2,308
Medicinals	54	-	-
Soaps	1,394	3,523	4,168
Other products	352	728	1,215
Total	183,062	200,096	210,691

Source: Dominion Bureau of Statistics. *Revised to exclude 84 tons valued at $10,500 to Malaya appearing in Trade of Canada. Material was not sodium sulphate.
Symbols: - Nil; e Estimate.

Table 2

SODIUM SULPHATE - PRODUCTION, TRADE AND CONSUMPTION, 1953-62

	Production(a)	Imports		Exports(b)	Consumption
		Salt Cake	Glauber's Salt		
1953	115,565	32,802	5,493	20,132	129,698
1954	158,417	30,235	5,134	66,049	138,275
1955	178,888	29,927	3,888	76,894	142,055
1956	181,053	30,319	2,768	60,579	161,273
1957	157,800	28,088	1,512	37,023	163,743
1958	173,217	25,813	1,217	39,763	168,067
1959	179,535	27,157	966	47,922	171,634
1960	214,208	24,706	1,151	63,831	183,062
1961	250,996	32,310	899	87,048c	200,096
1962	246,672	31,347	426	74,049	210,691

Source: Dominion Bureau of Statistics except where otherwise indicated. (a)Producers' shipments of crude sodium sulphate. (b)Exports to the United States for 1953 and 1954 as reported by the U.S. Department of Commerce, Bureau of the Census, in United States Imports of Merchandise for Consumption (Report FT 110). For 1955 and the years following as reported in Trade of Canada (DBS). (c)Revised to exclude 84 tons valued at $10,500 to Malaya appearing in Trade of Canada. The material was not sodium sulphate.

DEPOSITS

Sodium sulphate is found in many lakes and ponds of southern Saskatchewan in the form of brines and intermittent or permanent crystal beds. Sulphates in the soil are dissolved by the water from rains and snowfalls and the solutions collect in closed drainage basins. In the summer evaporation reduces the water content of the brine; the crystals are then precipitated as the weather cools in the fall. The seasonal repetition of this cycle over a long period has accumulated thick beds of sodium sulphate crystal in numerous lakes.

Sodium sulphate occurs in nature as Glauber's salt, or mirabilite ($Na_2SO_4.10H_2O$), and to a lesser degree as anhydrous sodium sulphate, or thenardite (Na_2SO_4). Both minerals are soluble in water and the solubility increases as the temperature rises. The variable solubility with temperature is used advantageously in Saskatchewan to recover a relatively pure product from the natural occurrences.

Reserves in Saskatchewan have been estimated at more than 200 million tons. Fifteen of the larger deposits have been estimated to contain at least one million tons each. Similar though smaller reserves occur in Alberta and British Columbia.

PRODUCTION, CONSUMPTION AND TRADE

Sodium sulphate has been produced continuously in Saskatchewan since 1919; output has increased from 15 tons in that year to more than 246,000 tons in 1962. The cumulative total is more than four million tons. The plants now operating could process more raw material but because efficient operations depend to a large degree on summer temperatures, which are variable, present companies may not be capable of reaching the full capacities of their plants. Therefore any significant increase in demand might require additional plants.

Most sodium sulphate is consumed in the manufacture of kraft paper. Although there has been a reduction in the amount of sulphate used per ton of paper, the continuous increase in demand for kraft products has resulted in the use of ever larger quantities of sulphate. It is mainly for this reason that the consumption of sodium sulphate is expected to show a proportionate increase.

In recent years about two thirds of Canadian production has been consumed in Canada and about one third has been exported to the United States. Sodium sulphate is imported by ocean freighters into eastern Canada from the United States and Europe, and to the west coast of Canada from the United States. Rail freight charges from Saskatchewan to these areas make it difficult to compete with sodium sulphate delivered by lower-cost ocean freight.

Table 3

PRINCIPAL DATA CONCERNING PRODUCERS

Company	Plant Location	Source Lake	Reported Annual Capacity (short tons)
Midwest Chemicals Limited	Palo	Whiteshore	100,000
Ormiston Mining and Smelting Co. Ltd.	Ormiston	Horseshoe	75,000
Sybouts Sodium Sulphate Co., Ltd.	Gladmar	East Coteau	30,000
Saskatchewan Minerals, Sodium Sulphate Division	Chaplin	Chaplin	150,000
	Bishopric*	Frederick	50,000

*In operation in January 1962.

RECOVERY AND PROCESSING

The first production of sodium sulphate from Saskatchewan was obtained by harvesting raw crystal from dried and frozen lake beds in the winter. This method is still in use but most of the production is now obtained by pumping concentrated lake brines to prepared reservoirs, in the summer months, and recovering the crystal which is deposited when cold weather chills the brine in the fall. These operations are carefully timed and controlled so that brine is pumped from the lake at its highest possible concentration and the remaining liquid, which contains some undesirable elements, is returned to the lake before crystallization in the reservoir is complete. The crystal bed is later removed to the plant using scrapers, shovels and draglines. One company, Ormiston Mining and Smelting Co. Ltd., uses a floating dredge to excavate crystal from the lake bottom and to pump it in brine through a 10-inch pipeline directly to the plant.

Processing consists essentially of removing water and dehydrating the natural crystal to an anhydrous powder using equipment such as submerged combustion units, evaporators and rotary kilns. In recent years rotary kilns have been used mostly for final drying of the product rather than for bulk dehydration.

The availability of natural gas in Saskatchewan has helped to increase production and improve efficiency in several plants, mainly as savings on storage, maintainance and corrosion costs that were appreciable when fuels such as low-grade coal or heavy oils were used. The end product from the processing plants is usually marketed as a bulk product grading about 97 per cent Na_2SO_4.

PRODUCING COMPANIES

Table 3 lists four companies that operate five plants in Saskatchewan with a combined annual capacity of about 400,000 tons. Courtaulds (Canada) Limited, at Cornwall, Ontario, produces a few thousand tons of by-product salt cake annually.

Saskatchewan Minerals, Sodium Sulphate Division, operated plants at Chaplin and at Bishopric, alternately, with one crew. This arrangement provides full-time employment for the operating staff while allowing time for evaporation to increase the concentration of sodium sulphate in the lake brine before it is pumped into the reservoirs. Research projects at Chaplin and also at the Research Council of Saskatchewan, at Saskatoon, were directed toward the production of higher grade salt cake from low-grade raw material.

Midwest Chemicals Limited constructed a new reservoir near the Palo plant and is making efforts to improve the grade of its product by removing insoluble materials.

Ormiston Mining and Smelting Co. Ltd. reported construction and plant improvements during 1962 as part of a long-term effort to increase efficiency and expand production.

OUTLOOK FOR THE CANADIAN INDUSTRY

The outlook for the sodium sulphate industry seems promising. Domestic consumption reached an all-time high in 1962. Exports, although lower than those of 1961, were higher than in any other year since 1955. In the United States, consumption has risen consistently since 1958 and, although new producing plants have been built, most are in the south and would have no transportation advantage for much of the market available to Canadian exporters. Similarly, a new 75,000-ton-per-annum plant in northern Mexico would compete for southern United States markets rather than those served by Canadian producers.

In addition to efforts in Saskatchewan to improve the grade of sodium sulphate in order to obtain markets other than kraft paper, attention has also been directed to the possible combination of sodium or magnesium sulphate and potash to produce potassium sulphate fertilizers.

With large reserves, efficient recovery and processing methods, rising consumption in the chief market (kraft paper) and an improvement in rail freight rates and delivery schedules, the Canadian sodium sulphate industry appears to be well established and in a position to experience further growth.

USES AND SPECIFICATIONS

More than 95 per cent of the sodium sulphate consumed goes into kraft paper, to which it adds strength and toughness. Some is used in the manufacture of newsprint, where an increase in wet-strength permits the operation of production machinery at higher speed. Sodium sulphate is also consumed in the manufacture of glass, detergents, mineral-feed supplements, in base-metal smelting, in chemical and medicinal products and as a soil conditioner.

The physical and chemical specifications for sodium sulphate vary. Material of 95 per cent Na_2SO_4 content has been used for the production of kraft paper, but higher grades are desirable. Glass, detergent and chemicals require grades of about 98 per cent. Fine chemicals and medicinal products call for grades above 99 per cent.

For detergents, grain size, uniformity and free-flowing characteristics are important in handling and use, and a high degree of whiteness is desired.

PRICES

Canada

The Canadian price of sodium sulphate (salt cake) bulk, carload, f.o.b. works, as reported by Canadian Chemical Processing in October 1962 was $16.50 a ton.

United States

According to the Oil, Paint and Drug Reporter of December 31, 1962, United States prices of sodium sulphate were:

Anhydrous, technical-grade, bags, car lots, per short ton	$56.00
Detergent, rayon-grade, car lots, per short ton - bags, f.o.b. works	$38.00
bulk	$34.00
Crude (salt cake), 100% Na_2SO_4, domestic, bulk, f.o.b. works, per short ton	$28.00

TARIFFS

Canada	British Preferential	Most Favored Nation	General
Crude, or salt cake, per lb	1/5¢	1/5¢	3/5¢

United States

Crude, or crude salt cake	free
Anhydrous, per long ton	$0.90
Crystallized, or Glauber's salt, per long ton	$1.00

Stone, Building and Ornamental

F.E. Hanes*

The estimated value** of stone produced in Canada in 1962 was $7.5 million, an increase of about 12 per cent over that of the previous year. Granite increased $551,600, approximately 15 per cent; limestone increased $210,000 about nine per cent; sandstone increased almost $98,200, 18.5 per cent; and slate and shale increased from $1,000 to $21,024. Marble production decreased $79,600, a drop of more than 50 per cent.

The estimated volume** of stone produced in 1962 was about 200,000 short tons, an increase of almost 15 per cent.

Calculations based on estimated amounts of 1962 production show granite as the most valuable stone produced in Canada. Granite also increased in qualtity over 1961 by approximately 2,700 short tons, accounting for 56 per cent of total value.

Limestone production, the largest of all the stones quarried, amounted to 43 per cent of total volume but only 34 per cent of total value.

Sandstone production was 94 per cent higher than the previous year. The volume was about 25 per cent of total volume, however its value was only 8.4 per cent of the total.

Although the value of slate and shale shows a large increase in 1962 over 1961, it is insignificant compared with the total value of stone produced. The value of marble produced decreased by 50 per cent in 1962 but increased in value per ton from approximately $55 in 1961 to $94. This was due to much smaller production and greatly improved quality.

Further detailed breakdown is not possible because of a lack of production figures.

Ontario produced over 50 per cent of the stone produced in Canada in 1962, an increase compared with the 1961 share when Ontario accounted for 45.6 per cent of the total. In 1961 the value of stone produced by Quebec was three times that of Ontario or 66 per cent of total value. For 1962 the estimated value was 66 per cent for Quebec and 20.9 per cent for Ontario. This anomaly - high production volume from Ontario but high production value from Quebec - results from the high-volume, low-cost sandstones of the one province and the high-cost, lower-volume granites of the other.

*Mineral Processing Division, Mines Branch. **Estimated from preliminary data based on past trends. Due to fluctuating values, figures for 1962 cannot be considered reliable.

Table 1
PRODUCTION OF BUILDING AND ORNAMENTAL STONE, 1961 and 1962

	1961		1962p	
	Short Tons	$	Short Tons	$
Granite...........	60,495	3,655,367	63,200	4,206,988
Limestone	85,249	2,361,009	86,589	2,570,778
Marble	2,851	158,000	830	78,392
Sandstone.........	25,503	530,214	49,541	628,390
Slate and shale....	500	1,000	388	21,024
Total	174,598	6,705,590	200,548	7,505,572

p Preliminary

Table 2
PRODUCTION OF BUILDING AND ORNAMENTAL STONE, BY GEOGRAPHICAL AREAS 1961 and 1962

	1961		1962p	
	Short Tons	$	Short Tons	$
Atlantic Provinces	5,530	316,586	8,348	367,924
Quebec	74,233	4,423,730	74,782	4,952,910
Ontario	79,637	1,400,796	101,787	1,567,389
Western Provinces	15,198	564,478	15,631	617,349
Total	174,598	6,705,590	200,548	7,505,572

p Preliminary

IMPORTS AND EXPORTS

Canada imported 10.2 times the value of stone it exported in 1962; a year earlier, the ratio stood at 11.6. Although small in amount, an improvement toward a better balance is slowly taking place.

The value of imported building, ornamental and monumental stone in 1962 increased by 7.2 per cent over the 1961 value to $3.6 million.

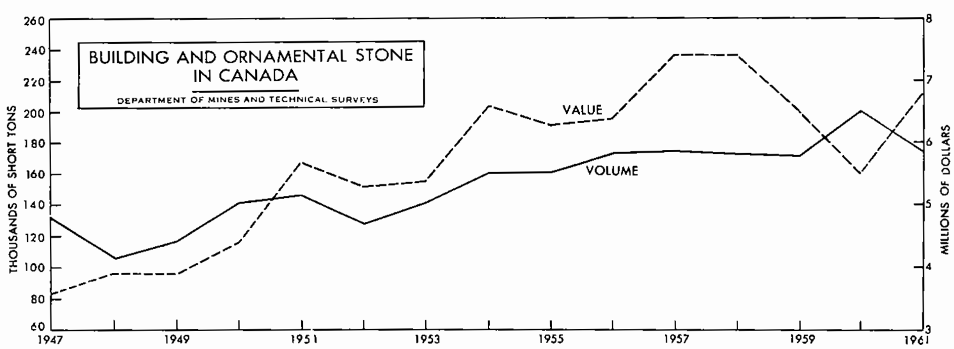


Table 3

PRODUCTION OF BUILDING AND ORNAMENTAL STONE, 1961

	Granite		Limestone		Marble		Sandstone		Shale and Slate	
	Short Tons	$	Short Tons	$	Short tons	$	Short Tons	$	Short Tons	$
By Type										
Building										
Rough	15,385	232,467	35,360	377,207	107	2,460	16,047	335,523	-	-
Dressed	18,962	1,999,283	45,106	1,956,146	2,744	155,540	2,733	112,823	-	-
Total	34,347	2,231,750	80,466	2,333,353	2,851	158,000	18,780	448,346	-	-
Monumental										
Rough	15,270	399,967	-	-	-	-	-	-	-	-
Dressed	8,997	987,154	-	-	-	-	-	-	-	-
Total	24,267	1,387,121	-	-	-	-	-	-	-	-
Flagstone	700	9,800	4,783	27,656	-	-	6,581	75,478	500	1,000
Curbstone	756	20,056	-	-	-	-	-	-	-	-
Paving	425	6,640	-	-	-	-	142	6,390	-	-
Total	1,881	36,496	4,783	27,656	-	-	6,723	81,868	500	1,000
Grand Total	60,495	3,655,367	85,249	2,361,009	2,851	158,000	25,503	530,214	500	1,000
By Geographical Area										
Atlantic Provinces	1,608	198,392	1,024	4,606	-	-	2,898	113,588	-	-
Quebec	51,160	3,380,558	19,628	883,632	2,851	158,000	94	540	500	1,000
Ontario	1,896	31,034	55,250	953,776	-	-	22,491	415,986	-	-
Western provinces	5,831	45,383	9,347	518,995	-	-	20	100	-	-
Total, Canada	60,495	3,655,367	85,249	2,361,009	2,851	158,000	25,503	530,214	500	1,000

Granite imports increased by 10.6 per cent over the 1961 period, for a total value of $1.1 million. Marble imports gained 22.8 per cent for a total value of $1.7 million or an increase over 1961 of about $312,000. Slate gained 131.4 per cent during this period while the number of roofing squares imported increased by 374. The total value of slate brought into Canada amounted to about $165,000; a year earlier it was $71,000. This large increase was brought about by the use of imported British slate on the new 43-storey Canadian Imperial Bank of Commerce building in Montreal. Limestone showed a decline in volume of 6,000 short tons and approximately $269,000 dollars.

Exports, consisting principally of unwrought monumental granite and marble, increased by 1,800 tons to 14,400 short tons, a gain of 14.6 per cent. The value of our total exported stone amounted to $352,000, an increase of $64,000 or 22.3 per cent in 1962.

DIMENSION STONE

Dimension stone is the name given to stone from deposits of igneous, sedimentary and metamorphic rocks which are quarried in large blocks, are amenable to sawing and shaping and are for building and ornamental use. Such stone must be sufficiently durable to ensure sound quality products.

DEPOSITS OF BUILDING AND ORNAMENTAL STONE

Suitable building and monumental stone is quarried from igneous and metamorphic rocks in Quebec, British Columbia, Ontario, New Brunswick, Manitoba and Nova Scotia. From Quebec comes granite, limestone, marble and small quantities of sandstone, shale and slate. Ontario produces limestone, sandstone and granite, and has undeveloped deposits of marble. Nova Scotia produces granite and sandstone. New Brunswick produces granite and limestone, and is also a potential producer of marble. Both British Columbia and Manitoba are sources of granite, Manitoba producing limestone as well. Both provinces contain deposits of marble at isolated locations.

Granite

Nova Scotia - Grey granite is produced near Halifax, Middleton-Nictaux and Shelburne. Black diorite is quarried in the Shelburne area. A hard, siliceous type of stone referred to as 'iron stone' is sporadically produced near Halifax, while quartzitic rocks sometimes referred to as 'blue stone' are produced in the Ostrea Lake and Echo Lake areas, northeast of Dartmouth.

New Brunswick - A coarse- to medium-grained, grey-brown granite is produced near St. Stephen, and fine- to medium-grained, grey, pink and blue-grey granites are quarried in the Hampstead (Spoon Island) district. A brown, pink-grey, coarse-grained granite is sporadically quarried near Bathurst. A light-pink to salmon-colored, medium-grained granite is available in the Antinouri Lake district. Black granite is quarried in the Bocabec River area and southwest of the Hampstead area. It is a ferromagnesian rock containing plagioclase feldspar, augite, pyroxene, and hornblende.

Table 4

BUILDING AND ORNAMENTAL STONE
IMPORTS AND EXPORTS

	1961		1962	
	Quantity	$	Quantity	$
IMPORTS				
Granite				
Granite, rough		398,578		452,860
Granite, sawn		131,137		195,563
Granite, manufactures		442,409		427,056
Total		972,124		1,075,479
Marble				
Rough		119,090		160,517
Sawn		859,427		1,091,774
Marble for tombstones		40,816		42,660
Ornamental for churches		177,182		124,723
Other manufactures		171,813		260,755
Total		1,368,328		1,680,429
Slate				
Roofing (squares)	497	10,836	871	26,861
Manufactures		60,650		138,524
Total		71,486		165,385
Building stone, other than marble or granite (short tons)	30,039	927,094	23,898	657,913
Total building and ornamental stone		3,339,032		3,579,206
EXPORTS				
Building stone, rough* (short tons)	12,579	238,116	14,415	258,521
Natural stone, basic products**		49,634		93,423
Total		287,750		351,944

*Includes building stone, unwrought and granite and marble, unwrought.
**Includes all kinds of building stone.

Quebec - Numerous quarries south of the St. Lawrence River supply fine- to medium-grained, grey and grey-white granites. These quarries are in the vicinities of Stanstead, Stanhope, St. Samuel-St. Sebastien and St. Gerard. Fine- and medium-grained, dark grey-blue essexite is quarried on Mount St. Gregoire. A coarse-grained, dark-green nordmarkite is sporadically quarried in the Lake Megantic mountain area. A fine-grained, green granite is also produced near St. Gerard. A potential source of medium-grained, black granite with a slight reddish-brown cast has been found in the Stanstead area.

North of the St. Lawrence River, red, brown and black granites are quarried in the Lake St. John-Chicoutimi area; blue-grey, rose-grey, deeper pink-grey and black and white gneissic granites come from the Rivière ã Pierre district; pink, fine-grained granite is quarried near Guenette. St. Alban supplies a pink-red granite, and St. Raymond a banded gneiss; brown-red to green-brown granites are quarried in the Grenville district. An augen-type, coarse-grained, rose-pink granite is obtained south of Mont Tremblant. A red granite is produced in the Ville Marie area.

Ontario - A salmon-pink, medium-grained granite is available near Vermilion Bay. A black anorthosite is produced in the River Valley area. Rough building blocks are quarried near Parry Sound from a multicolored gneissic rock. Potential red granites are available in the Lynhurst and Gananoque areas. A deposit of black and red granite is being developed in the area along the north shore of Lake Superior.

Manitoba - A durable, red granite of good quality is being quarried in the Lac du Bonnet area, 70 miles northeast of Winnipeg.

British Columbia - A light-grey and blue-grey, even-grained granite is produced on Nelson Island. Haddington Island is a source of fine-grained, bluish-grey and buff andesite.

Limestone

New Brunswick - Limestone for building construction is produced in the Saint John area.

Quebec - A fine- to medium-grained, fossiliferous, brownish-grey limestone is produced at several quarries in the vicinity of St. Marc des Carrieres. The stone, besides being used in rough and sawn finishes, takes a high polish and is suitable for decorative use. Rough building stones are produced in small quantities from quarries situated near Montreal particularly on Île Jésus, north of the city. Small amounts of rough building blocks are quarried at scattered points in the province.

Ontario - Much of Ontario's production comes from deposits of a dense, hard, grey-blue limestone in the Niagara Falls area. A thin-bedded, dense, buff to buff-grey limestone is quarried on the Bruce Peninsula, near Wiarton and Owen Sound, and some dark-grey limestone is quarried near Ottawa.

Manitoba - A mottled, buff-brown to grey-brown dolomitic limestone is obtained from several quarries in the Garson area. It usually is effectively used in rough and sawn finishes but takes a high polish and can serve as a decorative stone.

Sandstone

Nova Scotia - A massive-textured, fine- to medium-grained, olive-buff stone is quarried in the Wallace area. A coarser, darker stone is sporadically quarried near Antigonish.

Ontario - From thin-bedded sandstone deposits, numerous quarries along the scarp face of the Caledon Hills, between Georgetown and Orangeville, produce a fine-grained, sometimes mottled or speckled building stone that is varicolored in light buff, brown and deep brown-red. Medium-grained, buff to cream-colored stone is quarried near Bell's Corners. A highly colored, medium-grained, banded and mottled sandstone is produced from deposits 20 miles north of Kingston.

Alberta - A hard, very fine-grained, medium-grey sandstone, sometimes referred to as 'rundle stone', is quarried in Alberta. It is used as rough building stone.

Marble

Quebec - A small quantity of light- and dark-grey green-white mottled marble is quarried in the Philipsburgh area, near the United States border south of Montreal. Sporadic quarrying of a white-grey marble is carried on in the western part of the Stukely area.

Ontario - Several locations in the Perth-Almonte area are being investigated for potential deposits of dimension stone.

Sulphur

C. M. Bartley*

The full-year operation of most of the seventeen plants recovering sulphur from natural gas in western Canada resulted in a substantial increase in sulphur production in 1962, in spite of the fact that several large plants operated at rates much below capacity. In Alberta the output from fifteen plants totalled 1,069,581 short tons, 124 per cent above that of 1961, and sales at 616,971 tons were 85 per cent over those of 1961. Canadian output of sulphur in all forms reached a new high of more than 1,725,000 tons.

The productive capacity of sulphur plants in western Canada now totals 2,133,000 tons per year and construction expected in the next two years may increase capacity to more than 2,300,000 tons. Other sources of sulphur, such as smelter gas, pyrites and foreign crude oil bring total capacity to about three million tons annually.

Markets for sale gas (cleaned natural gas suitable for pipe lining and as a fuel) determine the output of sulphur and since these markets are expected to increase only slowly in the next few years sulphur production will increase only moderately up to 1966. After that time, however, anticipated additional domestic and export demands for sale gas will result in further expansion of sulphur production.

Reserves of sulphur in natural gas increased slightly in 1962 in spite of rising production and lessened exploration. Over the long term, gas-sulphur reserves will probably triple and expected oil production from the Athabasca oil sands will provide further byproduct sulphur in the future. Sulphur reserves in the oil sands are estimated to total hundreds of millions of tons.

With adequate immediate reserves in sour natural gas and tremendous future reserves in oil sands, with substantial low-cost production and with rapidly rising domestic and export sales, the Canadian sulphur industry is assured of an important place in the mineral production, industrial activity and foreign trade of Canada.

PRODUCTION AND TRADE

Elemental sulphur is produced from three sources in Canada, sour natural gas, sour crude oil, and metallic sulphide ores. In addition, "equivalent" sulphur (sulphur-containing material usable in place of elemental sulphur for certain purposes) is derived from smelter gas, pyrites concentrates and other sources. Until 1952 "equivalent" sulphur was the only domestic source in Canada, supplying part of the sulphuric acid and pulp industry requirements. The balance of these needs, together with demands for solid sulphur, were served by imported elemental sulphur.

