MINERAL REPORT 4

Mineral Resources Division
Department of Mines and Technical Surveys, Ottawa

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foreword

This annual report has been prepared by the Mineral Resources Division in collaboration with the Mines Branch of the Department of Mines and Technical Surveys. It contains reviews of the metallic minerals, industrial minerals and mineral fuels produced or consumed in commercial quantities in Canada during 1958, and is a continuation of a series of similar annual publications dating back to 1886. The report is based on preliminary mineral reviews issued as separates in 1959.

The figures on Canadian production, trade and consumption are final and have been collected by the Dominion Bureau of Statistics, except where otherwise indicated or where company data are concerned. The statistics on company operations have been supplied directly to the Department by company officials or obtained from company annual reports. The market quotations are mainly from standard marketing reports issued in Montreal, London or New York.

We are indebted to all who contributed information, in particular to mine operators, petroleum producers and others connected with the mineral industry.

W. Keith Buck,
Chief,
Mineral Resources Division

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METALLIC MINERALS

INDUSTRIAL MINERALS

MINERAL FUELS

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summary

B.F. Burke

General

The value of Canada's mineral production for 1958 is estimated at $2,100.7 million. This is $89.6 million, or 4.1 per cent, below the 1957 total of $2,190.3 million.

Production of metallic minerals declined $29.4 million, or 2.5 per cent, to $1,130.2 million from the all-time high of $1,159.6 million established in 1957. From 1957 to 1958, uranium production increased from 13,271,000 pounds of U_3O_8 valued at $136.3 million to 26,805,000 pounds valued at $279.5 million. This represents an increase of 102.0 per cent in quantity and 105.1 per cent in value. Gold increased by $6.6 million and silver by $1.9 million. These and some increased values in the minor metals were offset by decreases of $64.8 million in nickel, $41.1 million in iron ore, $32.5 million in copper, $8.4 million in platinum metals, $8.3 million in lead and $7.5 million in zinc. Of the 24 metals produced in Canada and listed in Canadian mineral production, 18 were lower in value of output in 1958.

Production of nonmetallic minerals, exclusive of structural materials, declined by $18.7 million, or 11.1 per cent - from $169.1 million in 1957 to $150.4 million in 1958. Of the 24 nonmetallic commodities produced in 1958, all except salt, peat moss and four others were lower in production value. For the first time, elemental sulphur from natural gas was included in mineral-production statistics. Although produced in previous years, it had not appeared as a separate statistical item.

Structural materials produced in 1958 were valued at $309.5 million, $12.6 million, or 4.2 per cent, more than the 1957 value of $296.9 million. The increase in the output of these materials reflects Canada's prosperous and expanding construction industry, which requires ever-increasing quantities of basic-mineral structural materials.

At $510.8 million, the value of mineral-fuel production was $54.0 million, or 9.6 per cent, below the 1957 total of $564.8 million. Reflecting the decrease in export shipments, crude petroleum declined 12.1 per cent in value and 9.0 per cent in quantity. Coal, continuing the decline in production which began a few years ago, dropped by 12.9 per cent, or $10.3 million, to $80.0 million, the lowest since 1947, when its production value was $77.5 million. Natural gas partly offset these decreases, rising 52.9 per cent in value to $32.1 million. This rise resulted from increased shipments to both the domestic and the export markets.

Mineral Production of Canada

	Unit of Measure	1958 Quantity	1958 $ 000	1957 Quantity	1957 $ 000
Metallics					
Antimony	000 lb	859	284	1,361	370
Bismuth	000 lb	413	771	320	585
Cadmium	000 lb	1,756	2,669	2,368	4,026
Calcium	000 lb	25	31	221	282
Cobalt	000 lb	2,710	5,308	3,923	7,785
Copper	000 s.t.	345	174,431	359	206,898
Gold	000 oz	4,571	155,334	4,434	148,757
Indium	000 oz	...	...	384	694
Iron ore	000 l.t.	14,041	126,131	19,886	167,222
Iron (remelt)	000 s.t.	...	5,121	188	10,084
Lead	000 s.t.	187	42,414	181	50,670
Magnesium	000 lb	13,592	4,065	16,770	5,255
Molybdenum (Mo content)	000 lb	888	1,153	784	1,167
Nickel	000 s.t.	140	194,142	188	258,977
Platinum metals	000 oz	154	4,840	217	7,896
Platinum	000 oz	146	9,481	200	17,835
Selenium	000 lb	307	2,302	321	3,535
Silver	000 oz	31,163	27,053	28,823	25,183
Tellurium	000 lb	38	65	32	55
Tin	000 lb	795	625	709	580
Titanium ore	000 s.t.	...	...	11	97
Tungsten (WO_3 content)	000 lb	691	1,899	1,921	5,279
Uranium(U_3O_8)	000 lb	26,805	279,539	13,271	136,304
Zinc	000 s.t.	425	92,502	414	100,043
Total, metallics			1,130,160		1,159,579
Nonmetallics					
Arsenious oxide	000 lb	2,323	95	3,697	137
Asbestos	000 s.t.	925	92,277	1,046	104,489
Barite	000 s.t.	196	2,196	228	2,993
Feldspar	000 s.t.	20	360	20	393
Fluorspar	000 s.t.	...	1,543	66	1,757
Gypsum	000 s.t.	3,964	5,189	4,577	7,745
Iron oxide	000 s.t.	2	113	8	187
Lithia	000 lb	3,853	2,048	5,140	2,827
Magnesite, dolomite and brucite		...	2,529		3,046
Mica	000 lb	1,505	90	1,282	112
Mineral water	000 gal	317	173	349	185
Nepheline syenite	000 s.t.	201	2,613	200	2,754

	Unit of Measure	1958 Quantity	1958 $ 000	1957 Quantity	1957 $ 000
Nonmetallics (cont'd)					
Peat moss	000 s.t.	149	4,779	138	4,735
Pyrite, pyrrhotite	000 s.t.	1,192	4,249	1,166	4,808
Quartz	000 s.t.	1,454	2,538	2,139	3,185
Salt	000 s.t.	2,375	14,990	1,772	13,990
Silica brick	000's of bricks	2,815	472	4,308	656
Soapstone and talc	000 s.t.	35	429	35	428
Sodium sulphate	000 s.t.	173	2,863	158	2,569
Sulphur in smelter gas	000 s.t.	241	2,361	235	2,322
Sulphur, elemental*	000 s.t.	94	1,873		
Titanium dioxide	000 s.t.	...	6,575	186	9,741
Other nonmetallics (diatomite and sodium carbonate)			0.5		2
Total, nonmetallics			150,355		169,061
Fuels					
Coal	000 s.t.	11,687	79,963	13,189	90,221
Natural gas	millions of cu ft	337,804	32,058	220,007	20,962
Crude petroleum	000 bbl	165,496	398,748	181,848	453,594
Total, fuels			510,769		564,777
Structural materials					
Clay products			41,710		35,922
Cement	000 s.t.	6,153	96,414	6,049	93,167
Lime	000 s.t.	1,596	19,466	1,379	16,679
Sand and gravel	000 s.t.	160,211	96,282	159,830	91,939
Stone	000 s.t.	38,157	55,583	40,282	59,198
Total structural materials			309,455		296,905
Total, all minerals			2,100,739		2,190,322

... Not available for publication.

* Elemental sulphur produced in 1957 but not itemized separately in mineral-production statistics.

History

The remarkable growth of Canada's mineral industry is illustrated in the following table, which shows the value of the three main classes of production at five-year intervals. The per capita value of mineral production for the same years is shown for the sake of comparison.

Mineral Production of Canada and Per Capita Value of Mineral Production

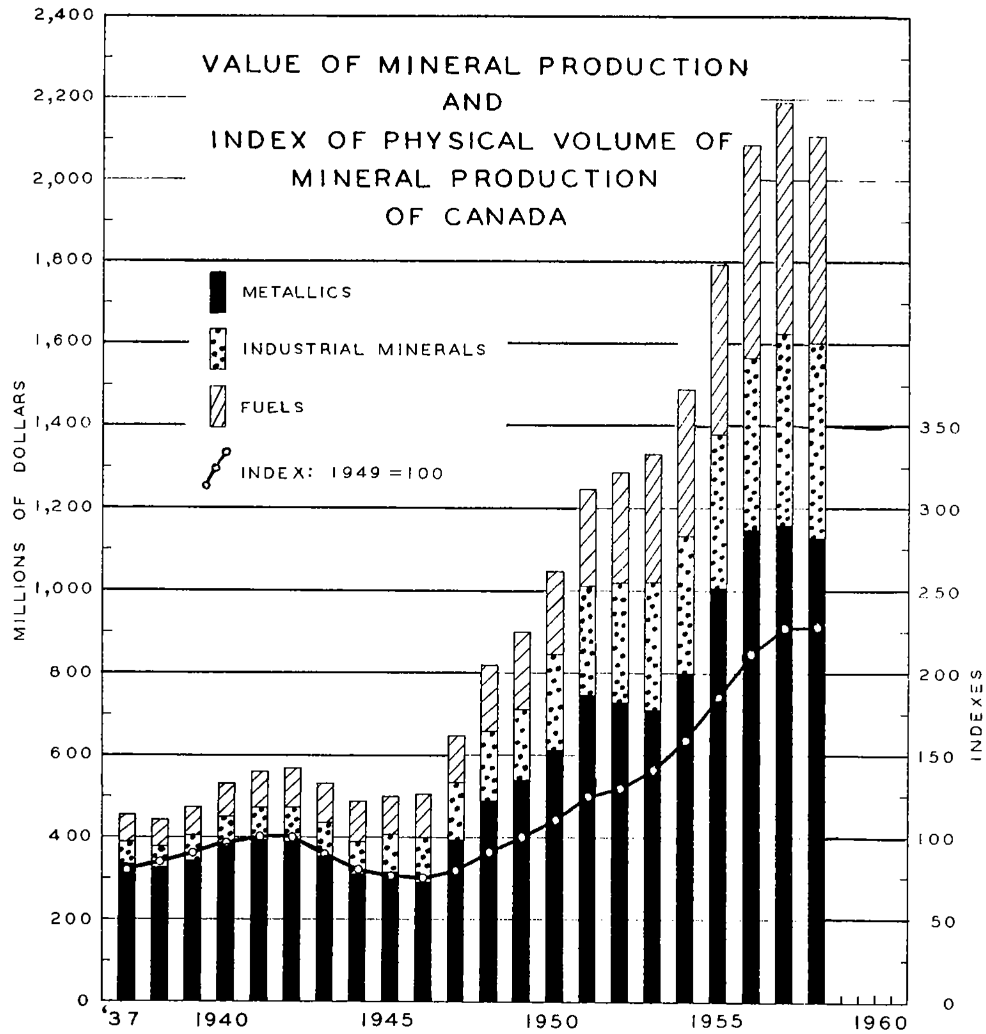
	Production				Per Capita Value of Mineral Production
	Metallics ($ millions)	Industrial Minerals ($ millions)	Fuels ($ millions)	Total ($ millions)	($)
1921	49	45	78	172	19.56
1926	115	56	69	240	25.61
1931	121	55	54	230	22.21
1936	260	43	60	363	32.82
1941	395	80	85	560	49.06
1946	290	110	103	503	40.86
1951	746	266	233	1,245	88.90
1956	1,146	420	519	2,085	129.65
1957	1,159	466	565	2,190	132.03
1958	1,130	460	511	2,101	123.24