*Mineral Processing Division, Mines Branch.

Table 1

SULPHUR - PRODUCTION AND TRADE

	1961		1962	
	Short Tons	$	Short Tons	$
PRODUCTION				
Pyrite and pyrrhotite[a]				
Gross weight	517,258		517,308	
Sulphur content	255,376	1,830,566	257,084	1,879,584
Sulphur in smelter gases[b]	277,056	2,708,110	292,728	3,089,537
Elemental sulphur[c]	394,762	7,287,881	695,098	9,286,999
Total sulphur content	927,194	11,826,557	1,244,910	14,256,120
IMPORTS (elemental sulphur)				
United States	329,480	7,087,760	194,989	4,629,132
France	76	6,456	100	8,456
Total	329,556	7,094,216	195,089	4,637,588
EXPORTS				
Sulphur in ores (pyrite)				
United States	na	860,599	na	890,055
Taiwan	na	39,156	na	-
Total		899,755		890,055
Sulphur, crude and refined				
United States	199,374	3,710,992	327,548	5,373,949
Australia	1,682	14,642	24,010	435,011
Taiwan	16,534	234,200	15,315	297,300
Britain	-	-	11,199	218,168
India	-	-	6,131	84,840
Belgium and Luxembourg	-	-	5,689	61,581
Korea	-	-	4,342	78,310
Indonesia	-	-	2,041	37,565
Pakistan	-	-	1,659	22,469
Philippines	-	-	1,099	19,144
Malaya	276	8,050	993	21,606
Total	217,866	3,967,884	400,026	6,649,943

Source: Dominion Bureau of Statistics.

(a) Producers' shipments of byproduct pyrite and pyrrhotite from the processing of metallic-sulphide ores.

(b) Includes also sulphur in acid made from roasting zinc-sulphide concentrate.

(c) Producers' shipments of elemental sulphur produced from natural gas. Includes a small quantity of elemental sulphur derived from treatment of nickel-sulphide matte at Port Colborne, Ontario.

Symbol: - Nil; na Not available.

Table 2

SULPHUR - PRODUCTION, TRADE AND CONSUMPTION, 1952-62
(short tons and dollars)

	Production				Imports	Exports		Consumption
	In Pyrites Shipped[(a)]	In Smelter Gases[(b)]	Elemental Sulphur[(c)]	Total	Elemental Sulphur	In Pyrite[(d)]	Other Sulphur[(g)]	Elemental Sulphur[(h)]
1952	263,241	160,547	8,931	432,719	415,185	197,897	-	387,617
1953	186,650	172,200	18,298	377,148	359,205	129,608	4,633	352,466
1954	311,159	221,247	22,320	554,726	310,127	188,608	3,339	358,953
1955	403,986	224,457	29,093	657,536	373,373	$2,001,575	3,051	393,148
1956	473,605	236,088	33,464	743,157	474,117	$2,649,349	4,331	431,202
1957	515,096	235,123	93,327	843,546	416,930	$2,852,753	12,364	480,941
1958	512,427	241,055	94,377	847,859	375,331	$1,879,251	7,608	515,047
1959	465,611	277,030	145,656	888,297	332,430	$1,018,608	26,526	483,482
1960	437,790	289,620	274,359	1,001,769	328,765	$1,259,151	143,040	507,810
1961	255,376	277,056	394,762	927,194	329,556	$ 899,755	217,866	513,000r
1962	257,084	292,728	695,098	1,244,910	195,089	$ 890,055	400,026	523,000e

Source: Dominion Bureau of Statistics.

(a) Sulphur content of pyrite and pyrrhotite shipped by producers. Not necessarily all recovered. For 1952-55, includes the sulphur content of acid made by roasting zinc-sulphide concentrate at Arvida, Quebec. Pyrite used to make byproduct iron sinter in 1961 and 1962 is not included.

(b) Sulphur in liquid sulphur dioxide and sulphuric acid from the smelting of metal-sulphide ores. For 1956 and years following includes sulphur in acid made from roasting zinc-sulphide concentrates.

(c) Elemental sulphur produced from natural gas. Refers to production for the period 1952-56 and, from 1957 on, to sales. Starting in 1957 elemental sulphur derived from the treatment of nickel-copper sulphide matte at Port Colborne, Ontario, is included.

(d) Exports of pyrite, sulphur content. Quantities for 1955 and following years are not available for publication.

(g) Exports of sulphur produced from natural gas and other sources.

(h) Consumption of elemental sulphur by industries. Coverage is incomplete.

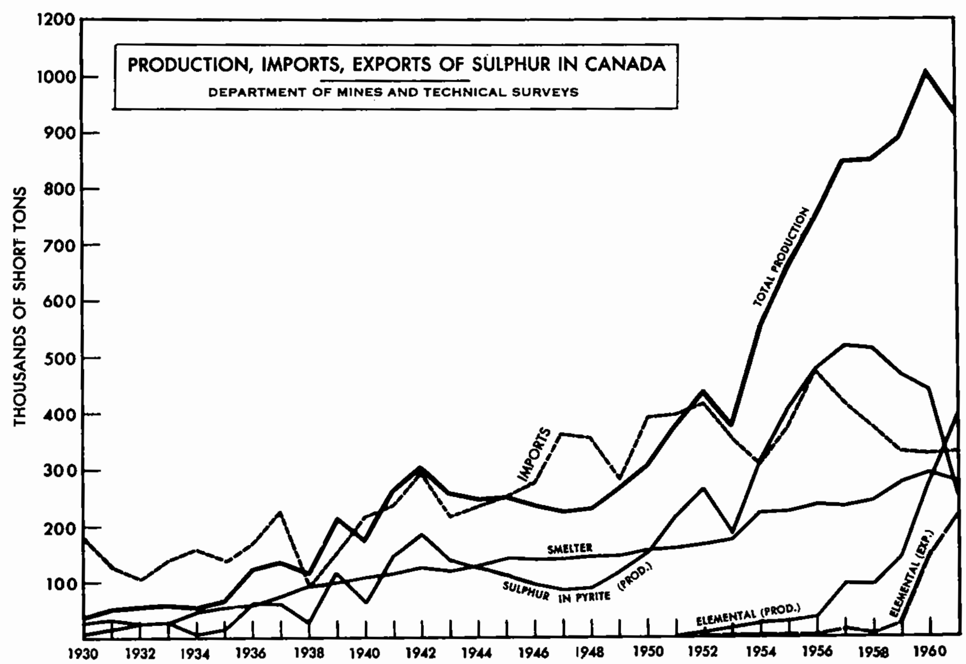
Symbols: - Nil; r Revised from previously published figure; e Estimate.

Table 3

CONSUMPTION OF ELEMENTAL SULPHUR IN CANADA, 1962
(short tons)

Pulp and paper	310,000e
Heavy chemicals, fertilizer	199,875
Rubber goods	2,831
Medicinals	12
Adhesives	54
Starch	323
Sugar refining	59
Petroleum refining	160
Iron and steel	1,397
Miscellaneous nonmetallic products	28
Miscellaneous chemicals	8,091
Total	522,903

Source: Dominion Bureau of Statistics. e Estimate.



The first Canadian plant to recover elemental sulphur from natural gas was built in Alberta in 1952. Other plants were built as demand for gas increased, but sulphur output did not reach significant proportions until large scale exports of natural gas to the United States were approved in 1960 and several large plants were built to treat gas for this market. As a result of these developments, sulphur production in western Canada increased from 146,646 tons in 1959 to 668,126 tons in 1962, and is continuing to rise.

The increase in elemental sulphur production has had several important consequences. Large amounts of high-purity domestic sulphur are available at lower costs than imported sulphur. As a result, less byproduct pyrites is being used, sulphur imports into Canada have been substantially reduced and sulphur is becoming an important item of export trade. In addition, over the long term it is expected that the availability of low-cost sulphur and natural gas in western Canada will encourage the development of industry.

Production (shipments) of sulphur in all forms totalled 1,244,910 tons valued at more than $14 million. All forms of sulphur (pyrites, smelter gas and elemental) showed increases although elemental sulphur showed the significant gain.

Imports of sulphur, largely from the United States, totalled 195,089 tons, down from 329,556 tons in 1961. This indicates that western Canadian sulphur is now competitive in part of the eastern Canadian market.

Exports of Canadian elemental sulphur increased substantially in 1962 to 400,026 tons, compared to 217,866 tons in 1961. The new high included 327,548 tons to the United States and 72,478 tons to overseas buyers. Several large export sales in early 1963 indicated a further expansion of exports in the current year. Pyrites exports, all to the United States, at $890,055 were slightly lower than in 1961.

Estimated world production of sulphur in 1962, listed in Table 8, indicates that Canada has become the fourth largest producer following the United States, the U.S.S.R. and Japan. Since French and Mexican production of elemental sulphur is unlikely to increase appreciably from its present level, Canada will probably become the second ranking producer of this form of sulphur - possibly in 1963.

The emergence of Canada as a major producer and exporter of sulphur, following similar sulphur production increases in Mexico and France, has changed the pattern of world sulphur trade. In order to gain entry to world markets, Mexican producers lowered the price of sulphur from $31 to $28 in 1955. United States Frasch sulphur producers removed the $3 export premium, lowering their price to $28, and in 1957 further reduced prices to $25 per ton. But Mexican sulphur remained competitive in both United States and overseas markets because of lower ocean shipping charges. In France, gas-sulphur production started at Lacq in 1959, and in 1962 had reached an approximate plant capacity of 1,400,000 tons per year. Because French sulphur had a ready market available in western Europe and had lower costs and transportation charges than the United States and Mexican product, it was readily marketed at then current prices. However, sales of French sulphur increased the competitive pressure between United States and Mexican Frasch sulphur producers and all Frasch producers made efforts to win markets traditionally supplied by pyrites.

The intrusion of increasing supplies of Canadian sulphur into this situation has been observed with interest and some apprehension by the world sulphur industry. The industry recognized that the large amounts of sulphur produced in the manufacture of natural gas would be marketed without regard for the size of the sulphur market available. Because there was little likelihood that sulphur prices would rise under these circumstances there was no incentive to stockpile sulphur in anticipation of higher prices. Indeed, with the massive supplies of low-cost sulphur available from Canadian and other sources there would appear to be little need to maintain a price which had been based, to some extent, on the need to insure production at some of the higher cost Frasch operations. Because of their low production costs, Canadian producers have been able to accept lower prices for sulphur and to compete they have been willing to do so.

Canadian sulphur has been marketed by three separate companies or groups of companies. Two major producers, The British American Oil Company Limited and Petrogas Processing Ltd., jointly formed a sulphur marketing organization called Cansulex Limited to sell sulphur to overseas buyers. This leaves North American markets open to all the individual companies, both in the Cansulex group, and outside of it. Shell Oil Company of Canada, Limited, sells on its own behalf throughout North America but its overseas sales are handled by International Sulphur Co. Limited of Calgary. Cansulex and Shell have accounted for most of the sulphur sold but substantial amounts have also been moved by Texas Gulf Sulphur Company, The California Standard Company, Canadian Oil Companies, Limited, and others. Many of the smaller companies are not associated with either group and sell independently in domestic, and to a lesser extent, in foreign markets.

During 1962 control of some sulphur production changed when Royalite Oil Company, Limited, was purchased by British American Oil Company and Shell Oil of Canada purchased control of Canadian Oil Companies.

Pyrites - Pyrite, Pyrrhotite and other Sulphides

Pyrites, the traditional source of sulphur in Canada, have lost some markets to lower cost elemental sulphur, but the current pyrites operations appear to be stable. Pyrites cannot compete with sulphur for all markets but under conditions where sulphur dioxide gas, iron oxide residues, and possibly some recoverable amounts of other elements are of value, pyrites may be attractive. The determining factor is usually the availability of reliable supplies of byproduct pyrite concentrate, in close proximity to large-scale processing plants. The fact that pyrites often move the long distances to consumers in Europe, Japan and the United States is a reflection of their value for several ingredients rather than for sulphur alone.

Canadian sources of pyrites are listed in Table 4, and production and trade are shown in Table 1. Canadian consumers using pyrites to produce sulphuric acid are: The Consolidated Mining and Smelting Company of Canada Limited (COMINCO), at Kimberley, B.C.; The Nichols Chemical Company, Limited, at Barnat, B.C., Sulphide, Ontario, and Valleyfield, Quebec; Canadian Industries Limited at Cutler and Copper Cliff, Ontario; Sherbrooke Metallurgical Company Limited at Port Maitland, Ontario, and Aluminum Company of Canada, Limited at Arvida, Quebec. Several other companies could recover large amounts of pyrites concentrate but, because of their location, have no markets for it.

Table 4

PRODUCERS OF PYRITE AND PYRRHOTITE CONCENTRATES

Company	Location	Products	Uses
The Consolidated Mining and Smelting Company of Canada Limited	Kimberley, B.C.	SO_2 iron ore	H_2SO_4 steel plant
The Anaconda Company (Canada) Ltd.	Britannia Beach, B.C.	pyrite concentrate	sale
The International Nickel Company of Canada, Limited	Copper Cliff, Ont.	SO_2 SO_2 iron ore	H_2SO_4 liquid SO_2 sale
Noranda Mines, Limited	Noranda, Que.	SO_2 iron ore pyrite concentrate	H_2SO_4 sale sale
Waite Amulet Mines, Limited**	Noranda, Que.	pyrite concentrate	sale
Quemont Mining Corporation, Limited*	Noranda, Que.	pyrite concentrate	sale
Normetal Mining Corporation, Limited*	Normetal, Que.	pyrite concentrate	sale

*These companies sell pyrite concentrate to consumers.
**Closed October 1962.

Smelter Gas

Sulphur dioxide gas recovered from smelter gases is cleaned and the concentrates are used to produce sulphuric acid and liquid sulphur dioxide. The main operations of this type are the smelters of COMINCO at Trail, B.C. and The International Nickel Company of Canada, Limited, (INCO) at Copper Cliff, Ontario. Similar recovery would be made at other smelting plants if markets for sulphuric acid were available.

Elemental Sulphur from Sulphides

Elemental sulphur is obtained by the electrolytic refining of nickel sulphide matte in the INCO refineries at Port Colborne, Ontario, and Thompson, Manitoba.

Using different processes, sulphur was recovered from pyrite by Noranda Mines, Limited, at Port Robinson, Ontario, from 1954-59, and from pyrrhotite by COMINCO at Kimberley from 1936-43.

Other Sulphur

The sulphur in nickel sulphide ore is converted into a sulphate by another process at the Fort Saskatchewan, Alberta, refinery of Sherritt Gordon Mines, Limited. An ammonia leach process is used to treat nickel-sulphide concentrates and byproduct ammonium sulphate is recovered. It is estimated that the equivalent of about 32,000 tons of sulphur are used in this process annually.

Sulphur from Oil Refineries

Many crude oils contain sulphur compounds which may be released as hydrogen sulphide gas during refining and recovered by the same processes that are used in gas-sulphur plants. Foreign crude oils refined in the Montreal area and near Saint John, New Brunswick supply hydrogen sulphide for sulphur production at the plants of Laurentide Chemicals & Sulphur Ltd. and Irving Refining Limited. Production from these two plants is estimated at 35,000 tons per year.

The Shell Oil Company of Canada, Limited, refinery under construction at Trafalgar, Ontario, is reported to include a unit to recover about 50 tons of sulphur per day.

Because North American crude oils normally contain only small amounts of sulphur, recovery from this source is not expected to be large in Canada.

Natural Gas Sulphur

Canada has become a major sulphur producer indirectly. Exploration for oil in western Canada gradually disclosed large reserves of natural gas, a proportion of which was "sour" (containing hydrogen sulphide). For many years the natural gas had little value because few markets were available in western Canada, and the potential large-scale distant markets in eastern Canada and the United States would require costly pipeline systems. Two conditions had to be satisfied before pipelines could be built to serve these markets. The first was ample reserves of gas to serve both domestic and export markets over a long period of time, and second, the assurance of long-term gas contracts. By 1960 both conditions had been satisfied. Markets for gas were large enough that sweet gas reserves were mainly committed, and large amounts of sour gas were required to fulfil the demands.

Before sour gas can be used as a fuel the hydrogen sulphide and other sulphur compounds in it must be removed. Large gas-cleaning plants were built to remove sulphur compounds, excess liquid petroleum gases and inert gases and to produce a fuel gas of definite specifications. Hydrogen sulphide is removed by passing the sour gas through a solution (usually monoethanolamine) which has an affinity for hydrogen sulphide. Concentrated hydrogen sulphide is stripped from the solution by distillation, the hydrogen sulphide going to the sulphur furnace and the regenerated solution being recirculated. The hydrogen sulphide is burned in a Claus furnace to produce a mist of sulphur droplets, which are condensed to liquid sulphur, and pumped to storage vats.

Two important facts are implicit in the production of sulphur from sour natural gas. First, the removal of hydrogen sulphide (H_2S) is obligatory if the gas is to be used as fuel; second, at least two products of value are recovered from the raw gas. This means that the cost of exploration, and production and treatment of raw gas may be shared by several products of which sulphur is only one. A low H_2S content in raw gas may be considered waste therefore sulphur derived from this material would be very low in cost because the raw material is free.

Reserves of sulphur in sour natural gas in western Canada at the end of 1962 are estimated to total more than 92 million short tons, and experienced engineers have suggested that three times this amount may eventually be found.

During 1962 seventeen gas-processing and sulphur-producing plants operated in western Canada. Output of sulphur totalled about 1,130,000 tons and shipments were more than 666,000 tons. For various reasons several of the plants, including some of the larger ones, operated much below capacity. Output during 1963 is expected to be considerably higher as operations are increased toward capacity.

Several other plants will probably be built to process gas from fields not yet producing but the building date of these future plants is uncertain. Existing plants have excess capacity at present. A plant may be in operation in the Wimborne field in late 1964 and others may be built in Crossfield East and Olds by 1964.

The accompanying map shows the location of the various sulphur producers and Table 5 lists operator, H_2S content of source gas and nominal capacity of the plant.

Table 5

SULPHUR PLANTS, WESTERN CANADA, 1962

Operating Company	Source field	Approximate percentage H_2S	Capacity in Short Tons: Daily	Capacity in Short Tons: Annual*
Producing plants (numbered on map and indicated by ●)				
1 Shell Oil Company of Canada, Limited	Jumping Pound, Alta.	4	110	38,000
2 Royalite Oil Company, Limited	Turner Valley, Alta.	4	33	11,500
3 Imperial Oil Limited	Redwater, Alta.	3	10	3,500
4 The British American Oil Company Limited	Pincher Creek, Alta.	10	755	264,000
5 Jefferson Lake Petrochemicals of Canada Ltd.	Taylor Flats, B.C.	3	330	115,000

Table 5 (cont'd)

Operating Company	Source field	Approximate percentage H_2S	Capacity in Short Tons Daily	Capacity in Short Tons Annual*
6 Steelman Gas Ltd.	Steelman, Sask. (not shown on map)	1	7	2,400
7 Texas Gulf Sulphur Company	Okotoks, Alta.	35	415	145,000
8 The British American Oil Company Limited	Nevis, Alta.	4-6	85	30,000
9 The California Standard Company	Nevis, Alta.	6	130	45,000
10 Canadian Oil Companies, Limited	Innisfail, Alta.	14	110	38,000
11 The British American Oil Company Limited	Rimbey, Alta.	2	280	98,000
12 Petrogas Processing Ltd.	East Calgary, Alta.	16	965	337,700
13 Home Oil Company Limited	Carstairs, Alta.	1	56	19,600
14 Western Leaseholds Ltd.	Wildcat Hills, Alta.	4	117	41,000
15 Jefferson Lake Petrochemicals of Canada Ltd.	Coleman, Alta.	14	420	147,000
16 Pan American Petroleum Corporation**	Windfall, Alta.	15-20	730	255,500
17 Shell Oil Company of Canada, Limited	Waterton, Alta.	22-27	1,550	542,500
Totals			6,103	2,133,700

Probable future plants (numbered on map and indicated by ○)

Operating Company	Source field	Approximate percentage H_2S	Daily	
1 The British American Oil Company Limited	Wimborne, Alta.	15	120	(1964?)
2 Same	Berland River, Alta.	15	280	
3 Same	Lookout Butte, Alta.	3	50	
4 The California Standard Company	Moose Mountain, Alta.	13	28	
5 Imperial Oil Limited	Waiparous Creek, Alta.	5	11	
6 Olds Gas Ltd.	Olds, Alta.	6	45	
7 Pan American Petroleum Corporation	Bigstone, Alta.	12	28	
8 Same	Crossfield East, Alta.	38	500	(1965?)
9 Shell Oil Company of Canada, Limited	Burnt Timber	6	45	

Table 5 (cont'd)

Operating Company	Source field	Approximate percentage H_2S	Capacity in Short Tons Daily	Capacity in Short Tons Annual*
10 Shell Oil Company of Canada, Limited	Panther River	87	425	
11 Same	Simonette	17	195	
12 Texas Gulf Sulphur Company	Hunter Valley	10	56	
13 Same	Wildhorse Creek	6	33	
Total			1,816	635,600
Cumulative total			7,919	2,769,300

Source: Oil and Gas Conservation Board of Alberta and others. *Calculated on the basis of 350 operating days a year. **Sulphur production owned by Texas Gulf Sulphur Company. Production will later increase to 1,800 tons per day.

Athabasca Oil Sand Sulphur

The occurrence of oil-bearing sand deposits along the Athabasca River in northern Alberta has been known since 1883 and their extent and nature was investigated by S.C. Ells of the Mines Branch fifty years ago. Although the sands contain extremely large quantities of oil and a small but significant content of sulphur, their location discouraged early attempts at development.

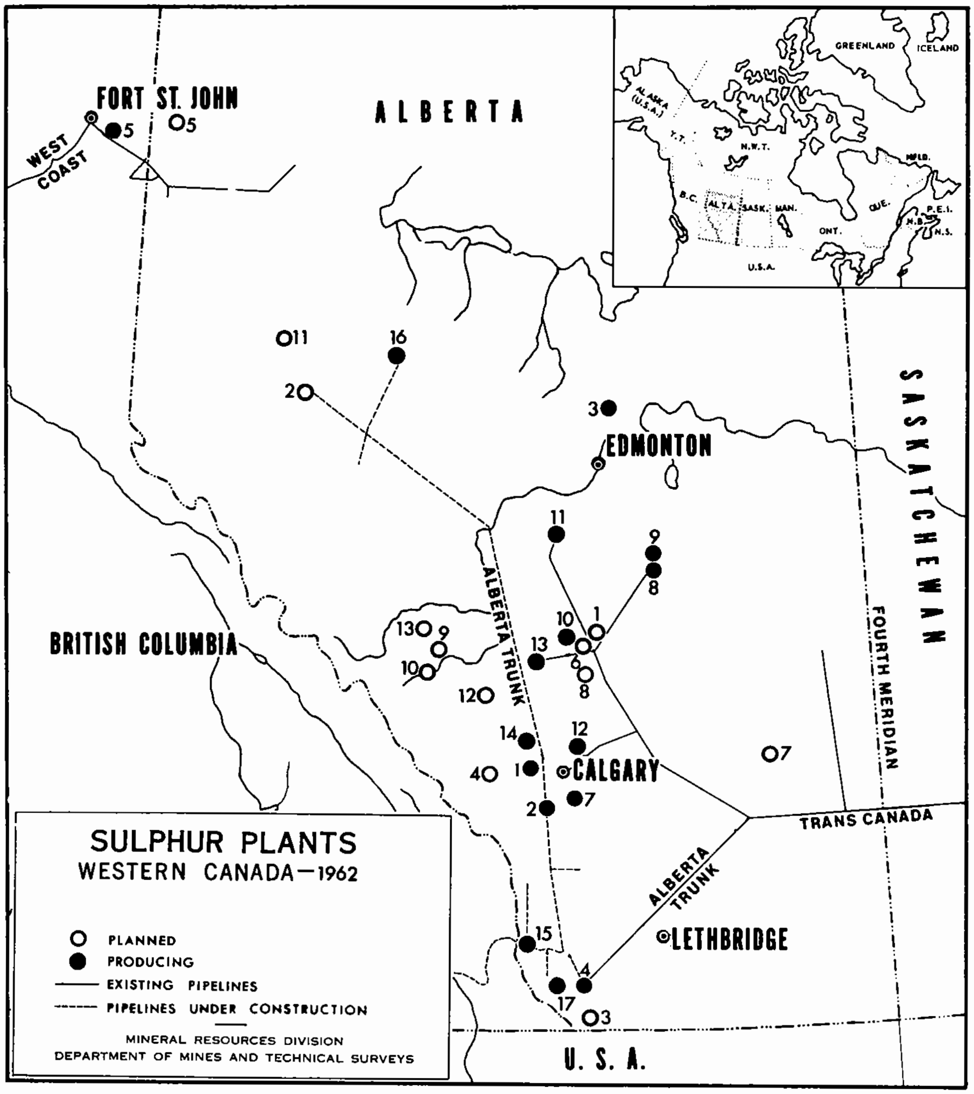
At present, however, interest in the oil potential of these deposits has revived and four proposals have been made to the government of Alberta regarding various methods of obtaining oil from them. If accepted the proposals would result in the production of 270,000 barrels of crude oil per day, and, since the sands contain 5 per cent of sulphur by weight, about 1,800 short tons of sulphur per day, or 600,000 tons per year.

Estimated oil reserves in the sands total more than 300 billion barrels and on this basis sulphur reserves would amount to about one billion tons. Large-scale production of oil from the sands would thus appear to reduce the danger of future sulphur shortages.

Sulphuric Acid

Sulphuric-acid production increased to 1,719,479 short tons in 1962. In spite of continued reduction in the amount of acid required for the treatment of uranium ores, production is almost back to the peak of 1,739,000 tons reached in 1959.

The Cutler acid plant operated by Noranda Mines, Limited, was sold to Canadian Industries Limited and is to be moved to Copper Cliff in order to expand production from that plant.



Successful shipments of sulphuric acid in plastic-lined paper bags have been made by Helmer Chemical Company Limited of Calgary. The acid is absorbed in Micro-Cel E, a synthetic silicate powder manufactured by Canadian Johns-Manville Company, Limited.

WORLD REVIEW AND OUTLOOK FOR CANADIAN SULPHUR

Total world production of sulphur in all forms in 1962 is estimated at about 27 million tons. Free World production increased 3.9 per cent to 22 million tons; Communist Bloc countries raised output some 10 per cent to 5 million tons. Sulphur is now in plentiful supply, in sharp contrast to the shortages of 1950-51, and with four countries capable of producing in excess of a million tons annually, prices have fallen to the lowest point in many years.

Table 6

SULPHURIC ACID - PRODUCTION, TRADE AND APPARENT CONSUMPTION
1953-62
(short tons of 100% acid)

	Production	Imports	Exports	Apparent Consumption
1953	822,608	70	47,889	774,789
1954	923,800	110	21,930	901,980
1955	950,277	151	29,578	920,850
1956	1,052,000	2,100	23,660	1,030,440
1957	1,290,000	1,046	29,550	1,261,496
1958	1,586,000	39,345	23,252	1,602,093
1959	1,739,000	18,489	27,863	1,729,626
1960	1,673,000r	9,526	43,430	1,639,096r
1961	1,614,000r	7,275	38,914	1,582,361r
1962	1,719,000p	7,162	34,960	1,691,202

Source: Dominion Bureau of Statistics. Symbols: p Preliminary; r Revised from previously published figure.

Table 7

AVAILABLE DATA ON CONSUMPTION OF SULPHURIC ACID,
BY INDUSTRIES, 1960 and 1961
(net tons of 100% acid)

	1960	1961
Iron and steel mills	48,149	55,100
Other iron and steel	12,440	13,000e
Electrical products	4,945	5,000e
Vegetable-oil mills	96	100
Sugar refineries	332	200
Leather tanneries	2,083	2,200
Textile dyeing and finishing plants	54	-
Pulp and paper mills	25,925	36,100
Processing of uranium ore	373,337	283,300
Manufacture of mixed fertilizers	101,821	114,600
Manufacture of plastics and synthetic resins	20,257	20,900
Manufacture of soaps and cleaning compounds	15,000	15,700
Other chemical industries	9,529	11,500
Manufacture of industrial chemicals(a)	833,890	833,400
Petroleum refining	16,931	13,800
Mining(b)	49,670	52,000
Miscellaneous(c)	60,026	96,300
Total accounted for	1,574,485	1,553,200

Source: Dominion Bureau of Statistics. (a)Includes consumption of 'own make' or 'captive' acid by firms classified to these industries. (b)Includes metal mines, nonmetal mines, mineral fuels and structural material. (c)Includes synthetic textiles, explosives ammunition and other petroleum and coal. e Estimate.

Table 8

ESTIMATED WORLD PRODUCTION OF SULPHUR IN ALL FORMS(a)
('000 short tons)

	1962					1961d
Country	Frasch	Other Solid Sulphur	In Pyrites	In Other(b) Forms	Total	Total
United States	5,583	1,054	414	490	7,567	8,031
U.S.S.R.	-	1,190	1,895	300	3,385	1,423
Japan	-	246	1,870	690	2,806	2,333
Canada	-	1,174c	265	286	1,725c	1,157
France	-	1,478	144	93	1,715	1,448
Mexico	1,512	73	-	-	1,585	1,363
Spain	-	47	1,140	41	1,228	1,158
Italy	-	61	797	117	975	1,029
China	-	269	605	-	874	861
West Germany	-	102	193	241	536	580
Cyprus	-	-	438	-	438	521
Norway	-	50	358	19	427	435
Poland	-	220	92	60	372	290
Portugal	-	7	318	-	325	340
East Germany	-	129	45	143	317	306
Other countries	-	311	817	1,402	2,530	4,340
Total	7,095	6,100	9,408	3,882	26,805	25,622

(a)Compiled from various sources (mainly U.S. Bureau of Mines and British Sulphur Corp. Ltd.). Because of rounding of figures and unavailable information the data do not add exactly to totals shown. (b)Sulphur in smelter gas, anhydrite-gypsum, spent oxide, hydrogen sulphide (other than elemental) and some smaller sources. Data is mainly 1961 production. (c)Total output rather than shipments. (d)From Sulphur, 1961, Dept. of Mines and Technical Surveys. Symbol: - Nil.

The increased competition among the various supplying countries has disrupted established trading patterns and has resulted in lower prices and new methods of handling and transporting sulphur. Some unusual sulphur movements have occurred, such as the shipment of French sulphur to Cuba and Alberta sulphur via Vancouver to Britain and the U.S.S.R.

The successful development of molten sulphur shipping in the United States, using large regional depots and rail, barge and ocean tankers, has resulted in higher efficiency and savings to both shippers and consumers. United States, Mexican and French producers are now building and planning similar terminals and operations in Europe. This method of handling and shipping sulphur is ideally suited to the United States and Mexican producers located on or near the coast of the Gulf of Mexico, and to the French gas-sulphur operations at Lacq, near the Atlantic port of Bayonne. These costly facilities are often financed by the sulphur producers under long-term supply contracts with major consumers. As a result producers obtain a captive market for their sulphur. Nonprice competition of this type cannot be used by the Canadian producers who must accept the cost of moving their sulphur long distances by rail to reach large markets, and additional handling charges if it is moved to overseas markets. Canadian sulphur producers had to choose between marketing in the limited area in which they could compete at traditional prices - accumulating tremendous stockpiles of sulphur - or, selling sulphur at lower prices. For reasons which follow there is no incentive to stockpile sulphur in hope of higher prices.

Another important but relatively unrecognized factor in the present situation is the impact of increasing amounts of elemental sulphur derived from oil refineries and similar operations. These producers are generally small and serve captive or local markets; none appear to supply significant amounts. However, they are producing sulphur on a world-wide basis and new plants are being built each year. It is estimated that in 1962 plants of this type reduced international trade in sulphur by at least 500,000 tons. The trend toward byproduct sulphur recovery at oil refineries will probably continue, notably in western Europe and in Japan, where oil consumption is rising rapidly.

In addition to these competitive factors, the Canadian sulphur industry is new, is composed of several groups in which sulphur varies from major to minor importance, and consists of companies that have had little or no previous experience with sulphur or the details of its international markets. Under such circumstances, with very large reserves in natural gas and oil sands, with low-cost coproduct and byproduct production, with sulphur in plentiful supply and markets being temporarily or permanently captured because of molten sulphur producer-consumer contracts, there is little likelihood that there will be any shortage of sulphur in the near future and consequently, little reason to expect appreciable increases in price. Canadian sulphur therefore must either be sold at low prices or accumulated in huge stockpiles.

Because of low production costs, Canadian producers can accept substantial land-freight charges and still sell sulphur competitively in many markets, and now occupy a strong position in the world-wide industry. The future outlook must therefore be considered to be very promising. If large amounts of sulphur can be sold in the next few years, producers, and Canada in general, will benefit through lower imports and substantial exports. If, for any reason, the major part of production cannot be marketed, large stockpiles will accumulate and will exert continued downward pressure on prices while encouraging the development of local industries to use it.

It is a well known and widely quoted fact that small changes in the price of sulphur do not restrict or expand its consumption. The major consumers, such as sulphuric-acid producers, require amounts determined by the demand for their product and purchase their needs with little regard for price. When pyrites were the only alternative source to Frasch-produced sulphur, an increase in sulphur prices tended to increase the use of pyrites, but with the many present sources and producers of high-quality elemental sulphur this does not apply. There is in fact good reason to believe that a stable lower price for sulphur will increase its consumption substantially. Expansion of the fertilizer industry - a pressing need in some of the developing countries - would consume vast amounts of sulphur. Acid leaching metallurgical processes for uranium, titanium dioxide, aluminum, nickel, fluorspar and other materials would become more attractive. Research underway suggests possible uses for sulphur in new chemical compounds, in the construction industry as insulation and, in some instances as a fuel.

The history of sulphur has been one of the steadily increasing demand for industrial needs highlighted by occasional surpluses and shortages, price fluctuations, new production techniques, such as the Frasch process, and the rise and fall of whole industries, such as that of the Sicilian sulphur operation. Sulphur is again in turmoil but demand is still growing and Canada now appears to be in a position to benefit.

PRICES

In the last quarter of 1962, the Canadian price of sulphur was quoted in Canadian Chemical Processing as follows:

Sulphur, elemental, carloads, works, ton	$17.00

United States prices per long ton quoted by the Oil, Paint and Drug Reporter of December 31, 1962 were as follows:

Crude, domestic, bright, bulk f.o.b. cars, mines	$23.50
Crude, export, f.o.b. vessels, Gulf ports	25.00
Crude, U.S. and Canada, f.o.b. Gulf ports	25.00
Domestic, dark	1.00 lower
Crude, imported, Mexican, bulk, filtered, f.o.b. vessel Coatzacoalcos	23.50
Pyrites, Canadian, 48-50% S, f.o.b. mines	4.50 - 5.00

TARIFFS

Canada

Sulphur, crude or in roll or flour form	free

United States

Sulphur in any form, sulphur ore such as pyrites or sulphide of iron in its natural state, and spent oxide of iron containing more than 25% of sulphur	free

Talc and Soapstone; Pyrophyllite

J. E. Reeves*

Production of talc and soapstone in Ontario and Quebec in 1962 was at a level similar to that of 1961. Production of pyrophyllite in Newfoundland declined slightly - the first decline since the present operation started.

Imports of ground talc increased by nearly 20 per cent. These consisted of several high-quality grades from the United States, the principal supplier, and especially high quality cosmetic and pharmaceutical talc from Italy and France. Average values were higher from all sources.

Export statistics on talc and soapstone are no longer available, but would presumably indicate no significant change from the last few years.

PRODUCERS

Quebec

Baker Talc Limited obtains talc and soapstone from the Van Reet mine near South Bolton, in southern Quebec. Lower-priced grades of ground talc are produced at the mill near Highwater, about ten miles south of the mine. Rough and sawn soapstone blocks are sold for sculpturing. An inclined shaft with a vertical depth of 120 feet was completed during 1962. This will make available ore from a deeper part of the deposits.

Broughton Soapstone & Quarry Company, Limited, mines talc and soapstone from separate deposits near Broughton Station, in the Eastern Townships. The talc is ground to produce several lower-priced grades of talc, and the soapstone is sawn into metalworkers' crayons, refractory blocks and blocks for sculpturing.

Ontario

Canada Talc Industries Limited mines talc and produces several lower-quality grades of ground talc at Madoc, in southeastern Ontario.

Newfoundland

Newfoundland Minerals Limited mines high-quality pyrophyllite from lenses near Manuels and ships it for processing and use to American Encaustic Tiling Company Inc., at Lansdale, Pennsylvania.

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*Mineral Processing Division, Mines Branch.

Table 1

PRODUCTION, TRADE AND CONSUMPTION

	1961		1962	
	Short Tons	$	Short Tons	$
PRODUCTION (shipments)				
Talc and soapstone				
Quebec(a)	16,274	178,911	15,285	154,086
Ontario(b)	7,417	107,660	8,082	127,912
Total	23,691	286,571	23,367	281,998
Pyrophyllite				
Newfoundland	24,425	404,059	22,794	343,210
IMPORTS, Talc				
United States	18,846	829,752	22,238	1,010,344
Italy	1,348	67,234	1,902	109,004
France	8	507	8	571
Britain	3	1,341	-	-
Total	20,205	898,834	24,148	1,119,919

	1960	1961	1962
CONSUMPTION, Ground Talc (available data)			
Paints and wall-joint sealing compounds	7,539	9,665	8,711
Roofing	7,656	7,519	7,641
Ceramic products	4,022	6,215	9,732
Paper	2,363	3,384	3,643
Rubber	2,157	2,460	1,532
Insecticides	2,552	2,007	2,116
Toilet preparations	1,639	1,446	1,560
Asphalt products	583	1,027	811
Gypsum products	922	892	831
Cleaning compounds	532	355	649
Pharmaceutical preparations ...	243	273	238
Leather products	20	20	17
Other products	228	425	496
Total	30,456	35,688	37,977

Source: Dominion Bureau of Statistics.
(a) Ground talc, soapstone blocks and crayons.
(b) Ground talc.
Symbol: - Nil.

Table 2

PRODUCTION AND TRADE, 1953-62

(short tons)

	Production*		Imports	Exports
	Talc and Soapstone	Pyrophyllite	Talc	Talc and Soapstone
1953	27,408	-	11,867	2,937
1954	28,134	9	12,392	3,609
1955	27,153	7	11,382	4,428
1956	27,947	1,379	16,268	2,613
1957	29,039	5,686	14,949	2,353
1958	27,951	7,454	16,593	1,931
1959	24,733	14,443	18,501	2,053
1960	21,411	20,225	19,153	1,660
1961	23,691	24,425	20,205	2,000e
1962	23,367	22,794	24,148	2,300e

Source: Dominion Bureau of Statistics.
*Producers' shipments.
Symbols: e Estimated, not available as a separate trade class after 1960;
- Nil.

TECHNOLOGY

Mineral talc is a hydrous magnesium silicate. It is soft, has a greasy feel or "slip", is flaky and grinds to a white powder. Chemically, it is relatively inert. It has a low moisture and oil absorption, a high fusion point and low electrical and thermal conductivity.

Many commercial talcs are mixtures of talc and certain other minerals. The deposits in southern Quebec were formed by the alteration of serpentinized peridotite, and contain - in addition to talc - unaltered serpentine, magnesite and iron-bearing minerals such as chlorite. These impurities cause the ground products to be somewhat off-white. Such products can be used where color specifications are not exacting; higher-quality products can be obtained by removing much of the impurity by some process of beneficiation. The Madoc deposits represent altered white dolomite and consist principally of talc, tremolite and dolomite in various proportions. Ground products are white and naturally low in iron but are limited in their use because of variable amounts of dolomite. Control of the dolomite content could result in widely acceptable high-quality products. Tremolite and similar fibrous minerals contribute properties desirable to varied applications of commercial talcs.

Soapstone is essentially a relatively impure talcose rock from which blocks and crayons can be readily sawn. The soapstone in southeastern Quebec was altered from serpentine rock and its gray color results from impurities.

Pyrophyllite is physically very similar to talc but is a hydrous aluminum silicate. It is an alteration product of siliceous rocks and is often accompanied by sericite and quartz. The color - near white - is generally acceptable to industry; however the impurities must be limited.

USES AND SPECIFICATIONS

Commercial talc is a versatile raw material that has numerous applications in industry, mostly as an industrial filler. Most of the talc used in Canada is consumed by about a dozen industries.

Higher-quality talc is used as an extender pigment in paints, a filler and coater in the manufacture of papers and an important raw material in the ceramic industry. Specifications for a talc pigment, as established in ASTM Designation D605-53T, relate to chemical limits, color, particle size, oil absorption and consistency of, and dispersion in, a talc-vehicle system. A low content of such minerals as the carbonates, a near-white color, a fine particle size with controlled distribution, and a high oil-absorption are important. However, because of the variety of paints and, therefore, of talc pigments, precise specifications are generally based on an agreement between consumer and supplier. Paper manufacturers require talc of high reflectance, high retention in the pulp, low abrasiveness and freedom from chemically active substances. The ceramic industry specifies fine particle size and freedom from impurities that would discolor the fired product. Talc of high purity is demanded for use in cosmetic and pharmaceutical preparations.

Lower-grade talc is used as a dusting agent for asphalt roofing and gypsum board; a filler in joint-sealing compounds for dry-wall construction, floor tile, asphalt pipeline enamels and auto-body patching compounds; a diluent for dry insecticides; and a filler and dusting agent in the manufacture of rubber products. Particle size is the main specification; color and impurity content are generally of little importance, although for asphalt pipeline enamels low carbonate is specified to avoid a reaction with soil acids.

Because of its unusual characteristics, talc has a number of minor applications, including its use in cleaning compounds, polishes, plastic products, foundry facings, adhesives, linoleum, textiles and oil-absorbent preparations.

Particle-size specifications for most uses require the talc to be basically minus 325 mesh. The paint industry demands from 99.8 to 100 per cent minus 325 mesh. For rubber, ceramics, insecticides and pipeline enamels, 95 per cent minus 325 mesh is usual. In the wall-tile industry 90 per cent minus 325 mesh is generally required. For roofing grades the specification is minus 40 mesh or minus 80 mesh and a maximum of 30 to 40 per cent minus 200 mesh.

Soapstone has now only a very limited use as a refractory brick or block, but, because of its resistance to heat and its softness, it is still used by metalworkers as marking crayons. Its softness and ability to be carved makes it an excellent artistic medium.

Pyrophyllite can be ground and used in much the same way as talc, but at present the use of the Canadian material is confined to ceramic tile. It must be basically minus 325 mesh and contain a minimum of quartz and sericite.

PRICES

Prices vary considerably according to quality. A product with a low impurity content, fine particle size and a high degree of whiteness will command a higher price. There are no published prices for Canadian products, but a range of United States prices of ground talc (from $10 to $15) is quoted periodically in E & M J Metal and Mineral Markets.

TARIFFS

Tariffs in effect at the time of writing include:

Canada	British Preferential	Most Favored Nation	General
Talc or soapstone	10%	15%	25%
Pyrophyllite	free	free	25%
Micronized talc	"	5%	25%

United States	
Talc, steatite or soapstone	
Crude and unground	0.08¢ per lb
Cut or sawed, or in blanks, crayons, cubes, disks or other forms	1/2¢ " "
Ground, powdered, pulverized or washed (except toilet preparations)	
Not more than $14 a ton	8 3/4%
More than $14 a ton	13 1/2%
Manufactures (except toilet preparations) of which talc, steatite or soapstone is the component material of chief value	
Not decorated	27%
Decorated	40 1/2%

Thorium

J. W. Griffith*

Canada began producing thorium raw materials in March 1959, when Rio Tinto Dow Limited** made trial shipments from Ontario's Elliot Lake district. Because the company's Elliot Lake plant is still Canada's sole producer of thorium salts, production statistics have not been released for publication. The plant, however, has a designed capacity for 150 to 200 tons of thorium compounds a year. Owing to a sharp drop in demand for thorium products in 1962, only small quantities of thorium oxide were produced at the company's Quirke plant and crude thorium cake was produced at the Nordic plant at a minimum economic operating rate.

The thorium produced by Rio Tinto Dow is used in magnesium alloys and gas mantles and as a fuel in nuclear reactors. Both the reactor at Indian Point, New York, owned by Consolidated Edison Co. of New York, Inc., and the one at Elk River, Minnesota, a joint project of the United States Atomic Energy Commission and the Rural Cooperative Power Association, use thorium fuel from Canada.

In 1958, both Faraday Uranium Mines Limited and Bicroft Uranium Mines Limited conducted experiments in the production of thorium from the uranium residues obtained at their plants near Bancroft, Ontario. For four months of the same year, the latter company operated a small-scale solvent-extraction pilot plant. The experiments were successful, but market conditions did not warrant full-scale production.

Dominion Magnesium Limited, at Haley, Ontario, manufactures three thorium products - sintered pellets of pure thorium, thorium powder and a thorium-magnesium master alloy (40% Th). The company receives thorium concentrates from Rio Tinto Dow Limited and ships the finished products to the United States.

Thorium is widely distributed throughout the earth's crust. It has an atomic weight of 232.14, an atomic number of 90, a density of 11.5 and a melting point of 1,800° C. It is a soft, lustrous, greyish-white metal which oxidizes readily; this dark oxide coating on its surface thus protects it against further attack. Thorium is found in more than 60 minerals, some of the most important of which are monazite, thorianite, thorite, uranothorite and thorogummite. Although monazite is the principal ore mineral of thorium, the latter is not an essential constituent of monazite. The principal thorium minerals in Canada are monazite, thorite, uranothorite, allanite, and the niobate-tantalate family of minerals.

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*Mineral Resources Division.

**Rio Tinto Dow was formed by The Rio Tinto Mining Company of Canada Limited and Dow Chemical of Canada, Limited.

SOURCES OF THORIUM

The principal sources of thorium in Canada are the uranium ores of the Elliot Lake district, which are estimated to average 0.06 per cent thorium dioxide (ThO_2). The thorium is carried in the minerals monazite, uraninite and brannerite. The ores that are now being mined near Bancroft for uranium are estimated to carry from 0.02 to 0.2 per cent ThO_2, but there has been less sampling for thorium than at Elliot Lake. Certain Bancroft deposits that are not being mined for uranium apparently carry considerably more thorium than do the uranium ores. The uranium ore reserves of the Elliot Lake and Bancroft areas are estimated to contain 180,000 tons of thorium. At the 1961 rate of uranium production in these camps it would be possible to recover 4,000 tons of thorium oxide a year as a byproduct.

OCCURRENCES IN CANADA

Pegmatitic and granitic occurrences containing uranothorite, monazite, thorite, allanite, and other radioactive minerals are found in many parts of Canada: some of which are the uranium-bearing pegmatites in the Haliburton-Bancroft area of southeastern Ontario; the pegmatites in the Pontiac-Gatineau region in Quebec; occurrences at Nisikkatch Lake, Gatzke Lake, Orbit Bay, Viking Lake, Laird Island on Tazin Lake, Charlot Lake, Grease Bay area, all in the Lake Athabasca region of northern Saskatchewan; Lac la Ronge occurrences in north-central Saskatchewan; Point du Bois area of Manitoba; and on Edgell Island off the southeast coast of Baffin Island.

Vein-type occurrences containing mostly monazite are found near Viking Lake, Gatzke Lake, Fond du Lac, Orbit Bay and on Laird Island (Tazin Lake), all in the Lake Athabasca region. They also occur in the Beaulieu River area, about 46 miles east of Yellowknife, Northwest Territories, and at Whitney Inlet, 35 miles northeast of Chesterfield Inlet on Hudson Bay. Vein-type occurrences containing monazite were also reported in central British Columbia, the Fort Chipewyan area of Alberta and in the Seal Lake area of Labrador.

Low-grade, thorium-bearing placer occurrences have been found at several locations: on the southwest shore of Yamba Lake, 200 miles northeast of Yellowknife, and in the McQuesten River monazite-bearing placers, in the Mayo District, Yukon Territory; in the Bugaboo Creek placers of the Purcell Mountains, B.C.; in the monazite-bearing placers of the Nation River, Omineca Mining District, B.C.; on Quesnel River, eight miles above the Fraser River junction, also in B.C.; and in placers containing monazite in Munro township, Ontario.

A fairly large, low-grade thorium-uranium deposit occurs in dolomite at McLean Bay, Stark Lake, near the east arm of Great Slave Lake, N.W.T. Fine-grained monazite and uraninite are dispersed fairly extensively throughout the dolomite. The thorium content was estimated at 0.025 per cent ThO_2.

Thorium is also found in metasomatic type of deposits at Atlin (Hussel-bee occurrence), B.C.; near the head of Moose Creek, just southeast of Yoho National Park, B.C.; in Baskatong and Huddersfield (Yates property) townships in Quebec; and in the niobium-bearing deposits at Oka, Quebec, which contain minor amounts of uranium and thorium.