In 1958, the value of mineral production was more than 12 times that of 1921. Between these years metallic minerals increased more than 23 times in value, industrial minerals 10 times and mineral fuels more than six times. In the earliest period fuels were the most important class of minerals produced; in 1921 they formed 45 per cent of the total value of output. By 1958, however, this percentage had declined to 24. The value of metallic mineral production, which amounted to 28 per cent of the total in 1921, increased to 54 per cent in 1958. The mineral industry experienced its greatest percentage increase in value of production between 1946 and 1951. Much of the increase resulted from upward price adjustments made between 1946, the first postwar year, and 1951, when prices advanced sharply owing to the Korean war.

Physical Volume of Production

The index of physical volume of production is a time series used to measure changes in the production volume of each industry. Aggregate values in the base period selected are used to determine the relative importance or weight of each component. This index has been considerably revised, and the base period is now 1949. Since prices are kept constant at base-period levels, the index measures volume changes. When current dollar values are used to measure production, industrial output tends to be overstated in time of inflation and understated in periods of deflation. Trends in production are more realistically indicated by a volume index embodying a good weight system.

Table 3 shows the indexes of physical volume of production (base 1949 = 100) unadjusted, for all industry, the manufacturing industry and the mining industry.



SOURCE: D.B.S.

MINERAL RESOURCES DIVISION, DEPT. M.T.S.

Indexes* of Industrial Production

(1949 = 100)

	Total, All Industry	Manufacturing	Mining			
			Total	Metal	Industrial Minerals	Fuels
1935	41.4	39.0	60.8	72.1	39.1	49.3
1940	63.9	60.4	96.2	114.5	67.3	77.7
1945	90.1	92.9	77.2	83.5	87.0	70.0
1950	106.9	106.2	109.5	103.5	139.1	112.1
1951	116.6	115.0	123.5	107.9	156.3	143.5
1952	120.9	118.5	131.0	110.3	155.5	163.9
1953	129.1	126.4	142.1	115.7	152.9	192.7
1954	128.5	122.9	158.7	129.0	161.4	215.6
1955	142.3	134.7	185.2	142.7	180.2	273.2
1956	154.9	145.1	212.3	151.0	187.6	344.7
1957	155.4	142.9	227.8	170.0	179.0	358.2
1958	153.0	139.1	226.8	180.3	163.3	330.7

*Unadjusted.

The average annual increase in the production volume of all industry between 1935 and 1958 was 6.2 per cent. Between 1935 and 1948, industrial output increased 133 per cent, the production of the manufacturing industries 150 per cent and the output of the mineral industry 48 per cent. Between 1948 and 1958, however, the volume of mineral production increased 152 per cent, of manufacturing 43 per cent and of all industry 59 per cent.

Net Value of Production

In comparing one commodity-producing industry with another and with the value of output of all commodity-producing industries, it is necessary to utilize production data from which duplication has been eliminated and which render an industrial comparison meaningful. The 'net value of production' is a statistical series employed for this purpose. Certain costs are eliminated so that the industrial contribution to the total represents the value added in the process by the industries in question. For example, in the production of a product such as steel pipe, the cost of materials, fuel, purchased electricity and process supplies consumed is deducted from the total value of output. This is done because the cost of these items is represented by production values in other industrial sectors. In the case of steel pipe, the cost of pig iron is deducted because this represents the output of the industry under which pig-iron production is classified. The elimination of these cost factors prevents duplication among industrial groups and makes it possible to assess the output value of each commodity-producing industry.

Net Value of Production in Canada, by Industry
($ millions)

	1953	1954	1955	1956	1957
Primary industries					
Agriculture	2,183	1,494	1,868	2,056	1,580
Forestry	558	584	664	761	663
Fisheries	90	97	91	106	94
Trapping	13	10	17	12	11
Mineral industry	791	901	1,062	1,224	1,308
Electric-power industry	449	489	543	594	633
Total primary	4,084	3,575	4,245	4,753	4,289
Secondary industries					
Manufacturing	7,993	7,902	8,754	9,605	9,822
Construction	2,554	2,608	2,770	3,344	3,714
Total secondary	10,547	10,510	11,524	12,949	13,536
Grand total	14,631	14,085	15,769	17,702	17,825

The foregoing figures show that the net value of mineral-industry production increased from $791 million in 1953 to $1,308 million in 1957 (the latest year for which complete data are available). This 65-per-cent increase exceeds that shown by any other primary industry. The construction industry experienced a 45-per-cent increase in net value of production. In 1953 the mineral industry contributed 5.4 per cent of the total net value of all commodity-producing industries. This increased to 7.3 per cent in 1957. The net value of mineral production is second to that of agriculture in the primary industries; but while net value of agriculture declined $603 million between 1953 and 1957, that of the mineral industry increased $517 million.

Provincial Distribution of Mineral Production

In 1958 Ontario produced 37.6 per cent of Canada's mineral output. This province accounted for 55.7 per cent of metal production. With the exception of some seven metals, most of which are by-products, Ontario production included all the metallic minerals produced in Canada. This province was the sole producer of calcium and platinum metals and the largest producer of cobalt, copper, gold, magnesium, nickel, silver and uranium. Thirty-three per cent of Canada's industrial-mineral production came from Ontario. Among these minerals Ontario leads in the production of arsenious oxide, nepheline syenite, quartz and silica, salt, clay products, cement, lime, and sand and gravel. The province also produces small quantities of natural gas and crude petroleum.

Mineral Production of Canada, by Provinces, 1958

	Metallics		Industrial Minerals		Fuels		Total	
	$ 000	% of Total	$ 000	% of Total	$ 000	% of Total	$ 000	% of Total
Ontario	629,295	55.7	151,709	33.0	8,598	1.7	789,602	37.6
Quebec	175,107	15.5	190,599	41.5	-	-	365,706	17.4
Alberta	10	-	29,779	6.5	316,150	61.9	345,939	16.5
Saskatchewan	94,162	8.3	12,813	2.8	102,966	20.1	209,941	10.0
Manitoba	26,019	2.3	16,783	3.6	14,416	2.8	57,218	2.7
British Columbia	108,098	9.6	32,363	7.0	10,688	2.1	151,149	7.2
Newfoundland	60,099	5.3	4,896	1.1	-	-	64,995	3.0
Nova Scotia	5	-	12,354	2.7	50,348	9.9	62,707	3.0
New Brunswick	922	0.08	8,514	1.8	6,840	1.3	16,276	0.8
Northwest Territories	24,189	2.1	-	-	706	0.1	24,895	1.2
Yukon Territory	12,254	1.1	-	-	57	0.01	12,311	0.6
Canada	1,130,160	100.0	459,810	100.0	510,769	100.0	2,100,739	100.0

Quebec, Canada's next largest mineral producer, accounted for 17.4 per cent of production in 1958. Quebec was second to Ontario in the production of copper, gold and magnesium and was the sole producer of titanium and molybdenum. The province was second only to British Columbia in the production of zinc.

Alberta produced 16.5 per cent of the mineral output of 1958. From this province came 61.9 per cent of the mineral fuels - more than two thirds of the crude petroleum and 6 per cent of the natural gas produced in Canada during the year. Alberta also produces such industrial minerals as clay products, cement, lime, sand and gravel, stone and salt, as well as elemental sulphur from natural gas. With the exception of an almost negligible amount of gold and silver, it produces no metallic minerals.

The two prairie provinces, Manitoba and Saskatchewan, together accounted for 12.7 per cent of mineral production. From one area straddling the border between these provinces, copper, zinc, cadmium, selenium and tellurium are produced. Copper, nickel and cobalt are obtained in Manitoba at Lynn Lake, and uranium in the Lake Athabasca area of northern Saskatchewan. These provinces also produce the precious metals, gold and silver.

British Columbia accounted for 7.2 per cent of mineral production in 1958, being the leading producer of lead and zinc and the sole producer of antimony, indium, tin and tungsten. This province produced 7.0 per cent of Canada's industrial minerals, the chief of which are structural materials, asbestos, barite, gypsum, pyrite and quartz. All three mineral fuels are produced. While coal production has substantially declined, there have been large increases in the output of petroleum and natural gas.

From the eastern seaboard provinces of Newfoundland, Nova Scotia and New Brunswick came 6.8 per cent of the year's mineral production. Newfoundland and New Brunswick produce copper, lead, silver and zinc. Newfoundland is second to Quebec in the production of iron ore and it leads in fluorspar. With the exception of small amounts of gold and silver, Nova Scotia produced no metals, but it leads in the production of barite and gypsum. All three provinces produce substantial quantities of structural materials.

Yukon Territory and the Northwest Territories produced 1.8 per cent of the mineral total. The metals produced - copper, gold, lead, zinc, nickel, silver and uranium - accounted for 3.4 per cent of the value of Canada's 1958 metal output. The two areas produce no industrial minerals, but small quantities of coal are obtained in Yukon Territory and minor quantities of crude oil and natural gas in the Northwest Territories.

Production Highlights of 1958*

Metals

Uranium

The uranium industry continued its spectacular growth in 1958. With its output at 13,403 tons of U_3O_8 valued at $279.5 million, uranium led the metals in value of production and was second only to petroleum among all the minerals produced in Canada.

During the year 25 uranium mines and 19 concentrating plants were in operation in Canada. Six new mines came into production in 1958. The total milling rate at the end of the year was 42,000 tons of ore a day. It is expected that the annual rate of production will be 15,500 tons of uranium concentrates, although the plants are capable of producing in excess of the rated capacity.

Canada ranked first in the world as a uranium producer. Other producers, in descending order, were the United States, the Union of South Africa, the Belgian Congo and Australia.

Reserves of measured, indicated and inferred ore in Canada at the end of 1957 were estimated at 376,888,000 tons with a uranium-oxide content of 414,600 tons.

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*See map

Nickel

For the first time since 1950,nickel production did not increase over that of the previous year. The 1958 production of 139,559 tons was 48,399 tons, or 26 per cent, below that of the previous year.

The nickel shortage, which began during the Korean war, ended in 1957, and in 1958 the supply was considerably in excess of demand. The large nickel surplus necessitated cutbacks. In March and again in May The International Nickel Company of Canada, Limited, announced 10-per-cent reductions in production. In July, the company went from a five- to a four-day week and this resulted in a further 20-per-cent reduction. In all, the reductions amounted to 35 per cent, the equivalent of 50,000 tons of nickel a year. On September 24 the employees of International Nickel went on strike. This strike, which lasted until December 22, resulted in a loss of about 28,000 tons of nickel.

Falconbridge Nickel Mines Limited operated at its capacity of 25,000 tons of nickel in 1958. Sherritt Gordon Mines Limited operated close to capacity.

Exploration for nickel in 1958 was more limited than in previous years. Proven and indicated reserves of nickel in Canada are the highest in the history of the industry.

The demand for nickel closely follows that for iron and steel. It began to improve in August and continued in subsequent months. Present indications are that the supply of nickel will be sufficient to meet all demands for some time to come.

Copper

The world oversupply situation which prevailed in 1956 and 1957 was carried over into 1958 despite production cutbacks by many of the large producers. A business recession in the United States in the first half of the year helped to aggravate this situation. Despite steady sales of copper in Europe and sales of copper wire to the Union of Soviet Socialist Republics (U.S.S.R.), the market was not strong enough to absorb the high level of production, and surpluses continued to increase until June. In the second half, a number of factors combined to reduce the stocks of refined copper and the year closed with the industry in a better-balanced condition.

Because of the closing of a number of mines and reduction in output from the mines of International Nickel, production of copper from Canadian ores totalled 345,114 tons, 13,995 tons below the total of the previous year.

Gold

General conditions in the gold-mining industry in 1958 showed some improvement over those of the previous year. Gold production amounted to 4,571,347 ounces, an increase of 3.1 per cent over the 1957 figure. The labour supply improved during the year, with the result that the tonnage of ore milled increased. With the exception of a strike of one week's duration at a Quebec gold mine, there were no disruptions due to labour trouble. The finding of new ore in some mines and the higher grade of the ore worked, an increase in the Royal Canadian Mint price for gold arising from a more favourable rate of exchange, and a small increase in the gold recovered from base-metal mines resulted in an increase in both the quantity and the value of the gold produced.

Ontario was the principal gold producer, with more than 59 per cent of Canada's total. Quebec followed with 23 per cent, Northwest Territories with 7 1/2 per cent and British Columbia with 4 1/2 per cent. Among the minerals produced in Canada, gold ranked fifth in value, being exceeded by petroleum, uranium, nickel and copper. Canada ranked second in the Free World in gold output, following the Union of South Africa.

Iron Ore

Shipments of iron ore in Canada in 1958 amounted to 14,041,360 long tons valued at $126,131,181. These totals were respectively 29.4 and 24.6 per cent less than those of the previous year.

The United States was the main market for Canadian iron-ore exports, although shipments to that country dropped by more than 4 million tons. Exports to the United Kingdom and Europe also declined.

During 1958 two new mines went into production, thus bringing to nine the total of operating mines. Direct-shipping ores accounted for 63.6 per cent of Canada's shipments, and concentrates and agglomerates for 20.3 and 16.1 per cent, respectively.

Despite the sharp drop in demand for iron ore in 1958, exploration and development of iron-bearing properties continued. Four companies had properties under development toward production. With these projects under way, Canada's annual production capacity should approach 35 million tons by 1962. Iron-bearing properties were actively explored by more than 100 companies in 1958.

Lead

The lead produced in Canada in 1958 came to 186,680 tons, 5,196 tons more than in 1957; but, because of lower prices, its value decreased to $42.4 million, $8.3 million less than in the preceding year.

When the year began, the price of lead was 12.25 cents a pound. By mid-year it had declined to 10.5 cents, but it subsequently advanced to 11.75 cents. The average for the year, 11.3 cents a pound, was the lowest since 1946.

Coal

Coal production continued to decline and reached the lowest level since 1911. Output in 1958 dropped to 11.6 million tons from the 13.2 million tons produced in 1957. The decline was greatest in bituminous coal produced in Alberta. This was due neither to a depletion of coal reserves nor to a lessening in the quality of the product but rather to a continuing loss of markets to oil and natural gas. The distant geographical position relative to the large coal market of central Canada has always been a handicap to the full development of the western coal fields.

Both exports and imports of coal were lower in 1958, exports being down to 339,000 tons from the 396,000 tons exported in 1957. Imports were 14.2 million tons in 1958 and 19.1 million in the previous year. Of the coal produced in Canada, 63.5 per cent originated in underground mines and 36.5 per cent in strip mines.

Reflecting increased productivity, the average output from strip and underground mines rose to 4.103 tons per man-day in 1958 from the 3.994-ton average of 1957.

Nonmetallic Minerals

Asbestos

In sympathy with the recession experienced in the first half of 1958 in the United States and Canada, asbestos shipments declined from 1,046,086 tons in 1957 to 925,331 tons in 1958. The value of shipments, which amounted to $92.3 million, was 11.7 per cent lower than in the previous year.

Strong competition was felt by Canadian producers in the European and Latin American markets. The U.S.S.R. increased exports in the first half of the year to Europe and in the latter half to Latin America.

During the summer of 1958, three new companies went into production in Quebec, and production capacity was increased by 20 per cent.

Cement

The large increase in residential construction accounted for the continued high level of cement production in 1958. Increased cement consumption has been met by an increase in the capacity of the Canadian cement industry.

Production, at 6.2 million tons, was 1.7 per cent higher than in 1957. The value of production, $96.4 million, was 3.5 per cent higher.

Two new companies started production, and this completed an expansion program within the industry that has been in continuous progress since the end of World War II. In Canada there are now 16 plants producing cement clinker, and two separate grinding plants. These production facilities are expected to be more than adequate to meet the country's demand for cement for some time to come.

Salt

Salt production in 1958 reached an all-time high of 2,375,192 tons valued at $14,989,542, increasing 34 per cent in quantity and 7 per cent in value over that of the previous year.

The increase took place chiefly in Ontario, where Canadian Brine Company, a subsidiary of The Canadian Salt Company Limited, started to supply brine to a chemical plant in Detroit, Michigan, from brine wells at Sandwich, Ontario. The brine is pumped through several 10-inch pipelines located in a trench in the river bottom.

Further increases in production capacity can soon be expected as development projects now under way are completed. Sifto Salt Limited, at Goderich, Ontario, will have a capacity of 400 tons an hour when the mine and plant are completed in late 1959.

Malagash Salt Company Limited will have a production of 1,000 tons a day when the mine at Pugwash, Nova Scotia, starts production.

Sulphur

Sulphur production from all sources amounted to 847,859 tons in 1958, 3,066 tons below the 1957 total. This includes the sulphur content of the pyrite and pyrrhotite shipped, the sulphur content of smelter gases used to make sulphuric acid and sulphur dioxide, and elemental sulphur obtained from sour natural gases.

Canada is now a major supplier of sulphur and within a few years is expected to be second only to the United States. Until a few years ago sulphur was in short supply throughout the world and all Canadian requirements of elemental sulphur were imported. The situation is now changed, sulphur being in abundant supply, and competition for markets is extremely keen. The very great demand for sulphuric acid as a leaching agent in the uranium industry and the large increase in sulphur production resulting from the rapidly expanding natural-gas industry caused substantial increases in Canadian sulphur output.

During 1958, important new developments occurred in the production of elemental sulphur. Oil and sulphur companies in western Canada increased elemental-sulphur production capacity from sour natural gas. The 1958 production of 94,377 tons is much below the present rated capacity.

The International Nickel Company of Canada, Limited, developed a new source of elemental sulphur at its Port Colborne, Ontario, nickel refinery by introducing a new process in a section of the refinery where nickel matte is used as anodes. International Nickel and Texas Gulf Sulphur Company began pilot-plant investigations on the recovery of sulphur from the roasting of pyrrhotite at the Copper Cliff iron ore recovery plant.

Lime

An all-time high was reached in the production of lime. Output, at 1,596,422 tons, was 16 per cent above that of the previous year.

Several companies expanded facilities to meet the increased demand for lime. Dominion Lime Limited placed in operation a new crushing and screening plant; Chemical Lime Limited constructed three new vertical kilns; and Cobo Minerals Limited completely rebuilt its plant at Coboconk, Ontario.

Fluorspar

The value of fluorspar production dropped 12.2 per cent to $1,542,589. Canada had no export market in 1958. This market was lost in 1957 when a Newfoundland producer completed its strategic stockpile contract with the Defense Materials Procurement Agency of the United States. In 1958 the aluminum industry, which accounts for about 80 per cent of fluorspar consumption, cut aluminum production, and this resulted in a reduction in fluorspar requirements.