Other quartz-pebble conglomerate type of occurrences are found in the Agnew Lake area of Ontario, midway between Sudbury and Blind River. The largest deposit is in Hyman Township. Reserves there are estimated at 750,000 tons ranging from 0.30 to 0.35 per cent ThO_2 and 0.095 per cent U_3O_8*.

EXTRACTION PROCESS

The Rio Tinto Dow thorium-recovery plant, near Elliot Lake, was constructed at a cost of one million dollars. The first operating unit was put up near the Quirke mine of Rio Algom Mines Limited. Early in 1961 the closing of the Quirke mine led to the construction of a second unit at Rio Algom's Nordic mill, although a part of the original facilities at Quirke was still being used for the production of thorium oxide refined from sludge produced and shipped by the new Nordic plant. If the thorium market improves, additional thorium-recovery units can readily be built to treat the waste solutions from other uranium mines of the Elliot Lake and Bancroft areas.

Thorium is obtained in dilute solution from the uranium-treatment plant. It is usually discarded in the mine-tailings dumps and is then not economically recoverable. The solution contains about a pound of thorium and about half a pound of rare earths to a thousand gallons. A relatively new process of solvent extraction** is used to extract and precipitate the thorium so as to separate it from iron, aluminum and the rare earths. The process, primarily chemical, requires large extraction tanks and tanks for stripping and thickening. The extraction tanks take the thorium from the barren uranium liquor; the stripping tanks remove the thorium from the solvent; and the thickeners precipitate thorium slurry. Wet thorium sludge is filtered on a rotary filter. Crude thorium sludge is scraped off in the final stage of drying and is gravity-fed to a packaging area. This 'cake' contains about 15 to 20 per cent thorium.

About 30 per cent of the cake is further refined to metallurgical-grade thorium oxide (99.8 + % ThO_2) at the Quirke plant. One hundred pounds of thorium oxide contain about 88 pounds of thorium.

The rare earths - ytterbium, thulium, erbium, europium, holmium, dysprosium, terbium, gadolinium, neodymium, praseodymium, lanthanum and particularly yttrium - are also contained in the Elliot Lake ores and could be recovered with thorium from the effluent of the uranium-treatment plants in the proportion of one pound to every three or four pounds of thorium.

USES

Apart from its use as an alloying constituent, thorium has few major industrial applications. Because of its great tensile strength at high temperatures, it is alloyed with magnesium for use in the skin components of supersonic aircraft and space vehicles. These alloys also go into castings such as

*Thomson, Jas. E.: Uranium and Thorium Deposits at the Base of the Huronian System in the District of Sudbury; Ont. Dept. of Mines Geological Report No. 1, 1960.

**Foreign plants use the sulphuric-acid process or that of caustic attack on monazite. Thorium products are then separated from the accompanying rare earths.

those in the compressor housings of jet engines. Thorium has been used for some time in incandescent gas mantles for gasoline lanterns, which are growing in popularity with campers. In atomic energy, thorium is one of the two naturally occurring source materials from which nuclear fuels may be generated. Over the past few years, experiments on the use of thorium as a fuel in 'breeder' reactors have been carried out in the United States and Britain.

A breeder reactor is one that converts a fertile material, such as thorium, into a fissile material which is capable of sustaining a chain reaction. In a breeder reactor it is theoretically possible to create more new fissionable material than is consumed. A number of technical obstacles, however, must be overcome if such a reactor is to become more attractive than the uranium-fuelled type.

Thorium has a number of special uses, for example, in arc-welding electrodes. It is used in the filaments of incandescent electric lamps along with tungsten and as a deoxidant in the production of such metals as molybdenum and molybdenum-rich alloys. It also is used in electron tubes and lamps for controlling starting voltages and maintaining stability, and as a catalyst in the chemical and petroleum industries. Because of its extremely high melting point, thorium oxide has been used as a refractory material and as an ingredient in special optical glass.

A large company in the United States recently introduced a new nickel product in which pure nickel is dispersion-hardened by the addition of from two to ten per cent ThO_2. This alloy is said to be more heat-resistant than the superalloys and not to lose its strength after exposure to extreme heat as they do. It is also said to be highly resistant to oxidation and corrosion and to have excellent thermal and electrical conductivity.

MARKETS, PRICES AND COSTS

Although the Canadian producer has captured a large share of the world thorium market formerly held by monazite sand producers, the thorium market is still small, and no rapid expansion of outlets can be foreseen for the near future. Most of the thorium produced in Canada is shipped to the United States and Britain in the form of concentrates. Canada is the major source of United States imports of thorium.

Metallurgical-grade thorium dioxide is priced at $5 a pound, and the fluoride (metallurgical-grade ThF_4) is $4.25 a pound as quoted by Rio Tinto Dow Limited. The prices of some thorium compounds were reported by J. G. Parker of the U.S. Bureau of Mines in <u>Engineering and Mining Journal</u>, February 1963, as follows:

	Per Cent ThO_2	Approximate Price per Pound (Dollars)
Compounds (10-49 lb lots)		
Carbonate	80	8.70 - 9.35
Chloride	50	7.70
Fluoride	79-80	6.60
Nitrate (mantle grade)	47	3.60
Oxide	98-99.9+	6.90 - 16.00

	Per Cent ThO_2	Approximate Price per Pound (Dollars)
Other forms		
Metal (nuclear grade)		19.55
Thorium hardener (for alloying)	20-40	12.50 - 15.00
Concentrates	20-30	1.75 - 2.25
Metal		
Ingot		
Less than 10 lb		54
100 to 500 lb		38
Over 2,000 lb		24
Powder or pellets		
Less than 10 lb		45-50
100 to 500 lb		34
Over 2,000 lb		20-22

TARIFFS

The Canadian tariff rates listed below were obtained from the Department of National Revenue, Customs and Excise Division. Those for the United States are from United States Import Duties (1962), a publication of the United States Tariff Commission.

Canada	British Preferential	Most Favored Nation	General
Thorium ores	free	free	free
Thorium isotopes	free	free	25%
Thorium dioxide	15%	20%	25%
Thorium bases or salts for the manufacture of incandescent gas mantles	free	free	free

United States	
Thorium metals and alloys	12 1/2%
Nitrates, oxides and other salts	35%
Monazite sand and other thorium ores	free

Tin

W. H. Jackson*

Canada's small output of tin is reported as the combined tin content of concentrates and of a primary lead-tin alloy derived from smelting. For 1962, production totalled 291 tons**; for 1961 it amounted to 500 tons. Imports of tin metal came to 2,274 tons, much lower than in 1961 and 1960 owing to sales from the Canadian stockpile. Consumption of virgin tin totalled 4,507 tons, the main increase being caused by tinplate demand. Tin stocks in the hands of consumers at December 31 amounted to 874. tons compared to 674 tons the previous year.

Tin production in Canada is derived from operations of The Consolidated Mining and Smelting Company of Canada Limited (COMINCO). Most is recovered from the tailings, amounting to 6,000 tons a day, from the zinc rougher-flotation circuit of the Sullivan concentrator at Kimberley, British Columbia. They grade 0.04 to 0.06 per cent tin; recovery is about 47 per cent in a concentrate containing 61 to 68 per cent tin. The remainder is in the form of a lead-tin alloy from the treatment of lead bullion dross in the indium circuit at the Trail smelter. COMINCO also makes in limited quantity Tadanac Brand high-purity tin (99.999 per cent) and Tadanac Brand special-research-grade tin (99.9999 per cent). The former contains two parts per million (ppm) lead and less than one ppm each of nickel, antimony and copper; the latter, zone-refined, contains 0.1 to 0.2 ppm each of lead and copper, with no other impurities detectable spectroscopically.

Mount Pleasant Mines Limited continued work on its prospect near Fredericton, New Brunswick. An adit was driven to intersect one mineralized zone. Underground diamond drilling was then undertaken to determine whether tonnages of commercial grade exist.

Sales commenced in May 1961 from the Canadian tin stockpile held by the Department of Defence Production. Disposals were made entirely within Canada and amounted to 904,000 pounds in 1961 and 4,137,000 pounds in 1962. The remaining 1,047,000 pounds were sold by the end of April 1963.

WORLD DEVELOPMENTS

The First International Tin Agreement was in force from July 1, 1956, to June 30, 1961. Controls on production and exports were in effect, from December 1957 to September 1960, to balance supply and demand. In addition, price movements were modified by means of a buffer stock operated by a manager appointed by the International Tin Council. Contributions to the buffer

*Mineral Resources Division.
**Long tons (2,240 pounds) used throughout.

Table 1

TIN - PRODUCTION, IMPORTS AND CONSUMPTION

	1961		1962	
	Long Tons	$	Long Tons	$
PRODUCTION				
Tin content of tin concentrates and lead-tin alloy produced	500	727,578	291	442,640
IMPORTS				
Blocks, pigs, bars				
Malaya	1,601	4,009,328	1,491	4,029,800
Belgium and Luxembourg	620	1,625,349	381	1,041,455
Britain	636	1,670,950	185	522,218
United States	414	968,777	167	467,977
Bolivia	126	293,904	50	142,258
West Germany	128	325,100	-	-
Total	3,525	8,893,408	2,274	6,203,708
Tinplate				
Britain	1,872	404,995	1,913	447,761
United States	1,208	186,894	1,799	310,330
Total	3,080	591,889	3,712	758,091
	Pounds		Pounds	
Tinfoil				
United States	26,445	36,971	13,633	18,567
Britain	175	145	-	-
Total	26,620	37,116	13,633	18,567
Babbitt metal				
United States	52,700	24,831	38,600	35,495
Britain	24,400	4,263	11,200	1,186
Total	77,100	29,094	49,800	36,681
	Long Tons		Long Tons	
CONSUMPTION				
Tinplate and tinning	2,108		2,461	
Solder	1,162		1,139	
Babbitt	299		191	
Bronze	234		207	
Galvanizing	7		7	
Other uses (incl. collapsible containers, foil, etc.)	143		502	
Total	3,953		4,507	

Source: Dominion Bureau of Statistics.

Table 2

TIN - PRODUCTION, IMPORTS AND CONSUMPTION, 1953-62

(long tons)

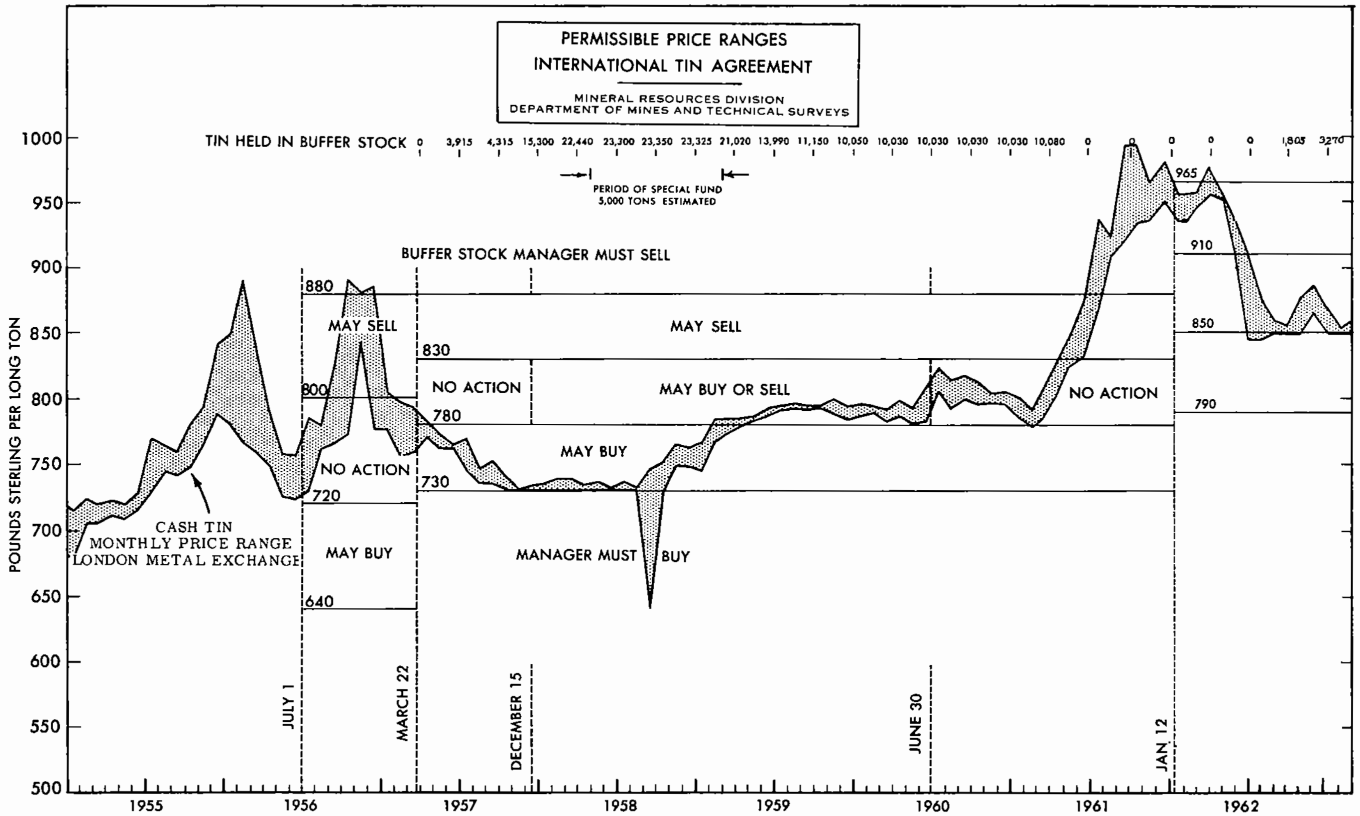
	Production	Imports				Consumption
	Tin Content	Blocks, Pigs, Bars	Tinfoil	Babbitt Metal	Tinplate	Virgin Tin
1953	287	3,702	7	22	6,442	3,903
1954	149	3,836	13	12	9,116	3,604
1955	220	4,318	15	19	9,915	4,019
1956	338	3,774	7	18	3,417	4,085
1957	317	4,155	7	17	4,884	3,622
1958	355	3,461	9	10	5,960	3,293
1959	334	4,183	8	29	4,977	4,223
1960	278	3,768	9	29	5,626	3,880
1961	500	3,525	12	34	3,080	3,953
1962	291	2,274	6	22	3,712	4,507

Source: Dominion Bureau of Statistics.

stock are obligatory for producer members. In June 1961 prices on the London Metal Exchange rose to the point at which the sales of buffer stock holdings became obligatory; the stock was exhausted by June 20, before the termination of the Agreement. The Second International Tin Agreement, drawn up for a five-year period, went into effect on July 1, 1961. In January 1962, the Tin Council agreed to raise the permissible ranges as shown on the accompanying price graph which illustrates the price movements of the last seven years and the ranges in which the buffer stock manager operates to modify price fluctuations.

A feature of commodity markets is that slight surpluses, real or imagined, can have a disproportionate downward effect on prices; the converse is also true. Some hold the view that the mere availability of tin from government stocks tends to permit consumers to work with lower inventories, thus affecting price response to supply changes.

In mid-1961, prices increased because of the close balance between supply-demand and because of the tightly held commercial stocks. A shortage appeared likely at the time. Between August 1961 and January 1962, the United States sold 3,900 tons of a special stock. Disposal was authorized in June 1962 of 50,000 tons from the national stockpile. It contained at that time 340,786 tons in the strategic stockpile and 7,505 tons in the supplemental stockpile or 188.3 per cent of estimated defense needs. Sales at a maximum rate of 200 tons weekly began on September 12, 1962. Italy and Canada also sold tin from government stockpiles in 1961 and 1962. Data on Free World metal supply and demand are listed in Table 3.



PERMISSIBLE PRICE RANGES
INTERNATIONAL TIN AGREEMENT
MINERAL RESOURCES DIVISION
DEPARTMENT OF MINES AND TECHNICAL SURVEYS
TIN HELD IN BUFFER STOCK
0 3,915 4,315 15,300 22,440 23,300 23,350 23,325 21,020 13,990 11,150 10,050 10,030 10,030 10,030 10,030 10,080 0 0 0 0 0 1,805 3270
PERIOD OF SPECIAL FUND
5,000 TONS ESTIMATED
BUFFER STOCK MANAGER MUST SELL
MAY SELL
NO ACTION
MAY BUY OR SELL
MAY BUY
MANAGER MUST BUY
880
830
800
780
730
720
640
965
910
850
790
CASH TIN
MONTHLY PRICE RANGE
LONDON METAL EXCHANGE
POUNDS STERLING PER LONG TON
1000
950
900
850
800
750
700
650
600
550
500
JULY 1
MARCH 22
DECEMBER 15
JUNE 30
JAN 12
1955
1956
1957
1958
1959
1960
1961
1962

Negotiations on an acceptable stockpile-disposal formula were a major concern of Tin Council in 1962. Whether supply-demand will be in balance for 1963 depends mainly upon the trade position of Eastern bloc countries, stockpile sales, the amount of secondary materials recycled by industry, and, upon demand.

Tables 4 and 5 indicate the relative importance of countries as producers of ore and metal. Smelter capacities are ample. Further increases in the supply of concentrate depend on the rehabilitation of tin mining industries in the Republic of the Congo, Bolivia and Indonesia.

Table 3

ESTIMATED FREE WORLD TIN POSITION

	1961	1962
Ore supply		
Production of tin in concentrates	137,000	143,400
Stocks at year-end	24,600	23,300
Metal supply		
Smelter production of tin metal	139,000	143,000
Net imports from Eastern bloc countries	5,268	236
Government stockpile sales		
Canada..................................	404	1,840
Italy....................................	660	660
United States		
Texas City stock	3,233	700
National stockpile	-	1,400
Buffer stock sales (+), purchases (-).......	10,030(+)	3,270(-)
Commercial stock at year-end..............	56,400	52,500
Commercial stock draw down...............	6,700	3,900
Metal consumption		
As reported by countries..................	158,000	157,000

Symbol: - Nil.

Table 4

ESTIMATED WORLD PRODUCTION OF TIN-IN-CONCENTRATES

(long tons)

	1961	1962
Federation of Malaya	56,028	58,603
China...	24,000	24,000
Bolivia	20,664	21,800
Indonesia	18,574	17,310
Thailand..	13,271	14,679
Republic of the Congo and Rwanda	8,044	8,637
Federation of Nigeria	7,779	8,210
Other countries*	13,640	14,761
Total...	162,000	168,000

Source: International Tin Council Statistical Bulletin.
*Russia not included.

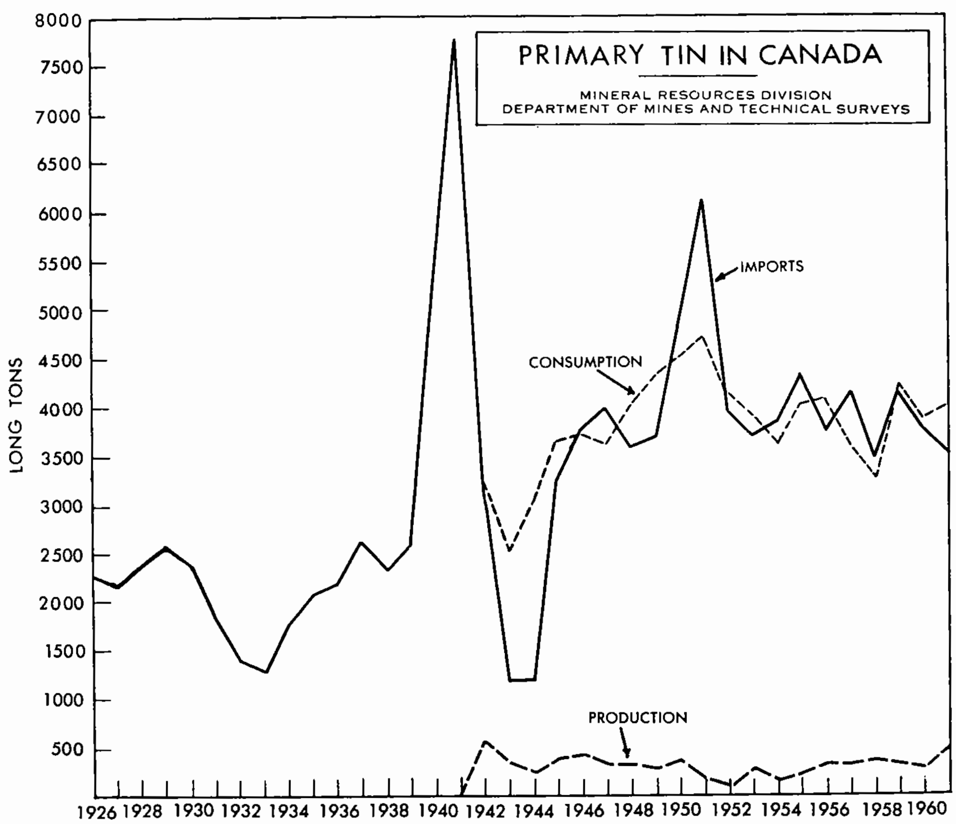


Table 5

ESTIMATED WORLD PRODUCTION OF PRIMARY TIN METAL

(long tons)

	1961	1962
Federation of Malaya and Singapore	79,114	82,073
China	24,000	24,000
Britain	24,449	18,749
Belgium	6,002	8,607
Nigeria	623	8,024
United States	8,500	5,500
Netherlands	2,729	4,282
Bolivia	2,016	2,024
Other countries*	20,567	10,741
Total	168,000	164,000

Source: International Tin Council Statistical Bulletin.
*Russia not included.

PRICES

The average value in cents (U.S.) per pound of tin traded on the three major exchanges was: Straits-ex-works, Malaya, 109.71; Cash, London, England, 112.06; Prompt, New York, U.S.A., 114.61. Allowing for differences occasioned by short-term supply of particular brands and trading operations such as hedging, each of these markets affects prices in the others and the difference is nominally one of transportation. The general relationship is that London is two cents higher than Malaya and New York four cents higher. In summer, a delivered price to Montreal is equivalent to New York allowing for currency exchange. In winter when the port is closed, a freight differential from Halifax or New York affects the price. To other destinations in Canada, freight would be extra. Small consumers purchasing from merchants who finance and hold stocks in inventory would pay more.

The Canadian price of Straits tin f.o.b. Montreal, was 133.80 cents a pound at the beginning of 1962. The high for the year was 137.46 cents, on March 19, the low 122.31 cents, on October 11. The year-end price was 124.21 cents a pound.

USES

In Canada most tin is used for tinplate and tinning, as shown in Table 1. Straits brand, or equivalent grade, is favored. Tinplate is made by electrolytically coating steel with tin and is used mainly in the manufacture of food containers. The tinning process is used to coat finished metal products, especially when they require a thick hygienic protective coating, and to coat copper wire.

Tin-lead solders are of three main types: dip solder, which contains 20 per cent tin, for making radiator cores and similar equipment; plumber's solder, which contains 30 to 35 per cent tin; and general-purpose solder. The last mentioned, when used to fill seams and join wires, contains 40 to 60 per cent tin; when it serves the electrical and electronics industries, the tin content is 59 to 65 per cent.

Bronze is a copper alloy containing three to 15 per cent tin. There are two main groups - the phosphor bronzes for machine parts, gears and bearings and the tin bronzes containing one to six per cent zinc for valves and fittings. Lead-tin bronzes possess improved machinability and bearing qualities.

The alloying elements for white metals are tin, antimony, lead, copper and bismuth. Modern pewterware contains 95 per cent tin, three to seven per cent antimony and one to two per cent copper. Britannia metal, which can be cast into intricate designs, contains 90 to 94 per cent tin. Type metal for linotype contains three to five per cent, and for foundry type 13 per cent. Fusible alloys melting at low temperatures are used for safety devices such as fire sprinkler systems and for pattern-making.

Babbitt alloys are used for bearings. The high-tin babbitts are 83 to 91 per cent tin, four to eight per cent copper and four to eight per cent antimony. Lead-base babbitts containing up to 12 per cent tin are not so widely used.

Tin is used as a minor constituent in dental amalgams, and with titanium, zirconium and other alloys. In research on the production of powerful magnets, most of the superconductors of electricity now in use are alloys of columbium or zirconium with tin. One major automobile manufacturer is alloying tin with cast iron for use in engine blocks.

Collapsible tubes of tin or tin-lead rather than aluminum are still employed where chemical inertness is required. Tinfoil is used in electrical condensers and as wrapping for some food products.

Organotin compounds are used mainly as stabilizers in vinyl plastics, as additives in toothpaste and as components of wood preservatives.