Newfoundland Fluorspar Limited, at St. Lawrence, Newfoundland, continued to be Canada's main producer, supplying fluorspar entirely to the aluminum industry. Huntingdon Fluorspar Mines Limited, in Ontario, produced during the year, and a small by-product production was recorded by Pacific Silica Limited, in British Columbia.

Potash

The first Canadian production of potash took place in November 1958 at the property of Potash Company of America, Limited, at Patience Lake, in Saskatchewan. This will be included in the mineral-production statistics of Canada for 1959, since it was shipped in the early part of that year. A second company, International Minerals and Chemical Corporation, is in an advanced state of development at its property near Esterhazy in eastern Saskatchewan. About 6,400 million tons of recoverable potash stretching across the whole central part of the province from east to west have to date been outlined. They are by far the largest and richest known in the world. Their comparatively great depth and the presence in them of formations containing water under pressure through which shafts must be sunk have severely handicapped development.

Potash Company of America, Ltd., completed a shaft to 3,450 feet in June. The surface plant is capable of handling 4,000 tons of feed a day and has an annual output of 600,000 tons of processed potash. International Minerals and Chemicals Corporation has completed more than one third of its shaft and surface plant, and production is expected to start in March 1960. The plant will have an initial capacity of 400,000 tons of processed potash a year.

Gypsum

Gypsum production dropped 13.4 per cent in 1958, from 4.6 million to 4 million tons. This was the result of the strike during the first nine months of the year at the properties of Canadian Gypsum Company, Limited, near Windsor, Nova Scotia. More than 75 per cent of Canada's gypsum production is normally exported to the eastern seabord of the United States. National Gypsum (Canada) Limited has discovered a large gypsum deposit near Princeton, east of Woodstock, Ontario. This company plans to develop the deposit to supply crude gypsum to a gypsum-products plant to be constructed in this area.

Gypsum, Lime and Alabastine, Canada, Limited, acquired a gypsum deposit near Nappan, Nova Scotia. This deposit will be developed to supply crude gypsum to a company-owned gypsum-products plant in Montreal.

Clay and Clay Products

Production in 1958 consisted of domestic clay and clay products worth \$41.7 million and \$23.7 million worth of production from imported clay. The total value, \$65.4 million, was \$6.7 million greater than the previous high, reached in 1956.

Products such as face bricks, building tile and drain tile, manufactured from domestic common clay and shale, were valued at \$35.1 million and accounted for most of the increase. This was due partly to the high level of construction activity, and partly to improved and expanded manufacturing facilities, particularly in the face-brick and building-tile fields.

New tunnel-kiln brick plants were brought into production by Toronto Brick Company Limited, Toronto, Ontario, and C. and M. Pelly Limited, Milton P. O., Newfoundland. A start on construction of a new tunnel-kiln brick plant was made by Diamond Clay Products Limited, near Burlington, Ontario. Canadian Potteries Limited built a large modern vitreous-china-sanitary-ware plant at Coquitlam, British Columbia. Canadian Ohio Brass Company Limited, Niagara Falls, Ontario, and Canadian Porcelain Company Limited, manufacturers of high-tension electrical porcelain, brought new tunnel kilns into production early in 1958. The last three companies use large quantities of imported china clay because no deposits are operated commercially in Canada.

Deposits of good-quality stoneware-type clays were developed during 1957 and 1958 by L. E. Shaw Limited at Shubenacadie, Nova Scotia, and by Medicine Hat Brick and Tile Company Limited, in the Cypress Hills of Alberta. A clay-processing was established at Assiniboia, Saskatchewan, to develop the use of Saskatchewan ball clays and kaolins.

CANADA'S ROLE IN THE WORLD AS A PRODUCER OF CERTAIN IMPORTANT MINERALS, 1958

METAL OR NONMETAL	WORLD PRODUCTION	RANK					
		1	2	3	4	5	6
Nickel (short tons)	249,000 100%	CANADA 139,559 56.0%	U.S.S.R. 58,000 23.3%	Cuba 19,782 7.9%	New Caledonia 13,400 5.4%	U.S.A. 11,740 4.7%	Union of S.A. 3,800 1.5%
Asbestos (short tons)	2,060,000 100%	CANADA 925,331 44.9%	U.S.S.R. 550,000 26.7%	Union of S.A. 175,644 8.5%	S. Rhodesia 127,115 6.2%	U.S.A. 43,979 2.1%	Italy 39,627 1.9%
Uranium (short tons)	44,000 100%	CANADA 13,403 30.5%	U.S.A. 12,560 28.5%	Union of S.A. 6,245 14.2%	U.S.S.R. 6,000 13.6%	Belgian Congo 3,450 7.8%	Australia 700 1.6%
Zinc (short tons)	3,097,988 100%	CANADA 425,099 13.7%	U.S.S.R. 410,000 13.2%	U.S.A. 412,005 13.3%	Australia 247,472 8.0%	Mexico 247,031 8.0%	Japan 157,599 5.1%
Aluminum (short tons)	3,880,657 100%	U.S.A. 1,565,557 40.3%	CANADA 634,102 16.3%	U.S.S.R. 600,000 15.5%	France 186,230 4.8%	W. Germany 150,757 3.9%	Norway 134,009 3.5%
Platinum and platinum metals (troy ounces)	880,000 100%	Union of S.A. 305,000 34.7%	CANADA 300,458 34.1%	U.S.S.R. 250,000 28.4%	Colombia 16,036 1.8%	U.S.A. 14,322 1.6%	Japan 643 0.07%
Gypsum (000's short tons)	36,660 100%	U.S.A. 9,600 26.2%	U.K. 4,470 12.2%	CANADA 3,964 10.8%	France 3,860 10.5%	U.S.S.R. 3,300 9.0%	Spain 1,160 3.2%
Bismuth (pounds)	4,600,000 100%	Peru 851,560 18.5%	Mexico 417,700 9.1%	CANADA 412,792 9.0%	Bolivia 244,700 5.3%	Korea 198,000 4.3%	Yugoslavia 169,670 3.7%
Cadmium (pounds)	19,900,000 100%	U.S.A. 9,673,000 48.6%	S.W. Africa 2,698,000 13.6%	CANADA 1,756,050 8.8%	Mexico 1,697,000 8.5%	Belgium 1,438,000 7.2%	Belgian Congo 1,075,000 5.4%
Gold (troy ounces)	40,400,000 100%	Union of S.A. 17,656,442 43.7%	U.S.S.R. 10,000,000 24.8%	CANADA 4,571,347 11.3%	U.S.A. 1,801,005 4.5%	Australia 1,098,914 2.7%	Ghana 851,433 2.1%

Silver (troy ounces)	236,800,000 100%	Mexico 47,591,259 20.1%	U S.A. 35,691,000 15.1%	CANADA 31,163,470 13.2%	U.S.S.R. 25,000,000 10.6%	Peru 25,917,755 10.9%	Australia 16,270,000 6.9%
Titanium concentrates (ilmenite) (short tons)	1,710,900 100%	U.S.A. 563,338 32.9%	India 346,080 20.2%	Norway 233,585 13.7%	CANADA 166,728 9.7%	Finland 117,384 6.9%	Malaya 83,806 4,9%
Magnesium (short tons)	103,900 100%	U.S.S.R. 45,000 43.3%	U.S.A. 30,096 29.0%	Norway 10,132 9.8%	CANADA 6,796 6.5%	Italy 4,661 4.5%	U.K. 2,691 2.6%
Molybdenum (short tons)	28,850 100%	U.S.A. 20,535 71,2%	U.S.S.R. 4,650 16.1%	Chile 1,486 5.1%	CANADA 444 1,5%	Japan 342 1.2%	Norway 241 0.8%
Cobalt (pounds)	29,200,000 100%	Belgian Congo 14,332,000 49.1%	U.S.A. 4,024,000 13.8%	N. Rhodesia 3,548,000 12.2%	CANADA 2,710,429 9.3%	Fr. Morocco 2,042,000 7.0%	New Caledonia 286,000 1.0%
Pyrites (sulphur content) (short tons)	8,288,000 100%	Japan 1,488,480 18.0%	Italy 757,120 9.1%	Cyprus 543,200 6.6%	CANADA 512,427 6.2%	U.S.A. 451,360 5.4%	Norway 375,200 4.5%
Copper (short tons)	3,756,481 100%	U.S.A. 990,253 26.4%	U.S.S.R. 510,000 13.6%	Chile 509,541 13.6%	N. Rhodesia 441,072 11.7%	CANADA 345,114 9.2%	Belgian Congo 261,865 7.0%
Lead (short tons)	2,379,486 100%	Australia 347,880 14.6%	U.S.S.R. 340,000 14.3%	U.S.A. 267,377 11.2%	Mexico 222,580 9.4%	CANADA 186,680 7.8%	Peru 147,887 6.2%
Barite (short tons)	2,600,000 100%	U.S.A. 486,287 18.7%	W. Germany 409,105 15.7%	Greece 227,091 8.7%	Mexico 217,350 8.4%	CANADA 195,719 7.5%	U.S.S.R. 130,000 5.0%
White arsenic (short tons)	40,000 100%	U.S.A. 11,508 28.8%	Sweden 11,000 27.5%	France 6,200 15.5%	Mexico 3,411 8.5%	Japan 1,540 3.8%	CANADA 1,162 2.9%

Note: The figures for the U.S.S.R. are estimates only.

Canada in Relation to the World

Canada ranks high as a producer of minerals, leading the world in 1958 in the production of four important ones, namely, nickel, asbestos, uranium and zinc. It ranked second with two minerals, third with five, fourth with five, fifth with three and sixth with one.

The table on pages and shows total world production and the production of the six countries leading in the more important minerals.

Trade

Exports of Minerals and Products

Exports of minerals and products in 1958 amounted to $1,709.4 million, $163.3 million, or 8.7 per cent, below the 1957 total. Exports of minerals in the raw state increased$21.4 million in value, but their value in the semiprocessed and fully fabricated state was below that of the previous year. Minerals in all degrees of manufacture represented 35.4 per cent of Canada's trade in 1958 instead of 38.7 per cent, as in 1957. In the raw and semifabricated state, mineral exports accounted for 28.2 per cent of Canada's export total.

Exports of Minerals and Their Products
($ millions)

	1958	1957	Increase or Decrease $ Millions	%
Iron and its products				
Raw material	107.7	152.3	- 44.6	- 29.3
Semiprocessed	43.4	89.4	- 46.0	- 51.5
Fully manufactured	281.3	277.1	+ 4.2	+ 1.5
Total	432.4	518.8	- 86.4	- 16.7
Nonferrous metals and products				
Raw material	425.4	303.2	+ 122.2	+ 40.3
Semiprocessed	557.2	656.3	- 99.1	- 15.1
Fully manufactured	44.0	46.7	- 2.7	- 5.8
Total	1,026.6	1,006.2	+ 20.4	+ 2.0
Nonmetallic minerals and products (including fuels)				
Raw material	143.1	199.3	- 56.2	- 28.2
Semiprocessed	84.1	107.9	- 23.8	- 22.1
Fully manufactured	23.2	40.5	- 17.3	- 42.7
Total	250.4	347.7	- 97.3	- 28.0
Total, minerals and their products				
Raw material	676.2	654.8	+ 21.4	+ 3.3
Semiprocessed	684.7	853.6	- 168.9	- 19.8
Fully manufactured	348.5	364.3	- 15.8	- 4.3
Total	1,709.4	1,872.7	- 163.3	- 8.7

Exports of Minerals and Their Products
in Relation to Total Export Trade

	1958		1957	
	$ Millions	% of Total	$ Millions	% of Total
Raw material	676.2	14.0	654.8	13.5
Semiprocessed	684.7	14.2	853.6	17.7
Fully manufactured	348.5	7.2	364.3	7.5
Total	1,709.4	35.4	1,872.7	38.7
Total, exports of all products	4,826.4	100.0	4,839.1	100.0

Exports of Minerals and Their Products,
by Destination, 1958
($ millions)

	United Kingdom	United States	Other Countries	Total
Iron and its products	24.6	249.3	158.5	432.4
Nonferrous metals and products	225.3	601.6	199.7	1,026.6
Nonmetallic minerals and products.	16.7	191.8	41.9	250.4
Total, minerals and products	266.6	1,042.7	400.1	1,709.4
Percentage	15.6	61.0	23.4	100.0

Imports of Minerals and Products

In 1958, imports of minerals in all degrees of manufacture from raw materials to fully fabricated goods were worth $2,967.3 million, 57.1 per cent of the value of Canada's imports. Fully manufactured products of mineral origin, chiefly in the iron-and-steel group, were worth $2,437.6 million, or 82.1 per cent of the total mineral-import value. Imports of minerals in the raw and semiprocessed state were valued at $529.7 million, or 17.9 per cent of this total.

Imports of Minerals and Their Products
($ millions)

	1958	1957	Increase or Decrease $ Millions	%
Iron and its products				
Raw material	28.9	36.4	- 7.5	- 20.6
Semiprocessed	15.8	28.1	- 12.3	- 43.8
Fully manufactured	1,807.5	2,066.5	- 259.0	- 12.5
Total	1,852.2	2,131.0	- 278.8	- 13.1
Nonferrous metals and products				
Raw material	39.3	66.6	- 27.3	- 41.0
Semiprocessed	30.3	39.7	- 9.4	- 23.7
Fully manufactured	362.6	378.6	- 16.0	- 4.2
Total	432.2	484.9	- 52.7	- 10.9
Nonmetallic minerals and products (including fuels)				
Raw material	399.2	457.8	- 58.6	- 12.8
Semiprocessed	16.2	21.8	- 5.6	- 25.7
Fully manufactured	267.5	298.1	- 30.6	- 10.3
Total	682.9	777.7	- 94.8	- 12.2
Total, minerals and products				
Raw material	467.4	560.8	- 93.4	- 16.7
Semiprocessed	62.3	89.6	- 27.3	- 30.5
Fully manufactured	2,437.6	2,743.2	- 305.6	- 11.1
Total	2,967.3	3,393.6	- 426.3	- 12.6

Imports of Minerals and Their Products
in Relation to Total Import Trade

	1958		1957	
	$ Millions	% of Total	$ Millions	% of Total
Raw material	467.4	9.0	560.8	10.0
Semiprocessed	62.3	1.2	89.6	1.6
Fully manufactured	2,437.6	46.9	2,743.2	48.8
Total	2,967.3	57.1	3,393.6	60.4
Total, imports of all products	5,192.4	100.0	5,623.4	100.0

Imports of Minerals and Their Products, by Source, 1958
($ millions)

	United Kingdom	United States	Other Countries	Total
Iron and products	205.2	1,520.3	126.7	1,852.2
Nonferrous metals and products	64.0	287.1	81.1	432.2
Nonmetallic minerals and products	30.1	296.5	356.3	682.9
Total, minerals and products	299.3	2,103.9	564.1	2,967.3
Percentage	10.1	70.9	19.0	100.0

Prices of Minerals and Products

Mineral prices were generally lower in 1958 than in 1957. The lower wholesale price level of minerals and products reflected the weak market conditions resulting from the 1957-58 recession. The wholesale price average of nonferrous metals and products was down 4.9 per cent, that of nonmetallic minerals and products 0.4 per cent, and that of iron and steel and products 0.04 per cent.

The following table shows that the average 1958 prices of the main minerals were, with few exceptions, below those of the previous year.

Average Annual Prices,* Main Minerals, 1957 and 1958

	1958	1957	Increase or Decrease: Cents or Dollars	Increase or Decrease: Percentage
Aluminum ingot, cents per lb	26.890	27.516	- 0.626	- 2.3
Antimony, N.Y., boxed, cents per lb	33.075	36.590	- 3.515	- 9.6
Bismuth, cents per lb	2.25	2.25	-	-
Cadmium, cents per lb	152.300	169.650	-17.350	-10.2
Calcium, dollars per lb	2.05	2.05	-	-
Chromium metal, dollars per lb	1.26	1.29	- 0.03	- 2.3
Cobalt metal, dollars per lb	2.00	2.03	- 0.03	- 1.5
Cobalt ore 10% Co, free market, f.o.b. shipping point, cents per lb Co contained	60.00	60.00	-	-
Copper, U.S. domestic, cents per lb	25.764	29.576	- 3.812	-12.9
Gold, Canadian dollars per oz	33.98	33.55	+ 0.43	+ 1.3

(table continued)

Average Annual Prices,* Main Minerals, 1957 and 1958 (cont'd)

	1958	1957	Increase or Decrease	
			Cents or Dollars	Percentage
Iron ore 51.5% Fe, dollars per l.t., Lower Lake ports:				
Mesabi, non-Bessemer	11.45	11.40	+ 0.05	+ 0.4
Mesabi, Bessemer	11.60	11.55	+ 0.05	+ 0.4
Old Range, non-Bessemer	11.70	11.65	+ 0.05	+ 0.4
Old Range, Bessemer	11.85	11.80	+ 0.05	+ 0.4
Lead, Common, N.Y., cents per lb	12.109	14.658	- 2.549	-17.4
Magnesium ingot, cents per lb	35.250	35.250	-	-
Mercury, dollars per flask (76 lb)	229.057	246.978	-17.921	- 7.3
Molybdenum metal, dollars per lb	3.35	3.35	-	-
Molybdenite 90-95% MoS_2, dollars per lb Mo contained	1.19	1.18	+ 0.01	+ 0.8
Nickel, f.o.b. Port Colborne (duty included), cents per lb	74.000	74.000	-	-
Platinum, dollars per oz	64.924	89.374	-24.450	-27.4
Selenium, dollars per lb	7.083	11.375	- 4.292	-37.7
Silver, N.Y., cents per oz	89.044	90.820	- 1.776	- 2.0
Sulphur, dollars per l.t.	23.50	25.75	- 2.25	- 8.7
Tin, Straits, N.Y., cents per lb	95.127	96.261	- 1.134	- 1.2
Titanium metal, dollars per lb	2.03	2.46	- 0.43	-17.5
Titanium ore (ilmenite) 59.5% TiO_2, f.o.b. Atlantic ports, dollars per l.t.	24.00 to 28.00	26.25 to 30.00		
Tungsten metal, dollars per lb	3.15	4.00	- 0.85	-21.2
Zinc, Prime Western, East St. Louis, cents per lb	10.309	11.399	- 1.090	- 9.6

*Except in the case of gold, prices are United States prices (U.S. currency) from E & M J Metal and Mineral Markets. Canadian prices follow closely.

Employment, Salaries and Wages

The number of employees in Canada's mineral industry, both salaried and wage-earning, totalled 139,540 in 1958. This includes employees of the nonferrous-smelting and -refining industry. Between 1938 and 1948 employment in the mineral industry increased 5.2 per cent; between 1948 and 1958 it increased 23.6 per cent.

During the 1938-58 period salaries and wages paid to workers employed in the mineral industry increased substantially. The annual average of salaries and wages of mineral-industry employees increased from $1,357 in 1938 to $4,375 in 1958, or 222 per cent. Between these two years the number of employees increased 30 per cent.

Employment in the metal-mining industry during the 20 years between 1938 and 1958 increased 42 per cent. In the smelting-and-refining industry, owing to the increase in refining facilities for the production of aluminum, employment increased 111 per cent. The number engaged in the production of industrial minerals increased 53 per cent in this period. In the production of mineral fuels, however, employment, reflecting the decrease in coal-mining activity, decreased 53 per cent. The employment figures for fuels represented in the following table exclude workers employed by companies engaged solely in petroleum and natural-gas exploration.

Employment and Salaries and Wages, Canadian Mineral Industry

	1938		1943		1948		1953		1958	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Metal-mining	43,703	74.9	37,575	80.0	41,890	114.7	51,711	191.4	61,999	289.6
Smelting and refining	12,788	19.5	26,749	48.5	19,701	52.8	25,115	94.5	26,959	131.1
Industrial minerals	19,850	17.3	17,062	23.7	23,473	48.7	26,446	83.3	30,356	114.2
Fuels	30,934	33.9	30,754	55.4	27,791	65.8	26,766	83.9	20,226	75.6
Total	107,275	145.6	112,140	207.6	112,855	282.0	130,038	453.1	139,540	610.5
		$		$		$		$		$
Annual average of salaries and wages		1,357		1,851		2,499		3,484		4,375

(1) Number of employees.
(2) Millions of dollars.