TARIFFS

Canada	British Preferential	Most Favored Nation	General
Tin in blocks, pigs, bars or granular form for use in Canadian manufacture ..	free	free	free
Tin-strip waste and tinfoil	free	free	free
Phosphor tin and phosphor bronze in blocks, bars, plates, sheets and wire ..	5%	7 1/2%	10%
Oxide of tin	free	15%	15%
Bichloride of tin and tin crystals	free	10%	10%
Sheet or strip of iron or steel, corrugated or not, and whether or not rolled with surface pattern, coated with tin....	10%	15%	25%
Sheet or strip of iron or steel coated with lead or with alloys of lead and tin	free	free	15%

Tariffs (cont'd.)

Canada (cont'd.)	British Preferential	Most Favored Nation	General
Manufactures of tinplate, painted, japanned, decorated or not, and manufactures of tin, not otherwise provided for	15%	20%	30%

United States	
Tin ore and black oxide of tin	free
Tin in bars, blocks and pigs, alloys of tin not specifically provided for, in which tin is the chief value; grain or granular scrap tin (including scrap tinplate).....................	free
Tinfoil less than 0.006 inch thick	35%
Powdered tin................................	10 1/2¢ per lb
Tinplate, taggers tin..........................	0.8¢ per lb
Terneplates.................................	1¢ per lb
Babbitt metal, type metal, solder	1 1/16¢ per lb on lead content
Chemical compounds and mixtures of tin	12 1/2%

Titanium

V.B. Schneider*

The value of titanium shipped in 1962 in ore, heavy aggregate and titanium-bearing slag was $11,573,862. Nearly all of this was accounted for by the sale of titanium dioxide which was $5,149,881 less than the high for Canadian production recorded in 1961. The reduction is accountable to the labor strike that closed the smelter at Sorel, Quebec, from August 28 to March 16, 1963.

The Canadian titanium industry is based mainly on the mining of ilmenite for the production of titanium-dioxide slag. To a minor degree ilmenite is also used as heavy aggregate and for the manufacture of ferrotitanium. It is mined in the Allard Lake and St. Urbain areas of Quebec. Most of the Allard Lake ilmenite is smelted at Sorel, Quebec, to produce slag containing 72 per cent titanium dioxide (TiO_2), a high-quality pig iron, and a complex calcium-magnesium-aluminum silicate used as a slag thinner in smelting. Much of the slag is exported, mainly to the United States, for use as a raw material in the manufacture of titanium-base pigments. Some is shipped to Canadian Titanium Pigments Limited, at Varennes, Quebec, and for the first time in 1962, to British Titan Products (Canada) Limited, at Ville-de-Tracy, Quebec.

The development of the TiO_2 pigment industry, which began in 1918, has been more rapid in the United States and Canada than elsewhere. By January 1963 installed capacity for these two countries was about 739,000 tons a year, whereas in other non-Communist countries capacity was 540,000 tons a year.

Ilmenite ($FeTiO_3$), rutile (TiO_2), and sphene ($CaTiSiO_5$), which is also called titanite, are the most abundant of the titanium minerals. Sphene, which contains 41 per cent TiO_2, is mined in the Kola Peninsula, U.S.S.R. Generally, only ilmenite and rutile are considered commercially important. The maximum titanium-dioxide content of ilmenite is theoretically 53 per cent; that of rutile is theoretically 100 per cent.

Most of the ilmenite mined is used for the manufacture of titanium-dioxide pigments. Pigment-grade titanium dioxide is made principally by treating ilmenite with sulphuric acid, removing the iron of the ilmenite in solution, and grinding the titanium component to pigment size. Ilmenite mined by Quebec Iron and Titanium Corporation (QIT) does not readily lend itself to this process because hematite is finely disseminated throughout the ilmenite and cannot be removed by standard ore-dressing methods. Thus, the amount of sulphuric acid consumed in iron removal would be excessive. At Sorel, a pyrometallurgical

*Mineral Resources Division.

Table 1

CANADIAN IMPORTS OF TITANIUM DIOXIDE, 1961 and 1962

	1961		1962	
	Short Tons	$	Short Tons	$
United States*	15,924	3,503,991	13,142	2,819,218
Britain	10,382	4,460,194	11,779	5,263,425
Japan	209	65,253	22	7,184
Czechoslovakia	103	36,324	-	-
The Netherlands	2	871	-	275
West Germany	1	226	-	-
Total	26,621	8,066,859	24,943	8,090,102

Source: Dominion Bureau of Statistics. *Includes extended pigments and TiO_2

Symbol: - Nil.

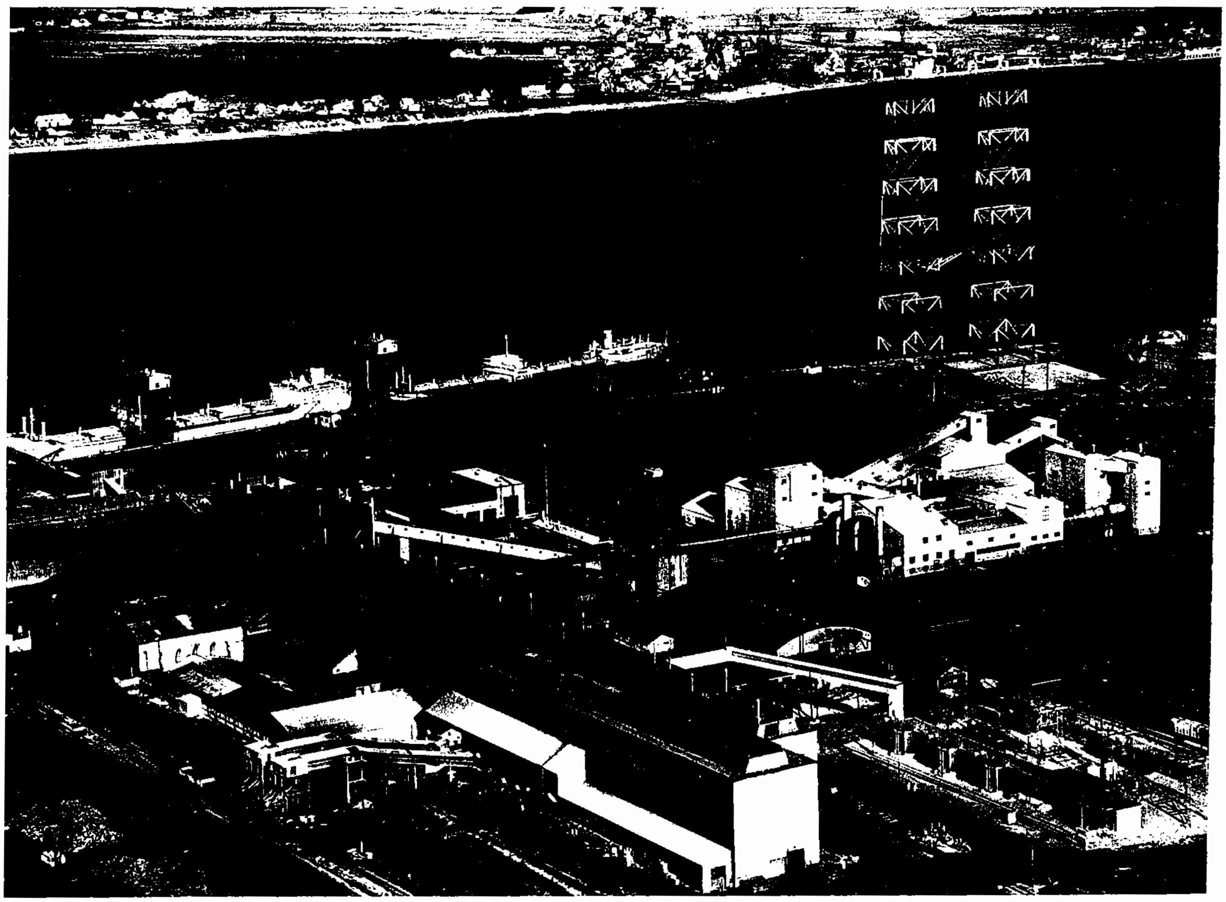
process is used to separate the iron as molten metal from the ilmenite and associated hematite. The high titania slag so produced is then converted to TiO_2 pigments but with a much reduced acid consumption.

Titanium dioxide owes its value as a pigment to its high refractive index. To take full advantage of this property the TiO_2 must be in powder form of extremely small uniform-sized particles. It is the high refractive index of TiO_2 pigment that accounts for its opacity. The amount of pigment required per unit area to block out, or obscure, a checkerboard surface is a measure of the relative opacifying power of pigments. In comparison with other white pigments, titanium dioxide has 10 to 12 times the opacifying power of white lead, six times that of zinc oxide or antimony oxide and four times that of lithopone.

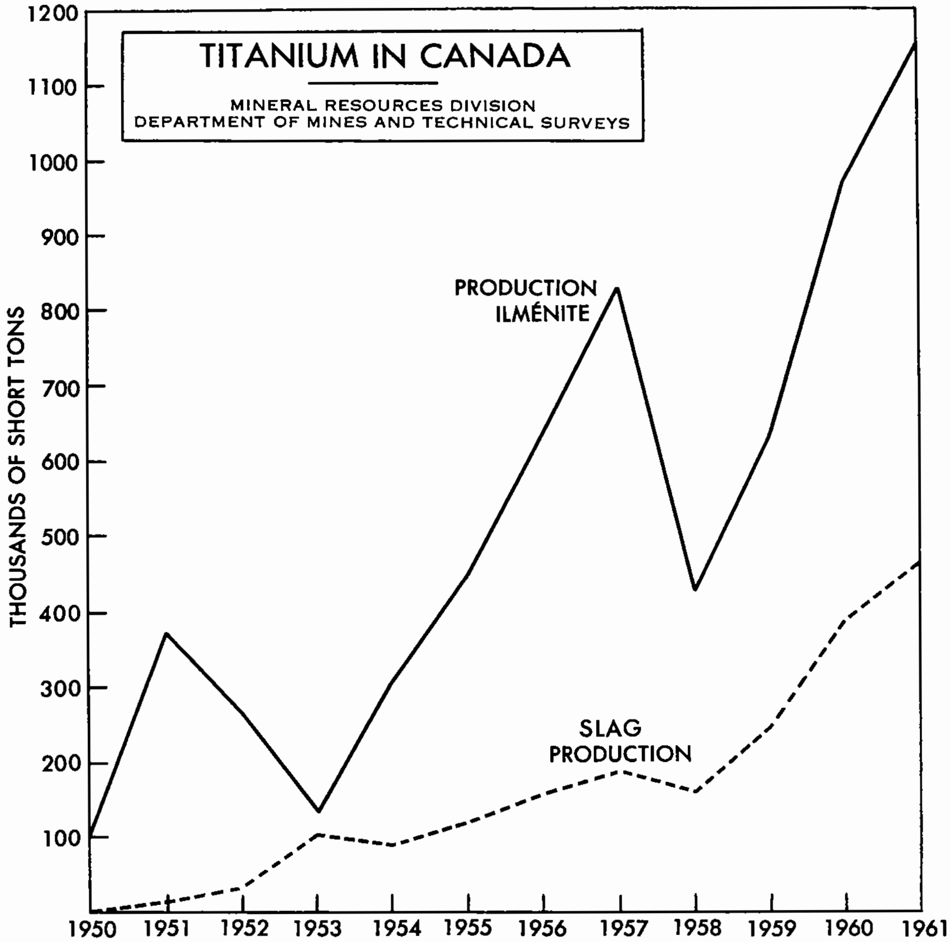
In addition to their superior opacity, titanium-dioxide pigments have a high degree of whiteness and brightness, enhance the durability of many media into which they are incorporated, and are chemically inactive and nontoxic. Because of this combination of properties titanium-dioxide pigments have largely replaced the materials formerly used as white pigments.

Heavy aggregate is used for shielding nuclear reactors, as a weighting material for oil- and gas-transmission lines and as diesel-locomotive ballast.

More than 75 per cent of the refined titanium dioxide and extended titanium-dioxide pigments consumed in Canada are used in the manufacture of paints, seven per cent in the manufacture of floor covering, three per cent in the manufacture of rubber and plastics, and 15 per cent in the manufacture of pulp, paper, oilcloth and miscellaneous products. An estimated 250 tons of ferrotitanium are used each year by Canada's primary iron and steel industry.



The Quebec Iron and Titanium Corporation plant at Ville-de-Tracy, Quebec on the St. Lawrence River. Ilmenite, stockpiled at the dock, is first treated in the concentrator plant on the right and then processed in the pyrometallurgical plant on the left. Finished products, pig iron and high titania slag, are loaded into railway cars shown in the left foreground.



PRODUCTION AND DEVELOPMENTS IN CANADA

Quebec Iron and Titanium Corporation (QIT)

This company, formed in 1948 with Kennecott Copper Corporation holding two-thirds interest and The New Jersey Zinc Company the remainder, operates eight electric-arc smelting furnaces, with an annual capacity of 1.1 million tons, at Sorel, Quebec.

Prior to treatment in the electric furnaces, the ilmenite is fed to the beneficiation plant where it is crushed and separated into two sizes - minus 5/16 inch to plus 20 mesh, and minus 20 mesh. Upgrading of the two fractions is accomplished in eight Dutch State Mine cyclones and 72 Humphrey spirals. The combined concentrates, containing about 37 per cent TiO_2 and 42 per cent Fe, are calcined in rotary kilns to lower the sulphur content. Electric smelting of the calcine, in arc furnaces with powdered anthracite coal, yields a slag containing about 70.5 per cent TiO_2 and 14 per cent FeO, and a low-phosphorus iron containing about 0.12 per cent sulphur and 2.25 per cent carbon.

Operations were maintained at capacity through August 28 when the Sorel treatment plant became strikebound; it was still closed at the end of the year.

Table 2

CANADIAN CONSUMPTION -
Refined Titanium Dioxide, Extended Titanium-Dioxide Pigments
and Ferrotitanium, 1960 and 1961
(pounds)

Refined titanium dioxide (TiO_2)	1960	1961
Industrial chemicals	14,285	46,457
Other chemicals	604,730	689,561
Linoleum and coated products	3,720,504	3,823,561
Paint and varnish	32,667,796	34,582,672
Pulp and paper mills	4,921,318	4,888,742
Rubber	1,532,501	1,869,110
Synthetic textile mills	91,850	64,650
Toilet preparations	28,605	48,937
Other nonmetallic minerals	1,235,340	1,143,366
Total	44,816,929	47,157,056
Extended titanium-dioxide pigments		
Paints (gross weight)	27,972,318	26,207,395
Estimated TiO_2 content	8,301,512	7,757,389
Ferrotitanium		
Primary iron and steel, Ti content	514,000	396,000

Source: Dominion Bureau of Statistics.

QIT owns one of the world's largest known reserves of ilmenite - 150 million tons of measured and indicated ore averaging 35 per cent TiO_2 and 40 per cent iron and many millions of tons of inferred ore. This ilmenite is intergrown with hematite in orebodies consisting of dikes, irregular lenses or sill-like bodies, lying within an anorthosite mass covering 134 acres. The largest orebody at Lac Tio contains estimated reserves in excess of 125 million tons of ilmenite. This reserve is in the Allard Lake area of Quebec about 22 miles north of Havre St. Pierre, about 500 miles downriver from Sorel.

Table 3

QIT PRODUCTION
(gross tons)

	1961	1962
Ore treated	1,032,122	665,851
Titanium slag produced	413,715	269,150
Iron produced	277,107	184,991

Source: Kennecott Copper Corporation's Annual Report for 1962.

Continental Titanium Corp.

Continental Titanium Corp., formerly Continental Iron & Titanium Mining Limited, owns mining rights in the St. Urbain area about eight miles north of Baie St. Paul, which is on the north shore of the St. Lawrence River 60 miles downriver from Quebec City. The company reports measured and indicated reserves of 12.5 million tons averaging 35 per cent iron and 37 per cent TiO_2, and inferred reserves of eight million tons. This company was formed in 1955. Since then it has been engaged in the mining of ilmenite for use as heavy aggregate and in the development of a continuous process designed to produce technical grade titanium dioxide. The process is one of high-temperature pressure-leaching with dilute sulphuric acid.

Canadian Titanium Pigments Limited

This company, a wholly-owned subsidiary of National Lead Company, of New York, continued full-time operations throughout 1962 of its titanium-dioxide pigment plant at Varennes, Quebec. The company manufactures anatase and rutile-type titanium-dioxide pigments. As in previous years, titanium-bearing slag from the QIT operation at Sorel, and molten sulphur, recovered by Laurentide Chemicals & Sulphur Ltd. from waste oil-refinery gases at Montreal East, continued as the two main raw materials. The liquid sulphur is used in the company's acid plant to produce sulphuric acid, which is used to digest the titania slag.

British Titan Products (Canada) Limited (BTP(C) Ltd.)

This wholly-owned subsidiary of British Titan Products Company Limited began the construction of a titanium-pigment manufacturing plant at Ville-de-Tracy, Quebec, in the latter half of 1960. It was completed and commissioned two years later. It is expected that the plant will reach its rated capacity of 22,000 tons a year early in 1963.

With a combined annual capacity of 94 million pounds of titanium-base pigments, the two Canadian pigment producers will be able to meet domestic requirements; furthermore, each plant is capable of ready expansion to meet any unexpected increase in domestic needs or export requirements. Canadian imports of titanium-based pigments have been in the range of 25,000 to 30,000 tons a year with the United States and Britain being the major suppliers, at about 15,000 tons and 10,000 tons respectively. It is certain that imports, particularly from Britain, will be sharply reduced now that the new plant at Ville-de-Tracy is completed.

FREE WORLD PRODUCTION OF TITANIUM ORES, CONCENTRATES, AND SLAGS

According to the U.S. Bureau of Mines Minerals Yearbook 1961, world production of titanium in 1961, in the form of ilmenite, rutile concentrates and titanium slag, amounted to about 2.45 million tons. This was an all-time high and preliminary reports and other indications point to a still greater production for 1962, probably 2.6 million tons.

Table 4

CANADIAN PRODUCTION -
Ilmenite and Titanium-Dioxide Slag, and Imports of
Titanium Oxide and Pigments, 1953-62
(short tons)

	Production		Imports
	Ilmenite(a)	Titanium-dioxide Slag (TiO_2 content)(b)	Titanium Oxide and Pigments(c)
1953	129,965	100,527	31,900
1954	304,550	88,408	32,106
1955	445,635	117,042	35,799
1956	630,197	157,374	37,872
1957	824,432	186,422	34,234
1958	420,932	161,312d	29,439
1959	626,310	234,670d	30,598
1960	967,373	386,639d	26,896
1961	1,155,977	463,316d	26,621
1962	745,753	301,448	24,943

Sources: Dominion Bureau of Statistics for production from 1952 to 1957 inclusive and for imports from 1953 to 1962; company annual reports for production from 1958 to 1962 inclusive. (a)Ilmenite shipped from Allard Lake to Sorel and from the St. Urbain area to customers. (b)Titanium-dioxide content of titanium slag produced at Sorel from Allard Lake ilmenite. (c) Containing not less than 14 per cent TiO_2. (d)Slag containing 70-72 per cent TiO_2.

United States production of ilmenite in 1962 was 807,725 tons and of rutile was 9,981 tons*; the combined tonnage is an all-time high. The United States is the largest consumer of ilmenite and rutile. It is also the largest producer of ilmenite but ranks far behind Australia in the production of rutile.

The indicated increase in the demand for rutile has been a boon to the producers. The Australian production, which has been about 100,000 tons annually, is expected to rise to over 200,000 tons a year in the next few years.

In 1961, E.I. du Pont de Nemours became the first company in the United States to produce TiO_2 pigment, at its plant at New Johnsonville, Tenn., from rutile using a chloride process. In 1962, Godfrey Cabot Corporation and American Potash and Chemical Corporation announced that they intended to produce TiO_2 pigment using rutile as the source material.

*U.S. Bureau of Mines, Titanium Preprint 1962.

Cabot's new plant in Ashtabula, Ohio, is expected to be on stream by mid-1963. Cabot has a license to use the process patented by the Société de Fabrique des Produits Chimiques de Thann et de Mulhouse, a member of the Pechiney group. The process is believed to be a flame chloride process similar to du Pont's.

American Potash & Chemical Corporation joined with Laporte Industries, Limited, of Britain to build a TiO_2 pigment-producing plant at Mojave, California. However, early in 1963, American potash bought out its partner's interest; the plant, which is expected to be on stream in 1963, will use a chloride process developed by Laporte Titanium, Limited, a division of Laporte Industries, Limited.

Table 5

PRODUCTION OF RUTILE CONCENTRATES
(short tons)

	1961	1962
Australia	113,600	133,283
United States	9,045	9,981
Republic of South Africa	3,483	3,575
Other countries*	2,472	4,061
Total*	128,600	150,900

Sources: U.S. Bureau of Mines, Titanium Preprint 1962.
*Estimate, excludes Russia.

Production of ilmenite in India, which amounted to 334,024 tons in 1959, has declined steadily to an estimated 200,000 tons in 1962; reports indicate that there will be further decreases in production and exports. The State Trading Corporation of India, the Kerala government and the Indian Atomic Energy Commission have been studying ways and means of making Kerala ilmenite more competitive.

Although still on a small scale, Brazilian production of beach sand minerals, including rutile and ilmenite, may be increased if du Pont do Brazil decides to exploit concessions along the coast from the mouth of the Paraiba River, in the state of Rio de Janeiro.

TITANIUM METAL PRODUCTION AND FABRICATION

Using technical-grade titanium-dioxide manufactured by Canadian Titanium Pigments Limited, Dominion Magnesium Limited, near Haley, Ontario, produced titanium in the form of sintered pellets weighing from five to seven grams each. The principal application for these pellets is for special fuses which are sold almost entirely in Britain. Shipments in 1962 amounted to 6,500 pounds.

Table 6

PRODUCTION OF ILMENITE CONCENTRATES
(short tons)

	1961	1962
United States	782,412	807,725
Canada*	463,361	301,448
India	191,800	152,100
Norway	342,723	330,000
Australia	187,459	204,000
Republic of South Africa	99,009	87,096
Others**	260,136	412,731
Total**	2,326,900	2,295,100

Source: Dominion Bureau of Statistics; U.S. Bureau of Mines, Titanium Preprint 1962. *Slag containing about 72 per cent TiO_2. **Estimate excludes U.S.S.R.