The average annual wage of wage earners employed in the metal-mining industry increased from $1,652 in 1938 to $4,525 in 1958, or 173.9 per cent. At the same time there was an increase of 86.3 per cent in the average annual tonnage of ore mined per worker. The wage cost, per ton of ore mined, increased from $2.06 in 1938 to $3.02 in 1958, or 47 per cent.

Between 1951, the earliest year for which pertinent data are available, and the end of 1958 man-hours worked increased 61 per cent in metal mines and 9 per cent in the production of industrial minerals. Tonnage of ore mined in metal mines increased from 48.4 million in 1951 to 78.8 million in 1958, or 63 per cent, while in industrial minerals the tonnage mined increased 79 per cent - from 43.8 million to 78.5 million.

Labour Costs in Relation to Tons Mined in Metal Mines

	Number of Workmen	Total Wages	Average Annual Wage	Tonnage Mined	Average Annual Tonnage Mined per Worker	Wage Cost per Ton Mined
	(wage earners)	($ millions)	($)	(000 s.t.)	(s.t.)	($)
1958						
Auriferous-quartz mines	15,035	54.9	3,651	14,767	982	3.72
Copper-gold-silver mines	7,364	32.0	4,345	11,485	1,560	2.79
Nickel-copper mines	8,146	39.6	4,861	12,862	1,579	3.08
Silver-cobalt mines	492	1.8	3,659	224	455	8.04
Silver-lead-zinc mines	3,688	16.3	4,420	5,890	1,597	2.77
Iron-ore mines	6,079	28.5	4,688	20,357	3,349	1.40
Miscellaneous metal mines	11,836	65.1	5,500	13,171	1,113	4.94
Total, metal mines	52,640	238.2	4,525	78,756	1,496	3.02
1948						
Auriferous-quartz mines	20,411	51.8	2,538	13,631	668	3.80
Copper-gold-silver mines	5,640	15.3	2,713	6,497	1,152	2.35
Nickel-copper mines	6,411	18.4	2,870	11,688	1,823	1.57
Silver-cobalt mines	147	0.3	2,041	9	61	33.33
Silver-lead-zinc mines	3,499	9.5	2,715	3,148	900	3.02
Iron-ore mines	924	3.0	3,247	1,237	1,339	2.43
Miscellaneous metal mines	214	0.5	2,336	667	3,117	0.75
Total, metal mines	37,246	98.8	2,653	36,877	990	2.68
1938						
Auriferous-quartz mines	26,938	44.3	1,645	14,750	548	3.00
Copper-gold-silver mines	5,144	7.8	1,516	7,930	1,542	0.98
Nickel-copper mines	5,260	9.6	1,825	6,283	1,194	1.53
Silver-cobalt mines	262	0.3	1,145	59	225	5.08
Silver-lead-zinc mines	1,403	2.5	1,782	2,387	1,701	1.05
Iron-ore mines	-	-	-	-	-	-
Miscellaneous metal mines	90	0.1	1,111	1	11	100.00
Total, metal mines	39,097	64.6	1,652	31,410	803	2.06

The number of man-hours worked per ton of ore mined in metal-mining dropped 30 per cent - from 2.43 in 1951 to 1.70 in 1958; in industrial minerals it declined from 1.39 to 1.19, or 17 per cent.

Man-hours Worked and Tonnages of Ore Mined in Metal Mines and in Production of Industrial Minerals

	Metal Mines			Industrial Minerals		
	Tonnage of Ore Mined	Man-hours Worked	Man-hours Worked per Ton Mined	Tonnage of Ore Mined	Man-hours Worked	Man-hours Worked per Ton Mined
	(millions s.t.)	(millions)		(millions s.t.)	(millions)	
1951	48.8	118.5	2.43	43.9	61.1	1.39
1952	52.3	125.7	2.40	44.2	61.9	1.40
1953	54.4	113.5	2.08	47.2	61.7	1.31
1954	59.0	112.6	1.91	61.5	62.5	1.02
1955	69.2	117.4	1.70	63.5	66.8	1.05
1956	77.3	127.1	1.64	73.1	68.5	0.94
1957	84.3	136.4	1.62	82.1	70.1	0.85
1958	78.8	134.3	1.70	78.5	66.3	1.19

Ore Mined and Rock Quarried

Between 1956 and 1958, the tonnage of ore mined and rock quarried in the mineral industry increased 4.6 per cent. The tonnage of metallic ores mined increased 1.9 per cent - from 77.3 to 78.8 million tons. This advance was principally the result of an increase in the tonnages obtained in the iron-ore- and uranium-mining industries. In the same period, the tonnages of ore mined and stone quarried in the industrial-mineral group, inclusive of structural materials, increased 7.4 per cent.

Tonnages of Ore Mined and Rock Quarried in the Canadian Mineral Industry

(millions of short tons)

	1956	1957	1958
Metallic ores			
Gold-quartz	14.5	14.4	14.8
Copper-gold-silver	10.4	10.6	11.5
Silver-cobalt	0.2	0.2	0.2
Silver-lead-zinc	7.7	6.7	5.9
Nickel-copper	18.5	19.3	12.9
Iron	23.9	26.4	20.3
Miscellaneous metallic	2.1	6.7	13.2
Total, metallic ores	77.3	84.3	78.8

(continued)

Taxes Paid by Five Important Divisions of the Mineral Industry

($ millions)

	1958	1957	1956	1955	1954	1953
Auriferous quartz mining industry	6.1	5.9	6.2	6.2	5.9	5.4
Copper-gold-silver mining industry	8.5	19.2	26.1	18.1	13.0	15.8
Silver-lead-zinc mining-and-smelting industry	10.8	12.7	20.8	23.0	16.6	15.0
Nickel-copper mining, smelting and refining industry	22.4	46.6	48.9	24.6	27.6	30.4
Asbestos-mining industry	11.4	12.1	11.7	9.2	9.2	14.8
Total	59.2	96.5	113.7	81.1	72.3	81.4

Taxes Paid to Federal, Provincial and Municipal Governments by Five Important Divisions of the Mineral Industry, 1958

	Federal Income Tax	Provincial Tax	Municipal Tax	Total
Auriferous quartz mining industry	3,087,316	2,251,167	753,675	6,092,158
Copper-gold-silver mining industry	3,884,364	3,155,812	1,515,048	8,555,224
Silver-lead-zinc mining-and-smelting industry	6,887,017	2,831,304	1,048,644	10,766,965
Nickel-copper mining, smelting and refining industry	12,575,448	8,266,048	1,550,379	22,391,875
Asbestos-mining industry	6,266,041	3,994,348	1,130,814	11,391,203
Total	32,700,186	20,498,679	5,998,560	59,197,425

Federal income tax declared by all companies in the mineral industry amounted to $62.9 million for the fiscal year ended March 31, 1957. This amounted to 5.5 per cent of the federal income tax declared by all Canadian industry.

Certain industrial groups classified under manufacturing are closely dependent on the mineral industry. These groups are listed in the following table under metallurgical and metal-fabricating industries, nonmetallic mineral products, and petroleum and products. The declared income tax of companies in these classes amounted to $213.4 million for the same fiscal period and, together with that of the mineral-industry group, amounted to $276.3 million, or 24.3 per cent of all federal income tax declared.

Federal Income Tax Declared by Companies
in the Mining and Related Industries,
Fiscal Year Ended March 31, 1957

($ millions)

Mining, quarrying and oil wells	
Gold-mining	2.5
Other metal-mining	39.0
Coal-mining	0.7
Oil and natural gas	9.6
Nonmetal mining	7.0
Quarries	2.4
Mineral and oil prospecting	1.7
Total	62.9
Metallurgical and metal-fabricating industries	
Iron castings	12.2
Primary iron and steel	37.4
Agricultural implements	5.9
Boilers and fabricated structural steel	12.6
Hardware and tools	5.2
House, office and store machinery	10.1
Machine-shop products	1.8
Machine tools	1.0
Miscellaneous machinery	16.7
Sheet-metal products	9.6
Wire and wire products	4.2
Miscellaneous iron and steel products	4.5
Aluminum products	1.0
Other nonferrous metal products	6.0
Total	128.2
Nonmetallic mineral products	
Abrasives, asbestos, cement and clay products	11.7
Miscellaneous nonmetallic mineral products	7.2
Fertilizers and industrial chemicals	6.0
Total	24.9
Petroleum and products	
Petroleum refining and products	44.0
Miscellaneous petroleum and coal products	3.7
Fuel, gasoline and other petroleum products	12.6
Total	60.3
Total, mining and related industries	276.3
Total, all industry	1,135.8

Capital Employed in the Mineral Industry

It is estimated that the capital employed in the Canadian mining and smelting industry at the end of 1955 totalled $3,400 million. Of this, $1,300 million, or 38.2 per cent, was resident-owned capital. Of the $2,100 million balance that made up nonresident-owned capital, $1,900 million was owned in the United States.

Capital Employed in the Mineral Industry

($ millions)

	Resident-owned	Nonresident-owned	Total Capital Employed
1926	400	200	600
1930	500	300	800
1939	500	300	800
1948	700	400	1,100
1951	800	800	1,600
1952	900	1,100	2,000
1953	1,100	1,400	2,500
1954	1,300	1,700	3,000
1955	1,300	2,100	3,400

The figures in the table above include total investment in petroleum extraction, exploration and development. Investment in petroleum-refining, merchandising and transportation not included, amounted to $1,500 million at the end of 1955.

Capital and Repair Expenditures

The forecast survey of industry's expenditures on capital and repairs indicates that in 1959 the mineral industry will expend $549 million on new capital construction and equipment and on repairs to existing plant and equipment. This includes amounts to be spent by the nonferrous-smelting and -refining industry but excludes petroleum-refining and marketing and the primary iron and steel industries. This anticipated expenditure is 3.7 per cent below that of 1958 and is 5 per cent of the capital and repair expenditures of all industries.