Table 7

NON-COMMUNIST WORLD TITANIUM-DIOXIDE
PRODUCING CAPACITY, 1962
(short tons of TiO_2)

	Location of Plant	Annual Capacity
North America		
Canada		
Canadian Titanium Pigments Limited	Varennes, Quebec	25,000
British Titan Products (Canada) Limited	Tracy, Quebec	22,000
Total Canada		47,000

Table 7 (cont'd)

	Location of Plant	Annual Capacity
Mexico		
Pigmentos y Productos Quimicos S.A. de C.V. (E.I. du Pont)	Vera Cruz	8,000
Industrias Quimicas Basicas de Mexica S.A., (in co-operation with Glidden Co.)	Vera Cruz	5,000*
United States		
E.I. du Pont de Nemours and Co., Inc.	Edgemoor, Del.	85,000
	Baltimore, Md.	55,000
	New Johnsonville, Tenn.	58,000
	Antioch, Calif.	35,000*
National Lead Co.	Sayreville, N.J.	167,000
	St. Louis, Mo.	108,000
The Glidden Co.	Baltimore, Md.	56,000
American Cyanamid Co.	Piney River, Va.	18,000
New Jersey Zinc Co.	Savannah, Ga.	72,000
	Gloucester City, N.J.	48,000
American Potash & Chemical Corp.	Mojave, Calif.	25,000
Cabot Corporation	Ashtabula, Ohio	40,000*
Stauffer Chemical Co. and Witco Chemical Co.	na	na
Total, United States (1962)		692,000
Total, North America (1962)		747,000
South America		
Argentina		
Titanit Compania Industrial de Pigmentos y Afines S.A.	Pilar (near Buenos Aires)	4,500
Brazil		
Compania Quimica Industrial C.I.L., S.A.	Engenheiro Trinidade, Sao Paulo	6,700
du Pont do Brasil S.A. Industrias Quimicas	Vitoria, Espirito Santos	5,600*
Compania Petroquimica Brasiliere Copre bras	Cubacto	na*
Total, South America (1962)		11,200

Table 7 (cont'd)

	Location of Plant	Annual Capacity
Europe		
Belgium		
Société Chimique des Derives du Titane (National Lead Co.)	Sas Van Ghent	11,000
Britain		
British Titan Products Company Limited	Grimsby, Lincs.	95,000
	Billingham, Durham	22,000
Laporte Titanium Ltd. (formerly National Titanium Pigments Ltd.)	Stallingborough, Lincs.	56,000
Total, Britain		173,000
Finland		
Vuorikemia Oy	Mantyluoto	18,000
France		
Societe de Fabrique des Produits Chimiques de Thann et de Mulhouse	Thann Haut Rhin	22,000
Les Produits du Titane, S.A. (jointly owned by Cie St. Gobain, Soc. de Thann et de Mulhouse and Pechiney)	Le Havre, Sein-Inf.	28,000
Total, France		50,000
West Germany		
Titangesellschaft GmbH (Farbenfabriken Bayer AG and National Lead Co.)	Leverkusen, Westfalen	56,000
Farbenfabriken Bayer AG	Verdingen, Westfalen	56,000
Pigment Chemie GmbH (Sachtleben AG and E.I. Du Pont de Nemours & Co.)	na	20,000*
Total, West Germany (1962)		112,000

Table 7 (cont'd)

	Location of Plant	Annual Capacity
Italy		
Montecatini Societa Generale per l-Industria Mineraria e Chimica	Spinetta Marengo	10,000
	Bovisa, Milano	10,000
Total, Italy		20,000
The Netherlands		
N.V. Titaandioxydefabriek (N.V. Billiton Maatschappij and Albatros Zqavelzuur Fabrieken N.V.)	Botlek, Rotterdam	11,000
Portugal		
Pigmentos de Titanium S.A. (Société Mineira de Sante Fe; Cie St. Gobain; and Société de Thann et de Mulhouse)	Cabo de Sinnes	6,700
Spain		
Union Quimica del Norte de Espana, S.A.	Bilbao	7,800
Chromogenia y Quimica S.A.	Barcelona	2,800
Total, Spain		10,600
Total, Europe, including Britain		412,300
Asia		
India		
Travancore Titanium Products Ltd. (owned partly by British Titan Products. Co. Ltd.)	Trivandrum Kerala	4,000
Botanium Ltd. (India Laporte Chemicals Ltd. and Nowrosejee Wadia & Sons Ltd.)	Bombay	4,500*
Japan		
Titan Kogyo Co., Ltd.	Ube, Yamaguchi Pref.	7,900
Teikoku Kako Company Ltd.	Saidaiji, Okayama Pref.	7,900
Furukawa Mining Co. Ltd.	Osaka, Osaka Pref.	7,900
Sakai Chemical Industry Co. Ltd.	Sakai, Osaka Pref.	11,000
Mitsui Metal Mining C., Ltd.	Tamano, Okayama Pref.	300
Ishihara Sangyo Kaisha, Ltd.	Yokkaichi, Mie Pref.	40,000

Table 7 (cont'd)

	Location of Plant	Annual Capacity
Japan (cont'd)		
Fuji Titanium Industry Co. Ltd.	Hiratsuka, Kanagawa Pref.	4,600
	Kobe, Hyogo Pref.	4,600
Total, Japan		84,000
Total, Asia (1962)		88,200
Republic of South Africa		
South African Titan Products Ltd. (African Explosives & Chemical Industries, Ltd. and British Titan Products Co. Ltd.)	Umbogintiwini, Natal	10,000
Australia		
Australian Titan Products Pty. Ltd. (British Titan Products Co. Ltd.)	Burnie, Tasmania	18,000
Laporte Titanium Ltd.	Bunbury, Western Australia	11,000*
Total, Australia (1962)		18,000
World Total (1962)		1,286,700

Sources: Data based on information from various sources including the U.S. Bureau of Mines, Minerals Yearbook 1960, and periodicals including: Metal Bulletin, July 16, 1962; Chemical Week, April 28, 1962; The Eastern Metals Review, January 5, 1962; and Australian Department of National Development, The Australian Mineral Industry, 1961. *Not yet in operation but planned for operation before 1965.
na Not available.

Atlas Titanium Limited, the special metals subsidiary of Atlas Steels Limited, continued to carry out second-stage melting of imported titanium ingots, process them to various mill products and sell them on Canadian and export markets. It also re-melted commercially pure titanium scrap in its 30-inch furnace for its own production of certain mill products. As in previous years, much of Atlas Titanium's production was material converted for its United States associate, Reactive Metals, Inc. This includes both second-stage melting of ingots in addition to the processing of mill products.

Of particular interest during the year was Atlas' development of a line of titanium baskets for use in electrolytic plating, particularly in nickel plating. In January 1963 Atlas acquired a fabricating subsidiary that will manufacture the baskets.

Commercial producers of titanium metal in the United States are: Union Carbide Metals Company, Ashtabula,Ohio; E.I. du Pont de Nemours and Co., Inc., Newport, Delaware; Reactive Metals Inc., Ashtabula, Ohio; and Titanium Metals Corporation of America, Henderson, Nevada. Metal Producers in Japan are: Osaka Titanium Manufacturing Co., Osaka; Toho Titanium Industry Co., Tokyo, and Nippon Soda Co., Ltd., Tokyo. In Britain, Imperial Chemical Industries Limited, Birmingham, is the principal producer. There is no available information about the titanium industry in the U.S.S.R.

In 1962 sponge-metal production and consumption in the United States increased for the fourth successive year. According to the United States Bureau of Mines, sponge production was 6,730 tons, up three tons from 1961; sponge consumption was 9,773 tons, up 95 tons. What is probably more encouraging to the titanium industry was the substantial increase in the production of such mill products as: sheet, plate and strip; forgings and extrusion billets; rod, bar and wire; and ingot output.

PRICES

The quotations which follow are from E & M J Metal and Mineral Markets, December 31, 1962.

	Dollars
Ilmenite, per gross ton, f.o.b. cars, Atlantic ports	
59 1/2% TiO_2	23.00 - 26.00
54% TiO_2	21.00 - 21.50
Rutile, per short ton delivered within 12 months,	
94% TiO_2	102.00
Titanium metal, 500 lb lots, 120 Brinell, 99.3% max	
per lb f.o.b. shipping point	1.32
Ferrotitanium	
Per lb contained Ti, lots of ton or more, lump (1/2"+),	
packed, delivered northeastern U.S.	
40% Ti max., 0.1% C max.	1.35
25% Ti max., 0.1% C max.	1.50
Per net ton, carload lots, lump, packed, delivered	
northeastern U.S.	
17-21% Ti, 3-5% C	375.00
15-19% Ti, 6-8% C	310.00

TARIFFS

Canada	British Preferential	Most Favored Nation	General
Titanium ore	free	free	free
Titanium oxide, and white pigments, containing not less than 14% TiO_2 by weight	free	12 1/2%	15%
Sponge and sponge briquettes, ingots, blooms, slabs, billets of titanium, or titanium alloys for use in Canadian manufactures (expires June 30, 1964)	free	free	25%

Tariffs (cont'd)

United States

Titanium ore, crude	free
Titanium metal	20%
Ferrotitanium	11%
Titanium potassium oxalate and all compounds and mixtures containing titanium	15%

Tungsten

V.B. Schneider*

Canada has not produced tungsten commercially since July 1958 when Canadian Exploration, Limited, closed its tungsten operations at Salmo, British Columbia. The operations were terminated on completion of a sales contract with the United States General Services Administration. The company still holds a stockpile containing approximately 37,000 short-ton units (20 lb) of tungsten trioxide (WO_3).

Canada Tungsten Mining Corporation Limited continued development of its Northwest Territories mining property. Concentrates produced by the company at its property, which is just east of the Yukon-Northwest Territories boundary and 135 miles north of Watson Lake, amounted to some 6,379 short-ton units of WO_3. Shipments amounting to 3,580 pounds of WO_3 were made to the tungsten-consuming industry for market testing. Under an arrangement entered into in 1961 by American Metal Climax, Inc., Dome Mines Limited and Ventures Limited it was decided to bring the property into production in 1962 and eventually mine by open-pit methods at the rate of 100,000 tons a year. Construction of the 300-ton-a-day concentration plant was completed by the end of October and ore, which had been mined earlier and stockpiled, was processed during the winter. No additional exploration work was performed on the property during the year; earlier diamond drilling had indicated ore reserves of 1.2 million tons grading 2.47 per cent WO_3.

The two principal minerals of tungsten are scheelite ($CaWO_4$) and wolframite (Fe, Mn) WO_4. Scheelite is found in association with gold-quartz veins at many active and long-dormant gold mines in Nova Scotia, Quebec, Ontario, Manitoba, British Columbia and the Northwest Territories. At present, these occurrences are not of economic significance, though byproduct scheelite was recovered from gold-mining operations during World War II and the Korean War. Wolframite has been found in stream gravels and in quartz veins in the Atlin area of northern British Columbia and the Yukon Territory.

Imports of tungsten ore in 1962 were about 2.8 million pounds, an all-time high; however, as the tungsten content of ore imports has never been reported, it is not possible to compare tungsten imports although some of the past year's ore imports were low-grade. Domestic consumption at about 1.3 million pounds of contained tungsten (W) was at an all-time high. Imports of ferrotungsten at 285,600 pounds were at their lowest since 1958.

*Mineral Resources Division.

Table 1

TUNGSTEN - IMPORTS AND CONSUMPTION, 1961 and 1962

	1961		1962	
	Pounds	$	Pounds	$
IMPORTS				
Scheelite*				
Argentina	55,100	29,095	2,316,600	613,874
Bolivia	91,600	48,338	191,900	75,432
Peru	-	-	132,800	60,403
Korea	50,000	42,088	80,000	31,239
United States	250,000	247,775	60,000	37,315
China (Communist)...........	-	-	51,000	31,050
Portugal	-	-	22,000	9,084
Brazil	55,100	36,031	-	-
Total	501,800	403,327	2,854,300	858,397
Ferrotungsten**				
Britain	445,400	217,796	235,100	108,893
United States................	1,900	3,401	26,000	36,237
France	-	-	18,500	13,825
Belgium and Luxembourg......	58,300	62,037	6,000	6,894
Austria	6,600	6,836	-	-
Portugal	6,100	7,346	-	-
Total	518,300	297,416	285,600	165,849
CONSUMPTION (W content)				
Scheelite	641,368		1,111,264	
Tungsten metal and metal powder	19,595		18,908	
Tungsten wire	8,482		11,694	
Ferrotungsten	80,567		85,617	
Tungsten-carbide power........	78,854		120,628	
Sodium tungstate and tungstic oxide	14,362			
Total	843,228		1,348,111	

Source: Dominion Bureau of Statistics.
* As reported in Trade of Canada; WO_3 content is not given.
** As reported in Trade of Canada; W content is not given.
Symbol: - Nil.

Table 2

TUNGSTEN - PRODUCTION, TRADE AND CONSUMPTION, 1953-62
(pounds)

	Production(a)	Imports(b)		Exports(c) Scheelite	Consumption(d)
	(WO_3 content)	Tungsten Ore	Ferrotungsten	(W content)	(W content)
1953	2,446,028	254,100	62,000	1,236,000	259,100
1954	2,170,633	7,200	85,900	1,239,187	170,980
1955	1,942,770	91,800	114,200	1,711,497	282,678
1956	2,271,437	123,800	205,500	1,763,793	284,318
1957	1,921,483	230,700	170,200	1,524,851	277,972
1958	690,976	884,100	199,000	477,079	316,738
1959	-	840,000	828,600	-	659,991
1960	-	1,156,900	980,700	-	947,222
1961	-	501,800	518,300	-	843,228
1962	3,580	2,854,300	285,600	-	1,348,111

Source: Dominion Bureau of Statistics.
(a) Producers' shipments of Scheelite.
(b) As reported in Trade of Canada. Tungsten content is not available.
(c) Export shipments as reported by producers.
(d) Scheelite, ferrotungsten and other tungsten products reported by consumers. From 1959 on, surveys covered a larger number of consumers.
Symbol: - Nil.

WORLD PRODUCTION, TRADE AND USES

Trade reports vary in their estimates of production of tungsten in 1962 outside the Communist-bloc countries. According to the United States Bureau of Mines*, this production in 1961 was about 16,600 tons of contained W; Communist-bloc production remained the same in 1962 as in 1961 at 18,373 tons of W. Production cutbacks in many non-Communist tungsten producing areas and increased imports of concentrates into consumer countries from Communist sources resulted in marked changes in the world supply pattern. If this supply trend continues, production of tungsten in the non-Communist world will be greatly reduced. The increased amounts of material being offered for sale resulted in a decline in the quoted price for foreign tungsten concentrates on the New York market to $8.50 a short-ton unit in 1962, the lowest price since 1938.

According to the United States Bureau of Mines*, inventories of tungsten in concentrates in government owned stockpiles amounted to 204,530,000 pounds as of May 30, 1962. This was 323 per cent of the maximum objective and indications that the surplus may be liquidated aggravated the effects of increased exports from Communist countries.

*U.S. Bureau of Mines, Mineral Industry Surveys, Tungsten in 1962.

The United States is the leading consumer of tungsten and until recent years was undoubtedly the predominant importer of concentrates. Consumption of tungsten in the United States increased from 9.8 million pounds in 1959 to 13.7 million pounds in 1962; in the same period imports of tungsten in concentrates decreased from 5.4 million pounds to 4.0 million pounds. Increased domestic production supplied the difference and at the same time increased producers' stocks from 3.7 to 5.3 million pounds. The principal United States mines producing in 1962 were: the Pine Creek mine of Union Carbide Nuclear Company, near Bishop, California; the Climax mine of American Metal Climax, Inc., at Climax, Colorado; the Hamm mine of Tungsten Mining Corporation, in Vance County, North Carolina. In addition 15 small mines reported production.

Other producing countries in 1962 included Australia, Bolivia, North Korea, Republic of Korea, Portugal and Peru.

Table 3

WORLD PRODUCTION OF TUNGSTEN ORE AND CONCENTRATES BY COUNTRIES

(short tons, 60% WO_3 basis)

	1961	1962
China (e)	22,000	22,000
U.S.S.R. (e)	11,000	11,600
United States*	8,245	8,429
Republic of Korea	7,529	7,628
North Korea (e)	5,500	5,500
Bolivia**	3,104	2,798
Portugal	3,213	2,364
Australia	2,866	1,940
Argentina	830e	1,800**
Japan	1,033	1,056
Other (e)	8,480	5,985
Total	73,800	71,100

Source: U.S Bureau of Mines, Mineral Industry Surveys, Tungsten in 1962.

*Shipments

**Exports

eEstimate.

CONSUMPTION AND USES

The use of cemented tungsten carbide has increased greatly during the last 15 years through improvements in the technology of tungsten-carbide manufacture. Tungsten in tungsten-carbide tools does much more work in metal-cutting operations than is possible with steel tools containing the same amount of tungsten. This has changed the end-use pattern of tungsten. About 15 years ago, 90 per cent of the tungsten consumed went into the manufacture of ferrous alloys and five per cent into the manufacture of tungsten carbides. In 1962, in the United States, 46 per cent of all tungsten consumed was used in the manufacture of tungsten carbides, 23 per cent in ferrous alloys, 19 per cent as tungsten metal, 11 per cent in high temperature and other nonferrous alloys, and one per cent in chemicals.

Table 4

CONSUMPTION OF TUNGSTEN IN CANADA BY USE, IN 1962
(lb of contained W)

Carbides	1,013,062
Electric and electronics	12,931
Nonferrous alloys	16,959
Iron and steel	290,290
Pigments	14,049
Ceramics	820
Total	1,348,111

Source: Compiled in Mineral Resources Division from data supplied by the Dominion Bureau of Statistics.

Tungsten carbide is used for tipping such tools as milling cutters, reamers, punches and drills; as dies for wire- and tube-drawing; in such water-resistant parts as gauges, valve seats and valve guides; and as cores in armor-piercing shells.

In the nonferrous or superalloy field, tungsten is alloyed with cobalt, chromium, nickel, molybdenum, titanium and columbium in varying amounts to produce a series of hard-facing, heat- and corrosion-resistant alloys. The high-temperature alloys are used mainly in turbojet engines for such parts as nozzle guide vanes, turbine blades, combustion-chamber liners and tail cones. They are also used in heat exchangers, boiler superheaters and boiler superchargers. Stellite, a nonferrous alloy containing from five 5 to 20 per cent tungsten with chromium and cobalt, is used in the production of welding rods for hard facing and in making high-speed tools.

The metal is used in ignition and other contact points in the automotive industry. It is also used for incandescent lamp filament and in making certain types of bronze.

The following are leading consumers of tungsten in Ontario: Atlas Steels Company, a Division of Rio Algom Mines Limited, Welland; Canadian General Electric Company Limited, A.C. Wickman Limited, Johnson Matthey & Mallory Limited and J.K. Smit & Sons of Canada Limited, all of Toronto; Canadian Westinghouse Company Limited, Hamilton; Dominion Colour Corporation Limited, New Toronto; Deloro Smelting & Refining Company, Limited, Belleville; and Wheel Trueing Tool Company of Canada Limited, Windsor. The principal consumer in Quebec is Crucible Steel of Canada Ltd., Sorel. In British Columbia, Kennametal of Canada, Limited, Victoria; Boyles Bros. Drilling Company, Ltd., Vancouver; and the Macro Division of Kennametal Inc., Port Coquitlam, use tungsten. Atlas Steels is Canada's leading consumer of tungsten in scheelite and ferrotungsten.

Macro Division of Kennametal Inc. is the only manufacturer of tungsten-carbide powder in Canada. Besides tungsten carbide, the company manufactures high-purity tungsten-trioxide powder, tungsten-metal powder and tungsten-titanium carbide. It makes such other products as tungsten-carbide ball-mill balls and 'Kenspray', a composition of tungsten-carbide particles bonded with a suitable matrix powder ready for application by conventional thermal spraying techniques. In 1962 vacuum furnaces were installed for the conversion of Macro hard-carbide powders into cemented carbide tool components. As raw material, the company uses wolframite, hubnerite and scheelite concentrates.

PRICES

According to E & M J Metal and Mineral Markets of December 31, 1962, tungsten prices in the United States were:

	Dollars
Tungsten ore, per short-ton (20-lb) unit WO_3, basis 65%, foreign, c.i.f. U.S. ports, import duty extra	
Wolfram	8.50 to 9.00
Scheelite	8.50 to 9.00
Tungsten metal, per lb	
98.8% min., 1,000-lb lots	2.75
Hydrogen reduced 99.99%	2.70 to 3.55
Ferrotungsten, per lb contained W, 70-80%, lots 5,000 lb or more, lump 1/4 in., f.o.b. destination U.S.	2.15 (nominal)
Tungstic acid, per lb, 1,000-lb lots in drums (according to Oil, Paint and Drug Reporter, Dec. 31, 1962)	2.23

TARIFFS

Canada	British Preferential	Most Favored Nation	General
Tungsten ores and concentrates	free	free	free
Tungsten oxide in powder or lumps or in briquettes made with binding material used in steel manufacture	"	"	5%
Tungsten carbide, in metal tubes for use in Canadian manufacturing	"	"	free
Ferrotungsten	"	5%	5%
Tungsten rod and tungsten when used in Canadian manufacture	"	free	25%
Tungsten metal, in lumps, powder, ingots, blocks, or bars, and scrap of alloy metal containing tungsten, for use for alloying purposes	"	"	"

(Tariffs continued)

United States

Tungsten ore and concentrates	50¢ per lb on tungsten content
Tungsten carbide and metal and combinations or mixtures containing carbide or tungsten metals, all the foregoing in grains, lumps or powder	42¢ per lb on tungsten content plus 25% ad valorem
Chromium-cobalt tungsten, chromium tungsten, ferro-chromium tungsten, tungsten nickel and all other alloys of tungsten not specifically provided for	42¢ per lb on tungsten content plus 12 1/2% ad valorem
Tungstic acid and all other compounds of tungsten not specifically provided for	42¢ per lb on tungsten content plus 20% ad valorem
Ferrotungsten	42¢ per lb on tungsten content plus 12 1/2% ad valorem

Uranium

J.W. Griffith*

Uranium production was slightly lower in 1962 with deliveries totalling 8,540** tons of uranium oxide (U_3O_8), valued at $174 million**, compared with 9,641 tons, valued at $196 million, in 1961. The reduction in 1962 was due to further cut-backs in production by some companies operating under the 'stretch-out' plan. This plan was initiated in 1960 in order to prolong deliveries under contract with the United States Atomic Energy Commission and the United Kingdom Atomic Energy Authority.

In 1962, output from the four mines in the Elliot Lake district of Ontario, operated by Denison Mines Limited, Stanrock Uranium Mines Limited and the Milliken and Nordic mines of Rio Algom Mines Limited was 67 per cent of the Canadian total. In the Bancroft area of southeastern Ontario, operations continued at two mines - Faraday Uranium Mines Limited and the Bicroft mine owned by Macassa Gold Mines Limited. The 1962 output from the Bancroft camp was 9 per cent of Canada's total. The remaining production came from two mines in the Beaverlodge Lake area of northern Saskatchewan - Eldorado Mining and Refining Limited and Gunnar Mining Limited.

Despite reduced sales, uranium remained one of Canada's most important exports; in 1962 it was tenth in terms of export value, having slipped from eighth place in 1961, sixth in 1960 and fourth in 1959. Production under government contracts, despite a 12,000-ton contract signed with the United Kingdom Atomic Energy Authority (UKAEA) in 1962, is expected to continue to decline for the next nine years as indicated in the accompanying graph and the following table.

The most significant development of the year in the Canadian uranium industry was the signing of a contract with the UKAEA for the delivery of 24 million pounds of uranium during the period 1962 to 1971 inclusive. The contract will permit each of the seven uranium mining companies to extend its period of operations approximately 16.7 months past the completion date of existing contracts with the United States Atomic Energy Commission (USAEC). It is the third contract that Canada holds with Britain; the first two were part of the

*Mineral Resources Division.

**Eldorado Mining and Refining Limited, Annual Report 1962. Dominion Bureau of Statistics reported 8,430 tons valued at $158 million.

original contracts between Eldorado Mining and Refining Limited, the Canadian Government's uranium purchasing agency, and the USAEC. The new contract calls for Eldorado to supply the UKAEA with U_3O_8 at an average price of $5.03 a pound, plus an allowance for carrying charges incurred by Eldorado. The contract also contains an escalation clause to take care of possible increases in basic cost levels over the long period of the contract and a premium for deferment of deliveries. The operating costs at some mines are higher than others and the prices to be paid under the UKAEA contract will vary accordingly. The prices were calculated to allow the same operating profit per pound of U_3O_8 for each producer.