Consumption of Fuels and Electricity

The Canadian mineral industry in 1958 consumed $154.7 million worth of fuel and electricity. This includes a total of $63.5 million used by the smelting-and-refining industry, of which $23.4 million was for mineral fuels and $40.1 million was the value of purchased electricity. In the production of industrial minerals, the value of mineral fuels consumed amounted to $34.7 million; in metal-mining it amounted to $13.1 million. Metal-mining, smelting and refining, however, accounted for 77 per cent of the value of the purchased electricity used. This percentage is high because of the large quantities of electricity consumed in refining aluminum and other nonferrous metals. In addition to the fuels and electricity purchased, electricity generated by the mineral industry in 1958 for its own use amounted to 1,565 million kwh. The value of this electricity is not available.

Consumption of Fuel and Electricity in the Canadian Mineral Industry, 1958

	Metal-mining	Smelting and Refining	Total, Metal-mining, Smelting and Refining	Industrial Minerals	Mineral Fuels	Total, Mineral Industry
Coal and coke						
Short tons	214,867	1,003,466	1,218,333	1,578,874	135,355	2,932,562
$	3,388,693	15,419,635	18,808,328	18,208,412	991,088	38,007,828
Gasoline and kerosene						
Gal	3,561,319	807,714	4,369,033	12,523,993	5,890,123	22,783,149
$	1,405,132	279,371	1,684,503	4,522,326	2,286,515	8,493,344
Fuel oil						
Gal	41,482,690	72,425,670	113,908,360	63,782,161	5,846,527	183,537,048
$	7,756,694	7,326,409	15,083,103	8,087,280	1,181,254	24,351,637
Liquefied petroleum gas						
Gal	237,786	45,168	282,954	174,291	654,880	1,112,125
$	97,381	16,816	114,197	62,932	221,478	398,607
Manufactured gas						
M cu ft	14,117	117,354	131,471	974,143	6,520	1,112,134
$	7,185	78,420	85,605	243,590	2,181	331,376
Natural gas						
M cu ft	144,231	1,909,312	2,053,543	12,816,604	6,786,559	21,656,706
$	24,159	249,789	273,948	3,190,937	672,882	4,137,767
Other fuels						
$	407,061	70,279	477,340	382,839	3,030	863,209
Total, fuels						
$	13,086,305	23,440,719	36,527,024	34,698,316	5,358,428	76,583,768
Electricity purchased*						
Millions of kwh	4,527	15,081	19,608	1,435	331	21,374
$	20,023,718	40,081,679	60,105,397	11,953,163	6,012,313	78,070,873
Total value fuels and electricity purchased						
$	33,110,023	63,522,398	96,632,421	46,651,479	11,370,741	154,654,641
Electricity generated for own use						
Millions of kwh	478	1,039	1,517	34	14	1,565

*To obtain total kwh of electricity consumed add electricity generated for own use.

ALUMINUM

W.H. Jackson

Canadian production of primary aluminum in 1958 amounted to 634,102* tons. The previous peak - 620,321 tons - was reached in 1956, when the industry was operating close to its 650,000-ton capacity. Capacity, which was 821,000 tons at the beginning of 1958, had increased to 866,000 tons by year-end. The business decline that began in late 1957 continued to affect world markets in 1958 because the rate of increase of the total demand was not sufficient to absorb the output of all reduction facilities. As Canadian production is directed towards export markets, it was necessary to curtail output at some plants in order to balance supply and demand. Inventory build-up also accounted for some of the year's output.

Domestic consumption of primary ingot accounted for 16.1 per cent of production in 1958. Producers' domestic shipments, a measure of consumption, were 101,886 tons; on the basis of end-use statistics, 1957 consumption was estimated to be 93,478 tons. Owing to a strike which reduced shipments to only 77,984 tons, producers' 1957 shipments cannot be used for direct comparison.

The value of aluminum exports in 1958 was $223,619,621, or 5 per cent of Canada's export trade with all countries. The percentage composition of aluminum exports on the basis of value is as follows: primary forms, 93.4; semifabricated, 4.6; scrap, 1.5; manufactured, 0.5. These ratios are little changed from those of previous years except that the tonnage of primary forms exported increased while dollar value declined.

The United States is the largest market for Canada's output of primary forms. Shipments amounted to 213,147 tons, or 44 per cent of Canadian exports and 90 per cent of United States imports. Another 33 per cent, or 159,232 tons, went to the United Kingdom. This was 14,171 tons lower than the 1957 sales of Canadian aluminum in that country. Of particular interest is the increase in shipments to countries now forming the European Common Market and the increase of more than 100 per cent in shipments to Australia, Mexico and Spain.

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*Short tons (2,000) pounds are used throughout this review.

Aluminum - Production, Trade and Consumption

	1958		1957	
	Short tons	$	Short tons	$
Production				
Ingot	634,102		556,715	
Imports				
Bauxite and alumina				
British Guiana	1,400,075	7,623,166	1,111,014	6,145,576
Jamaica	291,818	18,506,245	363,946	23,312,851
French Africa	233,504	1,271,616	338,175	1,838,769
Surinam	215,840	1,249,074	371,716	2,075,284
France	25,257	1,633,262	7,073	303,188
United States	2	775	64,208	4,375,545
Japan	-	-	13,354	780,136
Total	2,166,496	30,284,138	2,269,486	38,831,349
Cryolite				
Denmark	4,502	883,040	6,697	1,370,306
Italy	1,653	312,286	4,717	1,007,309
France	560	101,888	-	-
Other countries	120	30,427	4,504	930,684
Total	6,835	1,327,641	15,918	3,308,299
Aluminum products				
Semimanufactured.		9,992,671		5,266,381
Fullymanufactured.		19,674,616		22,588,720
Total		29,667,287		27,855,101
Exports				
Primary forms				
United States	213,147	92,568,071	215,544	95,816,699
United Kingdom	159,232	68,108,123	173,403	78,956,383
West Germany	28,462	12,544,971	18,952	8,987,814
Australia	15,995	6,868,730	7,430	3,750,509
Mexico	11,891	5,108,335	5,976	2,826,722
Belgium	9,718	4,308,331	3,113	1,550,549
Brazil	5,985	2,647,384	5,640	2,697,800
Spain	5,196	2,208,652	2,912	1,351,118
France	3,740	1,638,968	1,504	730,402
Other countries	29,561	12,840,021	44,196	20,760,518
Total	482,927	208,841,586	478,670	217,428,514
Semifabricated				
India	8,320	4,386,662	4,482	2,624,853
United States	3,169	2,669,564	3,294	2,848,983
United Kingdom	2,068	886,737	-	-
New Zealand	1,038	651,062	543	444,407
Portugal	444	229,704	105	60,316
Venezuela	391	243,228	254	187,935
Other countries	1,960	1,246,118	3,915	2,442,325
Total	17,390	10,313,075	12,593	8,608,819

Aluminum - Production, Trade and Consumption (cont'd)

	1958		1957	
	Short tons	$	Short tons	$
Exports (cont'd)				
Manufactured				
United States		368,952		301,955
Venezuela		148,499		129,373
India		114,857		5,696
Cuba		110,930		33,995
Other countries ...		433,936		638,452
Total		1,177,174		1,109,471
Scrap				
United States	10,022	2,530,105	9,100	2,235,349
West Germany	1,566	449,347	1,160	307,648
Italy	835	255,348	877	327,999
Other countries ...	190	52,986	1,242	477,487
Total	12,613	3,287,786	12,379	3,348,483
Consumption*				
Ingot	101,886		77,984	

*Producers' domestic shipments.

Aluminum - Production, Trade and Consumption, 1948-58
(short tons)

	Production (ingot)	Imports (primary forms)	Exports (primary forms)	Consumption (ingot)
1948	367,079	25	327,108	65,433
1949	369,466	40	296,906	58,767
1950	396,882	63	335,727	65,185
1951	447,095	270	354,414	86,241
1952	499,758	13	412,590	90,287
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	482,927	101,886

Primary Production

Aluminum Company of Canada Limited (ALCAN)

A wholly owned subsidiary of Aluminium Limited, the company is engaged primarily in the production of aluminum metal. Its reduction plants have an annual installed primary capacity of 776,000 tons, which is distributed among the individual plants as follows: Kitimat, 186,000 tons; Arvida, 367,000 tons; Beauharnois, 38,000 tons; Isle Maligne, 115,000 tons; and Shawinigan, 70,000 tons.

To service these plants with raw materials, the company maintains shipping and docking facilities through subsidiary companies. Bauxite mines and processing plants in Jamaica and British Guiana are operated respectively by Alumina Jamaica Limited and Demerara Bauxite Company Limited. In Canada, in addition to its reduction facilities and alumina plant, extensive facilities are operated to process or manufacture other commodities necessary to aluminum production. Fabricating plants are located at Kingston and Etobicoke in Ontario and at Vancouver in British Columbia. These plants produce aluminum and aluminum-alloy sheet, strip and foil, extruded shapes and tubes, rod and cable, forgings and castings.