Year	Scheduled Deliveries (tons U_3O_8)
1963	7,590
1964	6,093
1965	2,899
1966	2,100
1967	1,226
1968	1,200
1969	1,200
1970	1,200
1971	933

Table 1

URANIUM - PRODUCTION AND EXPORTS

	1961		1962	
	Short Tons	$	Short Tons	$
PRODUCTION (U_3O_8) - (shipments)				
Ontario	7,485	151,060,610	6,403	118,283,081
Saskatchewan	2,156	44,631,014	2,027	39,900,588
Total	9,641	195,691,624	8,430	158,183,669
EXPORTS (U_3O_8)				
United States		173,914,072		149,165,248
Britain		18,255,934		16,597,910
West Germany		512,658		206,032
Japan		39,733		39,689
Total		192,722,397		166,008,879

Source: Dominion Bureau of Statistics

Table 2

DETAILS OF THE 1962 URANIUM CONTRACT WITH THE UKAEA

Company	Allotment (pounds U_3O_8)	Approximate Delivery Period
Rio Algom	7,415,693	Dec. 1966 - Oct. 1971
Eldorado	3,082,929	Apr. 1965 - Jan. 1967
Denison	5,665,923	Oct. 1963 - Mar. 1965
Stanrock	2,886,105	Apr. 1963 - Aug. 1964
Gunnar*	2,916,284	Nov. 1963 - Oct. 1964*
Faraday	1,083,191	Oct. 1962 - Mar. 1964
Macassa	949,875	Jan. 1962 - June 1963

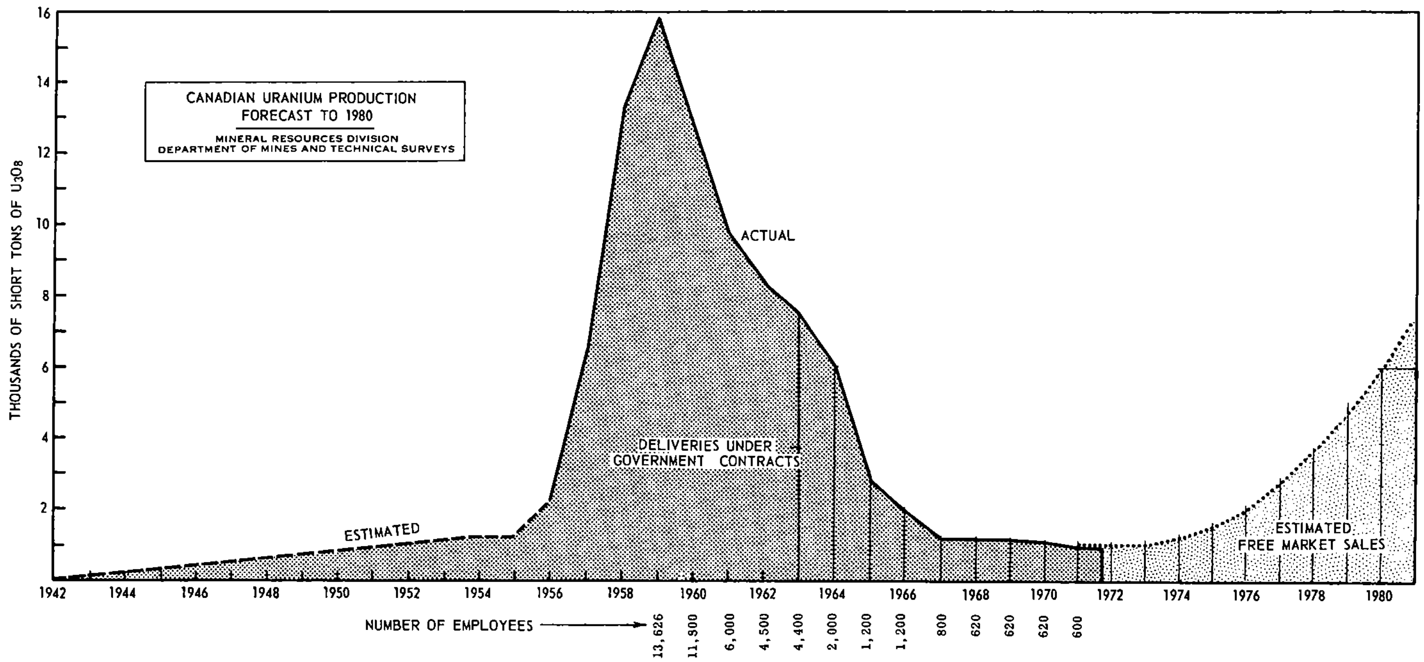
*Gunnar announced early in 1963 that it will not be able to deliver all of its share of the contract owing to insufficient ore reserves. Operations at the property will cease in the late summer of 1963. The undelivered quantity will likely be offered to the remaining producers on the same basis as the allotment of the original 24 million pounds but at the Gunnar price.

MINING OPERATIONS

During 1962 some producers continued operations at normal rates of production while others cut back considerably in order to prolong their operations as far into the 1960's as was economically possible. There were no mine closures. Most operators continued to make improvements in mining and ore-treatment methods to reduce production costs. The possibility of producing a nuclear grade product at the mine rather than crude 'yellow cake' which contains approximately 80 per cent U_3O_8 and which must be shipped to a refinery for further processing, has been seriously considered as a means of lowering the cost of the final product. To this end, Rio Algom Mines Limited constructed a pilot plant at its Nordic mill to determine if nuclear grade uranium products could be produced on a commercial scale for direct shipping to reactor designers and manufacturers.

Denison Mines Limited continued to make improvements in efficiency which helped to reduce costs over those of the previous year. The mill treated 1,828,993 tons of ore during the year - a decrease from that of the previous year due to a cut-back in milling rate to 5,000 tons a day during the latter part of the year. Mill-head grade was increased to 2.88 pounds of U_3O_8 a ton.

Operations continued at both the Milliken and Nordic mines of Rio Algom Mines Limited with total production amounting to approximately 2,497 tons of U_3O_8. The company adopted a stretch-out program which will enable it to keep one mine (Nordic) operating until October 1971. A number of technical improvements were made which helped to reduce costs although overall operating costs, at $7.10 a ton milled, were higher than in 1961 partly due to an increase in underground development at both mines and lower rates of production. Uranium


CANADIAN URANIUM PRODUCTION
FORECAST TO 1980
MINERAL RESOURCES DIVISION
DEPARTMENT OF MINES AND TECHNICAL SURVEYS
THOUSANDS OF SHORT TONS OF U3O8
16
14
12
10
8
6
4
2
ESTIMATED
ACTUAL
DELIVERIES UNDER
GOVERNMENT CONTRACTS
ESTIMATED
FREE MARKET SALES
1942
1944
1946
1948
1950
1952
1954
1956
1958
1960
1962
1964
1966
1968
1970
1972
1974
1976
1978
1980
NUMBER OF EMPLOYEES
13,626
11,900
6,000
4,500
4,400
2,000
1,200
1,200
800
620
620
620
600

sold on the open market during 1962 amounted to approximately 150,000 pounds valued at \$600,000. The quantity sold in this market was not appreciably less than that sold in 1961 but the value was lower because of the decline in the free market price.

The average mill-head grade at Faraday Uranium Mines Limited increased to an all-time high of 0.134 per cent U_3O_8 compared with an average of 0.087 per cent in 1959. As a result of reduced mining and development, unit costs were reduced to \$8.15 a ton (\$3.21 a pound of U_3O_8 based on a recovery of 94.66 per cent).

Production from the Beaverlodge operation of Eldorado Mining and Refining Limited amounted to approximately 980 tons of U_3O_8 recovered from 563,580 tons of ore grading 3.88 pounds of U_3O_8 a ton. The decrease in production over that of the previous year was a result of the adoption of a stretch-out policy which will enable the mine to continue operating until the first quarter of 1967. Significant reductions in ore-treatment costs were achieved during 1962 notwithstanding the lower tonnage treated.

Gunnar Mining Limited completed deliveries of U_3O_8 on behalf of Rayrock Mines Limited and Canadian Dyno Mines Limited in March 1962 and March 1963 respectively, and deliveries against the contract with Eldorado Mining and Refining Limited will be completed in November of 1963. Gunnar will not be able to deliver all of its portion of the 24-million pound contract with the UKAEA due to insufficient ore reserves. Deliveries will therefore end in late 1964 rather than in early 1965. The company expects to cease mining in the late summer of 1963 and milling operations will be completed at the end of 1963 or soon thereafter.

The number of employees in the uranium mining industry in Canada at the end of 1962 was estimated at 4,400 - a decrease of about 100 from the previous year and a substantial decrease from the all-time high of 13,626 in mid-1959.

RESERVES

The reserves of measured, indicated and inferred ore in Canada as of December 31, 1962, as estimated by the writer, were 284 million short tons grading 2.46 pounds of U_3O_8 a ton. This is equivalent to 265,000 tons of recoverable U_3O_8 or about 225,000 tons of U (metal), after deducting 20 per cent for unrecoverable ore in pillars and 5 per cent for ore treatment losses. These are lower than figures published previously, mainly because some company figures do not include inferred ore. However, it should also be noted that since September 1957, when the Department of Mines and Technical Surveys published a reserve figure of 377 million tons of ore, over 50 million tons have been mined and milled. The ore reserves in the Elliot Lake district constitute 97 per cent of the total in Canada.

PRICES

Under the earlier contracts the average price paid to Canadian ;ers was about $10.50 a pound. The prices paid under the 1962 contract ıe UKAEA range from about $4.10 to about $7.10 a pound of U_3O_8, the ;e being $5.03.

ENRICHED URANIUM

In 1962 Eldorado installed a facility at its Port Hope, Ontario, ry for processing enriched uranium oxide so that it would be able to t orders for enriched uranium oxide for nuclear fuel. The Crown ration expects to offer enriched uranium metal as well. The Eldorado does not actually produce enriched uranium but it purchases uranium luoride (a gas) in enriched form from the United States and re-processes nake enriched fuel for reactors. In July 1962, an amendment to the d States-Canada bilateral agreement was made so Canada could offer hed uranium fuel for sale to other countries.

BILATERAL AGREEMENTS

The countries and groups of countries which hold bilateral agreements Canada for co-operation in the peaceful uses of atomic energy, including xchange of nuclear raw materials, are: Australia, Euratom (Belgium, ce, West Germany, Italy, Luxembourg, and the Netherlands), Japan, stan, Sweden, Switzerland, United States and West Germany (a separate ement from that with Euratom of which Germany is a member). Britain t included in the above list because the British-Canadian arrangement in instance is quite different and has existed for a longer period of time; in nce it is much broader and freer.

NUCLEAR POWER IN CANADA

There appears to be a growing international acceptance of Canada's oach to the generation of nuclear-electric power, using the heavy-water, ral-uranium type reactor. Britain, India, Pakistan, Japan and other tries have recently shown greater interest, both financially and otherwise, ıis type. The United States has specialized in reactors which use enriched ıium but authorities there are having a 'second look' at the virtues of the adian system. Natural uranium is cheaper than enriched uranium and offers potential of lower over-all nuclear power costs. Most countries do not have lities for making enriched uranium but many have access to natural uranium.

The first Canadian natural uranium, heavy-water-moderated nuclear er station went into operation in April 1962 at Rolphton, Ontario, about 120 es northwest of Ottawa. Known as NPD (Nuclear Power Demonstration), it a net electrical output of 20,000 kilowatts which was reached on June 28, 2; it is a new source of electrical energy for Canada. The station was built as a co-operative project of Atomic Energy of Canada Ltd., Ontario Hydro and Canadian General Electric Company Limited. Ontario Hydro operates the station. The initial fuel load consisted of about 20 tons of uranium oxide. Aside from some expected difficulties during its initial operation, this plant has operated extremely well. Construction of the larger CANDU station at Douglas Point on the east shore of Lake Huron, midway between Port Elgin and Kincardine, Ontario, is well under way. The first unit of 200,000 kilowatts is scheduled for operation in 1965. Power costs for a two-unit (400,000 kilowatts) CANDU plant have been estimated* at 5.2 mills a kilowatt hour. About 46 tons of uranium oxide will be needed for the initial loading of this reactor but once in operation annual requirements are not expected to exceed 25 tons.

A contract to build an engineering test reactor at the Whiteshell Nuclear Research Establishment in Manitoba was awarded in 1962 to Canadian General Electric. The reactor, to be known as WR-1, is expected to go into operation in 1965. The primary purpose of WR-1 is to provide facilities for large-scale testing of fuel rods, heat transfer systems and components for organic-cooled, heavy-water-moderated power reactors. Like other Canadian reactors, it will use heavy water to maintain the chain reaction in the uranium fuel but the 'coolant' or heat-transfer media will be organic liquids instead of heavy water.

RESEARCH ON NEW USES FOR URANIUM

When demand for Canadian uranium dropped, Eldorado officials began investigating possible non-nuclear uses. The Mines Branch of the Department of Mines and Technical Surveys suggested alloying uranium with ferrous metals since uranium has an affinity for oxygen, sulphur, carbon, nitrogen and, within a limited temperature range, hydrogen. If it was found that even a small proportion of uranium could produce a better steel or ferrous alloy at a reasonable cost, a large new market would open up for use of uranium with the great quantities of these alloys produced. Uranium has properties similar to molybdenum and tungsten. In the past this has led to research in Europe and the United States on the substitution of uranium for these two metals in high-speed tool steels.

In fact, the first mention of uranium as an element for improving the quality of steel was made in a British patent granted in 1870. In general, however, research on the effects of uranium on steel have been sporadic, limited by the non-availability of the metal. The Physical Metallurgy Division of the Mines Branch, in collaboration with Eldorado and the Canadian Uranium Research Foundation, has for the past three years carried out research on non-nuclear applications of uranium with particular emphasis on its use as an alloying element in steel. The Canadian steel industry has co-operated fully in this program by producing large tonnage melts of uranium-bearing steel for service testing. Some major results of this work are outlined in the following paragraphs.

*Lewis, W.B.: Heavy Water Power Reactors - Fundamentals of Economic Design A.E.C.L. Paper presented to Canadian Nuclear Association Conference, May 1962.

Uranium was found to affect the resistance to pitting corrosion of steels. Work is still in progress on a large variety of corrosion tests to determine the relation between environmental conditions and the corrosion resistance of uranium steels. Field tests are under way in commercial plants in Canada.

Tests have shown that uranium, when added in small amounts, improves the high-temperature properties of steel. Short-time stress rupture tests were carried out and it was found that steels containing 0.57% U and 0.09% C take nearly 700 times as long to rupture at 26,000 psi and 807° F as uranium-free steel at the same temperature and load. Work is now in progress to check these results for longer periods of time and under different conditions of heat treatment.

Recent creep test data have shown that uranium also improves the high-temperature strength of certain alloy steels. In secondary hardening steels, additions of 0.03% and 0.114% uranium have increased the tempering temperature at which peak hardness is obtained in hardness-tempering temperature curves.

Small test heats of steel of the high-speed tool type were produced with uranium as an additive. The results showed that hardnesses, similar to those of standard tool steels, are obtainable.

Within the general field of weldability, most concern was that uranium additions might exaggerate the hardening and cracking tendency in the heat-affected zone adjacent to the weld. The tests showed that uranium in amounts up to 0.13% did not appear to affect the weldability of carbon steels.

Considerable work has also been done with non-ferrous alloys. Uranium, when added to copper- and nickel-base alloys, markedly improves the hot working characteristics. For example, a brass containing over 0.02% lead can not be hot worked without cracking. An addition of uranium allows it to be hot worked and permits the use of contaminated scrap, which is relatively cheap, in the charge.

OUTLOOK

The short-term outlook for the uranium industry in the Free World is one of diminishing production and a gradual shut-down of many mines. Under present firm contracts, production in Canada will continue to October 1971, at which time only one mine will be in operation (see Table 2). At the end of 1962 there were eight mines in operation, one of which, Bicroft, will close in June 1963 and another, Milliken, is expected to close on July 31, 1963. A third mine, Gunnar, will not be able to complete its contract owing to insufficient reserves and will close during the latter part of 1963. All others except Rio Algom's Nordic mine, are expected to close on or before the dates of completion of contract deliveries shown in Table 2.

Table 3

CANADIAN URANIUM PRODUCERS, STATISTICS, 1962

Company and Location	Production (st U_3O_8)	Approximate Value of Production ($ millions)	Tons Ore Treated (millions st)	Average Mill Rate (tons ore/day)	Mill Capacity (tons ore/day)	Millhead Grade (lb U_3O_8/ ton)	Mill Recovery (%)	Mine Production Costs ($ per lb U_3O_8)	Approximate Number of Employees	Published Year-end Ore Reserves (millions st)	Grade of Reserves (lb U_3O_8/ ton)
Elliot Lake District, Ont.											
Denison Mines Limited	2,422	na	1.83	5,680	6,000	2.88	93.11	na	1,000	100.00	na
Rio Algom Mines Limited (2 mines)	2,497	48.4	2.07	5,676a	6,400	2.56	94.3	2.95b	1,150	16.17	2.42
Stanrock Uranium Mines Limited	900e	20.0e	..	..	3,000	..	..	..	600	..	..
Bancroft Area, Ont.											
Faraday Uranium Mines Limited	387	7.6	0.31	839	1,500	2.68	94.66	3.21c	250	0.59	2.44
Macassa Gold Mines Limited (Bicroft)	..	..	..	..	1,400	..	..	..	450	..	..
Beaverlodge Area, Sask.											
Eldorado Mining and Refining Limited	980	21.7	0.56	na	2,000	3.88	89.6	na	600	1.58	4.6
Gunnar Mining Limited	1,052	16.3	0.79	2,155	2,000	na	na	2.83	400	0.70	3.0

Source: Company annual reports unless stated otherwise.

(a)Estimate based on total tons ore treated during 365 days.

(b)Based on an average operating cost of $7.10 per ton of ore milled and a recovery of 2.41 pounds U_3O_8 per ton.

(c)Development, mining and milling only.

Symbols: na Not available; .. Not available at time of writing; e Estimate.

Table 4

CANADIAN URANIUM SALES 1955-1962*

to the United States Atomic Energy Commission
and the United Kingdom Atomic Energy Authority

	Pounds U_3O_8 Sold	Value of Sales
1955	2,030,767	$ 24,878,129
1956	4,223,704	42,297,289
1957	12,152,916	125,539,886
1958	26,796,084	279,914,565
1959	30,996,065	325,328,282
1960	24,960,435	265,757,907
1961	19,270,884	202,330,734
1962	17,080,037	173,682,395
Total	137,510,892	$1,439,729,187

*Source: Eldorado Mining and Refining Limited, Annual Report 1962.

Despite the present over-supply of uranium and the resulting contraction of output, the long-range prospect appears to be much brighter. The chief use for uranium is still military applications but uses for peaceful purposes are increasing; the most promising is as a fuel in civilian nuclear power reactors for the generation of electricity. Although plans for the construction of nuclear power plants have slowed down somewhat, there are unmistakable signs that atomic energy is coming back into favor and that within a four- to eight-year period the cost of civilian nuclear power is expected to be competitive with power from conventional thermal power plants in many parts of the world. In some of the original nuclear power plants, particularly those in Britain, the life of the reactors, degree of burn-up of fuel, load factor, plant efficiency and other aspects have all proven to be better than anticipated. Such accomplishments would signify the emergence of nuclear power from the experimental stage. As of November 1962, there were an estimated 500 nuclear reactors in operation or under construction in the world. Included in this figure are an estimated 95 reactors in operation, under construction or definitely planned in 17 countries for the production of power. Some of these are more properly described as prototype or experimental power reactors. In some instances, there is more than one power reactor per station so that the number of nuclear power stations is less than 95.

The significance of all this is that there will be an increased demand for uranium, beginning about 1970, to fuel these and other reactors. Despite the present surplus of uranium in most of those countries which have significant nuclear power programs, some authorities are now stressing more than ever the need for a longer-range approach to nuclear power and the importance of future supplies of nuclear raw materials. The long-range picture now appears to be one of uranium shortages in the Free World.

During 1962 there was increasing concern about future uranium supplies because United States and France have recently revised their reserves downwards. The revision by the USAEC was from 230,000 tons of U_3O_8, reported in late 1960, to 167,000 tons reported in February 1963. French reserves have been reduced from 50,000 tons reported in 1960 to 24,500 tons reported in 1962. In addition to these countries, Australia's reserves are estimated to be very low and the orebodies in Katanga (formerly a part of Belgian Congo) were mined out several years ago; this leaves only Canada and South Africa with substantial reserves.

Zinc

D.B. Fraser*

Production of recoverable zinc in 1962 rose to a record 463,145 short tons, 47,141 tons greater than in 1961 and 7 per cent above the previous record of 433,357 tons in 1955. In terms of zinc contained in zinc and other concentrates, production totalled 501,937 tons, about 59,000 tons more than in 1961. The price of zinc declined in all markets during 1962, so the value of production rose only moderately over 1961.

Production of zinc concentrates in British Columbia was substantially higher in 1962 than in 1961. However the increase was to a large extent offset by the exhaustion of zinc-plant residues at Trail in mid-year resulting in only a small net increase in British Columbia's total zinc output. Production in the Flin Flon area of northern Manitoba and Saskatchewan was 8 per cent greater than in 1961. In Ontario an increase in the grade of zinc ore mined gave a 22-per-cent increase in production.

In Quebec the production of the one new mine during 11 months of 1962, together with increased output by most of the older producers, raised Quebec's total 31 per cent above the 1961 figure. Two new mines were opened in New Brunswick and one in Nova Scotia. The output of Newfoundland and Yukon Territory was about the same as in 1961.

The zinc refinery of The Consolidated Mining and Smelting Company of Canada Limited (COMINCO) at Trail, British Columbia and that of Hudson Bay Mining and Smelting Co., Limited, at Flin Flon, Manitoba, operated at capacity during the year. A record total of 280,158 tons of refined zinc was produced; output in 1961, the highest previously recorded, was 268,007 tons.

The mine output of Manitoba and Saskatchewan was refined at Flin Flon. Most of the zinc concentrates produced in British Columbia and Yukon Territory were refined at Trail; the rest was exported to refineries in the northwestern United States. The zinc production of mines in eastern Canada was exported to smelters in the United States and Europe. Some destined for the United States went first to Canadian roasting plants at Port Maitland, Ontario, and to Arvida, Quebec, for preliminary recovery of sulphur.

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* Mineral Resources Division.

An exploration shaft site of Pine Point Mines Limited located near the south shore of Great Slave Lake, Northwest Territories. Lead-zinc ore production is expected in the mid-sixties.

Table 1

ZINC - PRODUCTION, TRADE AND CONSUMPTION

	1961		1962	
	Short Tons	$	Short Tons	$
PRODUCTION				
All Forms(a)				
British Columbia....	194,486	48,971,608	206,716	50,025,192
Quebec............	54,005	13,598,467	70,737	17,118,299
Ontario	51,937	13,077,755	63,132	15,278,027
Manitoba	46,509	11,710,925	49,920	12,080,667
Newfoundland	34,638	8,722,020	32,541	7,874,869
Saskatchewan	28,360	7,141,004	30,900	7,477,708
Yukon.............	6,069	1,528,100	5,944	1,438,554
New Brunswick	-	-	2,498	604,575
Nova Scotia.........	-	-	757	183,090
Total	416,004	104,749,879	463,145	112,080,981
Mine output(b)........	443,099		501,937	
Refined(c)...........	268,007r		280,158	
EXPORTS				
Zinc blocks, pigs, and slabs				
Britain............	86,068	16,596,924	92,338	16,274,265
United States	70,443	15,615,353	74,733	17,381,615
India...............	15,387	2,881,957	20,266	3,181,999
Netherlands	5,273	1,082,379	4,438	815,864
Thailand	2,089	383,714	3,440	538,654
Philippines	2,893	547,328	2,898	464,193
West Germany	4,268	884,129	2,602	449,720
Pakistan	130	23,539	2,568	396,340
Belgium and Luxembourg.......	203	42,570	2,186	405,043
Brazil	2,705	512,772	1,354	215,100
Taiwan.............	275	53,983	1,047	177,912
Japan	13,527	2,444,655	95	13,003
Other countries	5,011	967,451	2,758	461,863
Total	208,272	42,036,754	210,723	40,775,571

Table 1 (cont'd)

	1961		1962	
	Short Tons	$	Short Tons	$
Exports (cont'd)				
Zinc contained in ores and concentrates				
United States	131,490	10,728,277	194,743	16,078,821
Belgium and Luxembourg	22,265	1,815,306	24,066	1,587,548
France	5,794	459,229	8,748	428,082
Britain	11,581	940,516	5,905	526,111
Poland	-	-	4,032	280,000
West Germany	21,349	1,979,885	3,047	220,434
Netherlands	1,085	78,187	1,752	82,503
India	-	-	164	25,229
Norway	5,758	385,859	-	-
Total	199,322	16,387,259	242,457	19,228,728
Zinc and zinc-alloy scrap, dross and ashes				
United States	959	120,273	2,757	405,577
Belgium and Luxembourg	1,704	101,306	2,111	97,640
Netherlands	184	10,013	330	19,515
Britain	181	12,321	200	15,634
Japan	366	62,588	94	14,786
Switzerland	93	5,265	-	-
West Germany	58	7,687	-	-
Total	3,545	319,453	5,492	553,152
Zinc fabricated materials, not elsewhere specified				
Britain	224	90,168	229	653,971
United States	121	74,769	183	89,203
Trinidad	44	17,719	53	20,525
Brazil	93	18,300	-	-
Other countries	16	5,844	3	2,025
Total	498	206,800	468	765,724

Table 1 (cont'd)

	1961		1962	
	Short Tons	$	Short Tons	$
IMPORTS				
Zinc in pigs, slabs, blocks, anodes	771	199,651	710	187,341
Zinc bars, rods, plates, sheet	869	470,338	765	426,222
Zinc dross and zinc scrap..............	127	15,479	345	24,889
Zinc dust and granules	864	256,244	889	263,866
Zinc slugs, discs, shells		201,601		199,241
Zinc manufactures, not otherwise provided for		2,685,775		3,319,067
Zinc chloride	192	38,604	218	46,012
Zinc sulphate	904	77,897	1,501	147,984
Zinc white oxide	2,239	455,097	2,736	576,795
Lithopone	630	91,250	734	120,156
Total.............		4,491,936		5,311,573

	1961			1962		
	Primary	Secondary	Total	Primary	Secondary	Total
	(short tons)					
CONSUMPTION						
Zinc used for or in the manufacture of:						
Copper alloys (brass, bronze, etc.)	7,229	229	7,458	6,516	100	6,616
Galvanizing:						
Electro......	690	36	726	695	60	755
Hot-dip......	34,127	637	34,764	35,898	402	36,300
Zinc diecast alloy	9,921	-	9,921	10,534	-	10,534

Table 1 (cont'd)

	1961			1962		
	Primary	Secondary	Total	Primary	Secondary	Total
			(short tons)			
Consumption (cont'd)						
Other products (including rolled and ribbon zinc, zinc oxide)	8,911	1,973	10,884	11,677	2,192	13,869
Total.........	60,878	2,875	63,753	65,320	2,754	68,074
Stocks on hand at end of year	7,051	1,366	8,417	6,614	734	7,348

Source: Dominion Bureau of Statistics.
(a) New refined zinc produced from domestic primary materials (concentrates, slags, residues, etc.) plus estimated recoverable zinc in ores and concentrates shipped for export.
(b) Zinc content of ores and concentrates produced.
(c) Refined zinc produced from domestic and imported ores.
Symbols: r Revised from previously published figure; - Nil.

Exports of refined zinc were at about the same level in 1962 as in 1961. Shipments to the major markets, Britain and United States, increased moderately, however those to India rose by over 30 per cent. Shipments to Japan declined to 95 tons in the whole of 1962 from 13,527 tons in 1961.

Exports of zinc in concentrates to the United States were nearly 50 per cent higher in 1962 than the previous year and totalled 194,700 tons, 62,000 tons more than the annual ore quota.

Domestic consumption of zinc, which increased for all categories except brass, rose in 1962 to 68,074 tons from 63,753 tons in 1961.

The history of zinc production in Canada since 1925 and the importance of export markets are shown in the accompanying graph. In 1962 Canada was the second-ranking zinc producer of the Free World. In mine output of contained zinc the United States was the principal producer, with a total of 555,000 tons. Other leading mine producers were: Canada, 502,000; Australia, 339,000; Mexico, 269,000; Peru, 250,000, and Japan, 212,000. Leading producers of refined zinc were: United States, 938,000; Canada, 280,000; Japan, 270,000; Belgium, 226,000; West Germany, 197,000; Australia, 188,000 and France, 181,000.

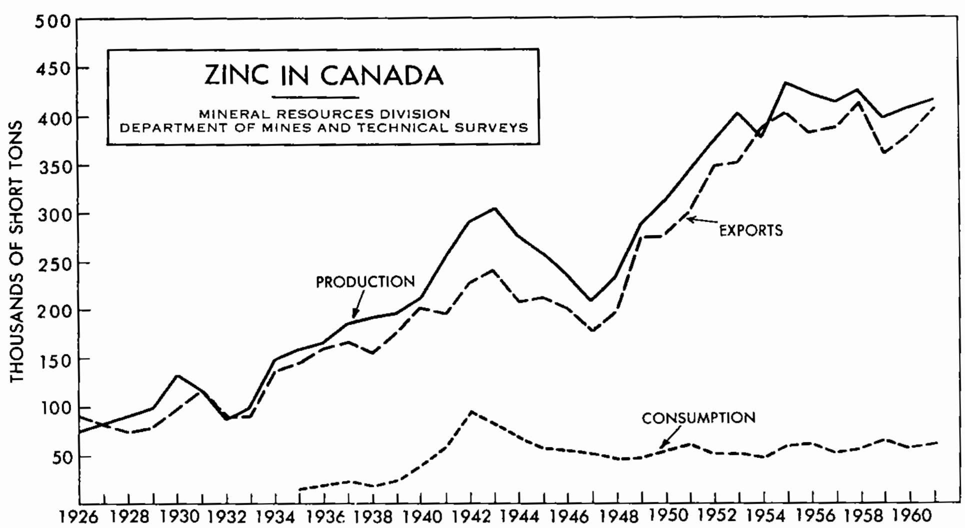
Table 2

ZINC - PRODUCTION, EXPORTS AND CONSUMPTION, 1952-62

(short tons)

	Production		Exports			Consumption(c)
	All Forms(a)	Refined(b)	In ore and concentrates	Refined	Total	
1952	371,802	222,200	181,754	166,864	348,618	51,581
1953	401,762	250,961	192,656	158,388	351,044	50,717
1954	376,491	213,775	180,172	206,038	386,210	46,735
1955	433,357	256,542	190,585	213,837	404,422	58,062
1956	422,633	255,564	199,313	183,728	383,041	61,173
1957	413,741	247,316	187,141	202,007	389,148	52,713
1958	425,099	252,093	217,823	195,708	413,531	56,097
1959	396,008	255,306	181,084	179,552	360,636	64,788
1960	406,873	260,968	169,894	207,091	376,985	55,803
1961	416,004	268,007r	199,322	208,272	407,594	60,878
1962	463,145	280,158	242,457	210,723	453,180	65,320

Source: Dominion Bureau of Statistics. (a) New refined zinc produced from domestic primary materials (concentrates, slags, residues, etc.) plus estimated recoverable zinc in ores and concentrates shipped for export. (b) Refined zinc produced from domestic and imported ores. (c) Refined virgin zinc only.
Symbol: r Revised from previously published figure.



In 1962, Free World consumption of slab zinc rose from the 1961 level by 4 per cent. Consumption in the United States was 1,032,000 tons, an increase of 101,000 tons. In other large markets, consumption either declined slightly or remained at about the same level as in 1961.

UNITED STATES QUOTAS

The import quotas on unmanufactured lead and zinc imposed by the United States government September 1958, continued in effect throughout 1962, limiting commercial imports to 80 per cent of their annual average for the five-year period from 1953 to 1957. The quota on Canadian zinc ores was 33,240 tons of contained zinc per quarter; on zinc metal it was 18,920 tons per quarter.

United States imports of zinc ores and concentrates from all countries for 1962, as reported by the United States Department of Commerce, amounted to 467,398 tons of contained zinc, or 87,558 tons more than the total annual quota. Imports from Canada were 192,423 tons, or 59,463 tons more than the quantity allowable under the quota.

The same source reported that zinc metal imported by the United States from all countries during 1962 amounted to 141,957 tons, or 837 tons more than the quota. Imports from Canada were 72,825 tons, or 2,855 tons less than the amount permitted by the quota.

INTERNATIONAL LEAD AND ZINC STUDY GROUP

The International Lead and Zinc Study Group, formed in May 1959 under United Nations auspices, held its fifth session in two parts, in March and May 1962, and its sixth session the following October. All meetings were in Geneva. The membership of the Group comprises 25 countries who represent over 95 per cent of the world's lead and zinc production and consumption.

At the fifth session the statistical estimates showed new supplies of zinc to be in approximate balance with consumption. At the sixth session, in the fall, a small surplus was forecast for the second half of 1962. However, the small imbalance was not considered significant.

In considering longer-term problems the Study Group, at the October meeting, made arrangements for a study of the principles, objectives and possible forms of international agreements or arrangements. Accordingly, members were asked to submit their views on this question in memoranda form by January 1963. The special working group, made up of representatives of eleven countries (including Canada), was directed to meet in March 1963 to examine the replies and assess the measure of agreement and difference of views among members of the Study Group.

PRODUCING MINES

The Consolidated Mining and Smelting Company of Canada Limited, Canada's leading lead-zinc producer, operated three mines in British Columbia, the Sullivan, the H.B. and the Bluebell. These mines supplied 82 per cent of lead and zinc produced at the company's metallurgical plants at Trail. Purchased ores and concentrates supplied 12 per cent; 6 per cent was obtained from re-treatment of stockpiled zinc-plant residues and lead blast-furnace slag. The stockpile of zinc-plant residues was exhausted in mid-1962. The company's output of zinc from all sources was 199,393 tons, a new record. In the previous year 193,649 tons were produced.

Hudson Bay Mining and Smelting Co., Limited, Canada's second-ranking producer, operated three mines in the Flin Flon district on the Manitoba-Saskatchewan border, and one near Snow Lake some 90 miles east of Flin Flon. A record total of 80,766 tons of slab zinc was produced in the company's electrolytic zinc refinery at Flin Flon.

Four new zinc-producing mines were opened during 1962. In the Sherbrooke district of Quebec, Solbec Copper Mines, Ltd. began production of copper, lead, and zinc concentrates in February and produced 12,200 tons of contained zinc during the year. Two mines were opened near Newcastle, New Brunswick: the Wedge copper mine of COMINCO, whose ore also contains zinc and lead, and the lead-zinc-copper mine of Heath Steele Mines Limited. Production of recoverable zinc from the two totalled 3,300 tons, the first mine operating for eleven months, the second for 6 months of the year. The first production of zinc and lead from ores adjoining a barite deposit at Walton, Nova Scotia, was recorded in 1962.

Waite Amulet Mines, Limited, in October, completed mining of its ore deposits near Noranda, Quebec and suspended operations.

The mine production of principal zinc producers is shown in Table 3.

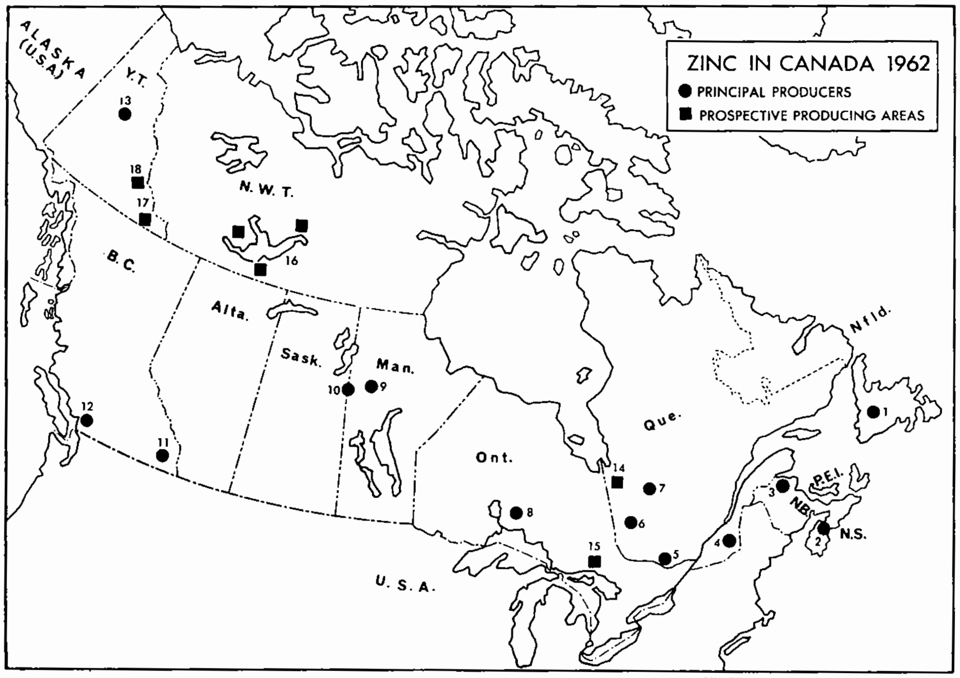
OTHER DEVELOPMENTS

Manitoba

Hudson Bay Mining and Smelting Co., Limited, completed surface plant construction at Osborne Lake, 13 miles northeast of Snow Lake, and continued sinking a 3-compartment shaft. At year end a depth of 696 feet had been reached and three level-stations completed.

Quebec

Underground development and plant construction was continued by Mattagami Lake Mines Limited and Orchan Mines Limited in the Matagami Lake district 100 miles north of Amos. Construction of a 3,000-ton concentrator to treat Mattagami Lake's zinc-copper ore was begun. Orchan Mines began building a 1,000-ton concentrator for its zinc-copper ore, with a separate 900-ton unit to treat the copper ore of New Hosco Mines Limited. At Valleyfield,



MINERAL RESOURCES DIVISION
DEPARTMENT OF MINES AND TECHNICAL SURVEYS

PRINCIPAL PRODUCERS

1. American Smelting and Refining Company (Buchans Unit)
2. Magnet Cove Barium Corporation
3. The Consolidated Mining and Smelting Company of Canada Limited (Wedge mine)
   Heath Steele Mines Limited
4. Solbec Copper Mines, Ltd.
5. New Calumet Mines Limited
6. Manitou-Barvue Mines Limited
   Normetal Mining Corporation, Limited
   Quemont Mining Corporation, Limited
   Sullico Mines Limited
   Vauze Mines Limited
   Waite Amulet Mines, Limited
7. The Coniagas Mines, Limited
8. Geco Mines Limited
   Willroy Mines Limited
9. Hudson Bay Mining and Smelting Co., Limited
   Chisel Lake mine
10. Hudson Bay Mining and Smelting Co., Limited (also refinery)
    Flin Flon mine
    Coronation mine
    Schist Lake mine
11. Canadian Exploration, Limited
    The Consolidated Mining and Smelting Company of Canada Limited (also refinery)
    Sullivan mine
    H. B. mine
    Bluebell mine
    Mastodon-Highland Bell Mines Limited
    Reeves MacDonald Mines Limited
    Sheep Creek Mines Limited
12. Howe Sound Company (Britannia Division)
13. United Keno Hill Mines Limited

PROSPECTIVE PRODUCING AREAS

14. Mattagami Lake
15. Sudbury
16. Great Slave Lake
17. Watson Lake
18. Pelly River

30 miles west of Montreal, construction of an electrolytic zinc-reduction plant began in January. The plant will have a capacity of 73,000 tons of slab zinc annually, and will obtain 80 per cent of its zinc-concentrate feed from the new Matagami district mines and the remainder from the Geco mine in Ontario and the Quemont and Normetal mines in Quebec. The new mines and the zinc plant are scheduled to start production in October 1963.

Lake Dufault Mines, Limited, began shaft sinking during 1962 at its Noranda district property where reserves were estimated to be 1,300,000 tons containing 5 per cent copper, 10 per cent zinc and 3.2 ounces of silver per ton.

New Brunswick

Brunswick Mining and Smelting Corporation Limited completed arrangements in June 1962 for bringing one of its two large zinc-lead-copper deposits near Bathurst into production. These deposits together contain 58 million tons of ore. The building of a 3,000-ton concentrator was begun and production of zinc, lead and copper concentrates is scheduled to begin in the early part of 1964. Societe Generale des Minerais, S.A., of Belgium, will for twelve years, purchase the total output of zinc and lead concentrates for treatment in Belgium. Under the terms of the agreement, however, Brunswick may, after 5 years, construct a smelter and divert some concentrates to it.

Northwest Territories

Construction of a 430-mile railway from Roma, in northwestern Alberta, to Hay River and Pine Point on Great Slave Lake, began in February 1962 and by year-end some 70 miles had been opened. Completion of the entire line is scheduled for the end of 1966 at which time Pine Point Mines Limited, a COMINCO subsidiary, will begin production of lead and zinc concentrates. The development program at Pine Point that will begin in 1963 includes test stripping and development for planned open-pit mining, some diamond drilling, and the construction of a 5,000-ton concentrator and service buildings. Annual shipments during the initial years of operation will total some 215,000 tons of lead and zinc concentrates.

USES

Zinc is used mainly in galvanizing in which it is applied as a protective coating to iron and steel products to prevent rusting. The Steel Company of Canada, Limited, and Dominion Foundries and Steel, Limited, both of Hamilton, are the main consumers of zinc for galvanizing. Each operates continuous-strip galvanizing lines.

Zinc-base die castings are widely used for automotive, household-appliance and machine parts. The alloys most commonly used for die-casting are made of high-purity zinc to which is added about 4 per cent aluminum, 0.04 per cent magnesium and from 0 to 1 per cent copper. Schultz Die Casting Company of Canada, Limited, at Lindsay, Ontario, and Barber Die Casting Co.

Table 3

PRINCIPAL ZINC MINES IN CANADA, 1962

Company	Mine and Location	Mill Capacity (short tons /day)	Grade of Ore (principal metals) Lead (%)	Zinc (%)	Copper (%)	Silver (oz/ton)	Ore Produced (short tons) 1961	1962	Contained Zinc Produced (short tons) 1961	1962
British Columbia										
									100,299	
The Consolidated Mining and Smelting Company of Canada Limited	Sullivan, Kimberley	10,000	na	na	-	na	2,461,695	2,583,068	14,579	131,359
	Bluebell, Riondel	700	na	na	-	na	252,821	237,742		14,029
	H.B., Salmo	1,200	na	na	-	na	472,731	468,979	22,080	20,293
Reeves MacDonald Mines Limited	Reeves MacDonald, Remac	1,000	1.22	3.78	-	na	420,508	417,448	16,449	14,601
Canadian Exploration, Limited	Jersey, Salmo	1,900	2.3	4.4	-	na	374,032	384,894	15,754	15,754
Sheep Creek Mines Limited	Mineral King, Toby Creek, southwest of Invermere	500	2.59	5.50	-	1.17	211,010	208,670	11,123	10,161
Howe Sound Company	Britannia, Howe Sound	4,500	-	0.88	1.47	na	458,429	501,078	3,327	3,855
Mastodon-Highland Bell Mines Limited	Highland-Bell, Beaverdell	70	3.1	3.8	-	43	18,953	19,480	486	396
Yukon Territory										
United Keno Hill Mines Limited(a)	Calumet, Mayo district Elsa, Mayo district Hector, Mayo district	500	5.84	4.42	-	40.55	186,116	184,123	7,756	6,943
Manitoba and Saskatchewan										
Hudson Bay Mining and Smelting Co., Limited	Flin Flon, Flin Flon district)		0.20	4.4	2.47	1.02	1,014,925	925,030)		
	Coronation, Flin Flon district)	6,000	-	0.24	4.28	0.12	312,145	347,731)	83,239	85,248
	Schist Lake, Flin Flon district)		-	7.0	2.56	0.96	98,802	88,316)		
	Chisel Lake, Snow Lake, Man.)		1.6	13.4	0.40	2.27	271,877	338,377)		
Ontario										
Geco Mines Limited	Geco, Manitouwadge	3,300	0.25	4.68	1.81	2.14	1,276,778	1,282,414	42,050	49,357
Willroy Mines Limited	Willroy, Manitouwadge	1,200	0.14	5.56	1.69	1.45	421,772	495,028	22,934	21,272

Quebec										
The Coniagas Mines, Limited	Coniagas, Bachelor Lake	325	2.0	13.0	-	7.5	79,826	108,212	11,962	12,574
Manitou-Barvue Mines Limited(b)	Golden Manitou, Val d'Or	1,300	0.77	6.02	b	5.03	162,860	169,140	8,847	9,442
New Calumet Mines Limited (a)	New Calumet, Calumet Island	750	1.98	7.16	-	4.06	96,872	95,623	6,817	6,457
Normetal Mining Corporation, Limited	Normetal, Normetal	1,000	-	5.17	2.7	1.88	355,001	354,751	12,469	14,802
Quemont Mining Corporation, Limited	Quemont, Noranda	2,300	-	2.64	1.25	0.86	822,275	804,629	15,250	15,765
Sullico Mines Limited	East Sullivan, Val d'Or	2,800	-	0.60	0.76	0.24	1,028,201	991,868	3,423	4,725
Vauze Mines Limited(c)	Vauze, Noranda	350	-	4.29	4.64	1.79	22,300	109,242	307	1,728
Waite Amulet Mines, Limited(d)	Waite Amulet, Noranda	2,000	-	4.08	3.86	0.96	248,829	171,306	2,255	5,672
Solbec Copper Mines, Ltd.(g)	Solbec, Stratford Centre, Sherbrooke district	1,000	0.62	4.88	1.85	na	g	271,384	g	12,178
New Brunswick										
The Consolidated Mining and Smelting Company of Canada Limited (h)	Wedge, Newcastle	h	na	na	na	na	h	223,920	h	1,568g
Heath Steele Mines Limited(j)	Heath Steele, Newcastle	1,500	na	na	na	na		na		2,500e
Newfoundland										
American Smelting and Refining Company (Buchans Unit)	Buchans, Buchans	1,250	7.23	12.44	1.07	4.59	387,000	378,000	46,413	42,442
Nova Scotia										
Magnet Cove Barium Corporation(c)	Magnet Cove, Walton	125	5.4	3.15	0.77	17.05	9,333	47,416	345	581

(a) Production given for the fiscal year ending September 30,1962.
(b) Manitou-Barvue also milled, in a separate circuit, 291,440 tons of copper ore grading 0.99 per cent copper.
(c) Began production in last quarter of 1961.
Symbols: na Not available; e Estimate; - Nil.

(d) Closed October 1962; mining completed.
(g) Began production February 1962.
(h) Production started January 1962. Ore was treated in milling facilities rented from Heath Steele Mines Limited.
(j) Began production mid-year.

Limited and Pressure Castings of Canada Limited, in the Toronto-Hamilton area, are among the leading users of zinc for die-casting.

Brass, a copper-zinc alloy containing as much as 40 per cent zinc, is used in many industrial fields in the form of sheets and strips, tubes, rods and wire, castings and extruded shapes. The principal fabricators of brass mill products are Anaconda American Brass Limited, New Toronto, and Noranda Copper and Brass Limited, Montreal.

Zinc oxide is used in compounding rubber and in making paint, rayon yarn, ceramic materials, inks, matches and many other commodities. The principal producers in Canada are Zinc Oxide Company of Canada, Limited, and Durham Industries (Canada) Ltd., both in Montreal, and Canadian Felling Zinc Oxide Limited, Milton, Ontario.

Rolled zinc is used in Canada mainly for making dry-cell batteries, terrazzo strip, weather stripping, roofing drains and gutters, and anticorrosion plates for boilers and ships' hulls. Burgess Battery Company Limited, Niagara Falls, is the only producer, most of its output being used to make dry-cell battery cups.

Zinc dust is used to make zinc salts and compounds, to purify fats, to manufacture dyes and to precipitate gold and silver from cyanide solutions. The more industrially important compounds of zinc are zinc chloride, zinc sulphate and lithopone, a mixture of barium sulphate and zinc sulphide used for making paint.

Refined zinc is marketed in grades that vary according to the content of such impurities as lead, iron and cadmium. The principal grades produced are: Special High Grade, used chiefly for die-casting; High Grade, used for making brass and miscellaneous products; and Prime Western for galvanizing.

In Canada, the electrolytic process is used to produce Special High Grade and High Grade zinc. To meet consumer requirements for Prime Western, Canadian producers add lead in small amounts to the higher grades.

Table 4

UNITED STATES CONSUMPTION, BY END USE, 1961 and 1962
(short tons)

	1961	1962
Galvanizing	382,077	388,570
Brass products	128,523	129,805
Zinc-base alloy	341,766	423,608
Rolled zinc	41,204	42,233
Zinc oxide	18,137	18,517
Other uses	19,506	29,088
Estimated undistributed consumption	-	-
Total	931,213	1,031,821

Source: U.S. Bureau of Mines, Minerals Yearbook 1961, p. 1334; Zinc Preprint 1962. Symbol: - Nil.

RESEARCH

Previously initiated research projects on zinc were continued in 1962 at the Mines Branch, Department of Mines and Technical Surveys, in co-operation with the Canadian Zinc Research and Development Committee and the American Zinc Institute Expanded Research Program.

Experimental work was completed, in hot-dip galvanizing, on a long-term investigation concerned with study of the influence of galvanizing bath composition on the structure and properties of laboratory-prepared sheet galvanized coatings. A total of 15 alloying elements, not normally encountered in galvanizing practice, were examined and some of these gave indications of potential usefulness in general galvanizing. The voluminous data collected is to be published shortly.

In a second project on zinc coatings, investigation of the elevated temperature behavior of two basic grades of commercial galvanized strip was also completed. Long-term heating exposure revealed significant differences between the materials tested, which, it is believed, are related to basic differences in the coating processes used. This study has been extended to a galvannealed type of zinc coating.

Fundamental research activity continued on determination of viscosity, density and surface tension of molten zinc and some of its alloys. Experiments carried out with considerable precision and accuracy on different grades of pure zinc and various binary and ternary zinc-base compositions have not confirmed pertinent anomalies given in published data. The anomalies are considered to be in error. This study is being extended to other selected compositions and systems.

PRICES AND TARIFFS

The Canadian price of Prime Western zinc on the basis of deliveries at Montreal and Toronto was 11.50 cents a pound throughout 1962.

During 1962 the United States price, East St. Louis, Illinois, was 12.00 cents a pound from January to the end of March. On April 1 it declined to 11.50 cents and remained at this level for the balance of the year.

At the beginning of 1962 the United Kingdom current bid price of zinc was £71 1/2 sterling per long ton (2,240 pounds). At the end of the year the corresponding price was £65 3/4 sterling.

Zinc ores and concentrates entered Canada duty free. Slab zinc was subject to a 1/2-cent-a-pound British preferential duty, a 1/2-cent-a-pound most favored nation duty, and a 2-cent-a-pound general duty. Varying schedules were applied to imports of zinc in semi-fabricated forms.

The United States tariff on the zinc content of ores and concentrates was 0.6 cents a pound. On slab zinc it was 0.7 cents a pound. Varying tariffs were applied to imports of zinc in other forms.

Index to Companies