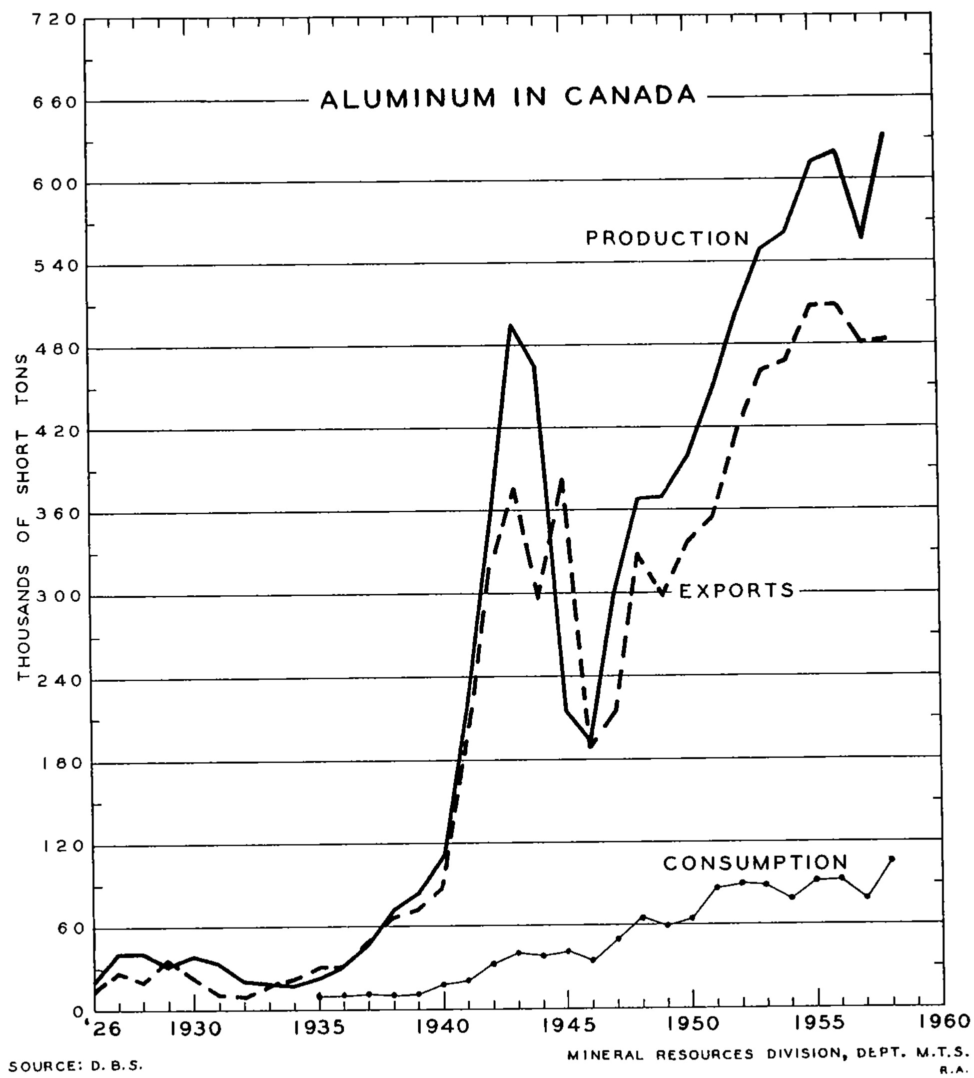
Efficient production of aluminum requires the availability of firm electrical power. Except at the Beauharnois plant near Montreal, the company has developed its own hydroelectric facilities. In the Saguenay district of Quebec 2,600,000 horsepower is installed, of which perhaps 1,500,000 is firm. Upon completion of the Chute-des-Passes project in 1959 another 1 million horsepower will be available. In British Columbia the Kemano plant, which services the Kitimat smelter, has a generating capacity of 1,050,000 horsepower.

While ALCAN has deferred completion of certain planned additions to its smelting capacity, expansion can be rapidly carried out when markets warrant it, owing to continuing development of bauxite, alumina and electrical plants. Despite successive reductions in its operating rate, which at year-end was about 65 per cent of capacity, the company produced 600,400 tons of virgin aluminum in 1958.

Canadian British Aluminium Company Limited

Two stages of the company's new smelter facilities at Baie Comeau, Quebec, are complete. The plant, which has a capacity of 90,000 tons a year, went into full production early in 1959. Output in 1958 was mostly in the form of ingot, though plans have been made for the installation of equipment to produce rolling slab, extrusion billet and wire bar.

Electricity is supplied by the Manicouagan Power Company and by the Bersimis power station of the Quebec Hydro-Electric Commission. Under the terms of an agreement with ALCAN, alumina is supplied from Arvida and payment is made in the form of aluminum metal. Conveniently located docking



facilities for deep-sea vessels facilitate ingot shipments from the plant to overseas markets.

The greater part of production is now exported to British Aluminium Company Limited in the United Kingdom. However, the incorporation of a new company, Phillips/CBA Conductors Limited, will provide an outlet for ingot in Canada. This company will manufacture aluminum rod, wire and cable in a plant to be constructed at Brockville, Ontario.

Aluminum Fabricators

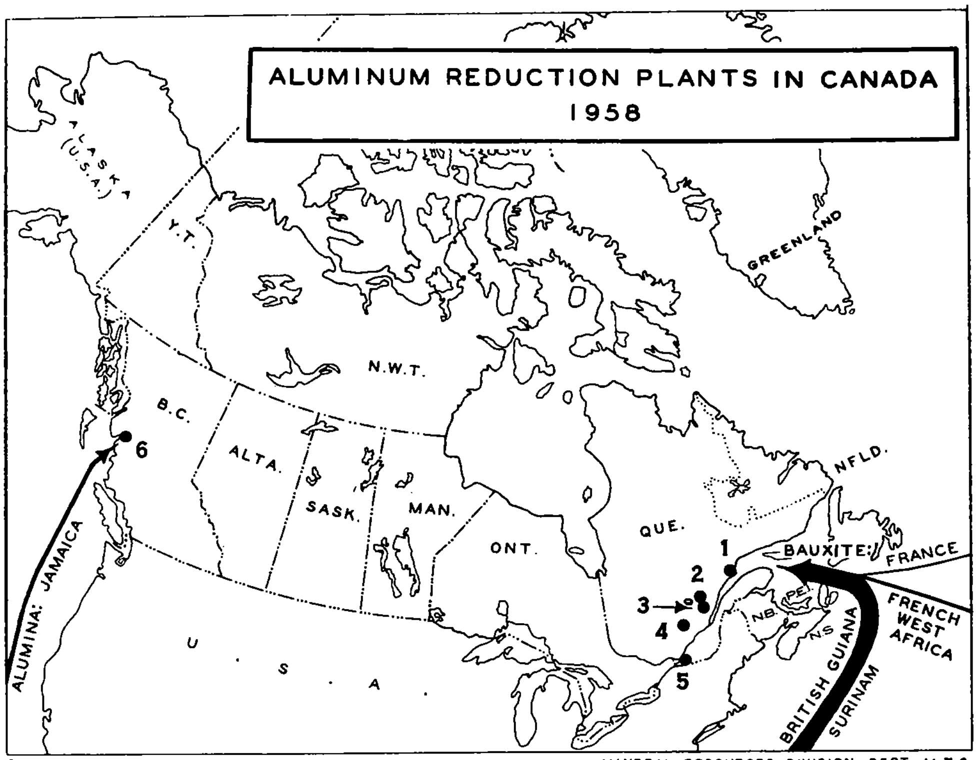
The following companies not previously mentioned are among the major consumers of aluminum ingot and ingot alloys in Canada:

Algoma Steel Corporation, Limited	Sault Ste.Marie, Ont.
Atlas Steels Limited	Welland, Ont.
Barber Die Casting Co., Limited	Hamilton, Ont.
Bay Bronze Ltd.	Winnipeg, Man.
Canada Metal Company Limited, The	Toronto, Ont.
Canadian General Electric Company, Limited	Peterborough, Ont.
Canadian Steel Improvement Limited	Toronto, Ont.
Dominion Foundries and Steel Limited	Hamilton, Ont.
Dominion Magnesium Limited	Haley Station, Ont.
Dunbar Aluminum Foundry Limited	Kitchener, Ont.
Electric Tamper & Equipment Co. of Canada Limited	Lachine, Que.
Electrolux (Canada) Limited	Montreal, Que.
Eureka Foundry & Manufacturing Co. Limited	Scarborough, Ont.
Hoover Co. Limited, The	Hamilton, Ont.
Industrial Engineering Limited	Vancouver, B.C.
McKinnon Industries Limited	St. Catharines, Ont.
Metals and Alloys Limited	Leaside, Ont.
Precision Dies & Castings Limited	Toronto, Ont.
Primco Limited	Hull, Que.
Reynolds Aluminum Company of Canada Ltd.	Cap-de-la-Madeleine, Que.
Schultz Die Casting Co. of Canada, Limited	Wallaceburg, Ont.
Steel Company of Canada, Limited, The	Hamilton, Ont.
Supreme Aluminum Industries Limited	Toronto, Ont.
Wagman & Son Limited, Z.	Toronto, Ont.
Werner (Canada) Limited, R.D.	Oshawa, Ont.

Sources of Raw Materials

Bauxite, an ore from which aluminum is extracted, has not been found in Canada. Owing to the geological history of the country, it is doubtful if any deposits exist. Anorthosites, nepheline syenites, shales and clays are abundant, but are all high in silica and contain only 25 to 30 per cent alumina. Although some work has been directed towards the recovery of aluminum from these rocks, a commercially feasible process to compete with bauxite has yet to be developed.

Bauxite ores suitable for Canadian use assay 55 to 60 per cent alumina, mostly in the form of the mineral gibbsite, along with impurities such as iron, silica and titanium. As is common with other ores, factors such as grade, impurities, methods of recovery and problems of transportation determine whether a deposit is economically mineable.



R.A. MINERAL RESOURCES DIVISION, DEPT. M.T.S.

Legend

1. Baie Comeau
2. Isle Maligne
3. Arvida
4. Shawinigan
5. Beauharnois
6. Kitimat

British Guiana and Surinam continue to provide the bulk of Canadian bauxite imports, though some African ore from Iles de Los is also used. Reserves are adequate for the foreseeable future. These ores are shipped by sea to Port Alfred, Quebec, and are then transported by rail some 20 miles to the Arvida works for processing to alumina. This one alumina plant supplies all aluminum-reduction plants in eastern Canada. Alumina for the Kitimat smelter is supplied by the 270,000-ton-capacity plant of Alumina Jamaica Limited, at Ewarton, Jamaica. Transport of alumina by sea from Jamaica to Kitimat via the Panama Canal results in substantial savings in the bulk tonnage shipped over the 6,500-mile distance. From 4 to 5 tons of bauxite are required to produce 2 tons of alumina, which will in turn produce 1 ton of aluminum.

Large quantities of raw materials other than alumina are essential to the production of aluminum from its ores. These raw materials must be processed to exacting specifications prior to plant use. Petroleum coke, used as pot-lining and electrodes, may be consumed in quantities up to 60 per cent of the weight of the metal produced. Artificial cryolite, manufactured at Arvida from fluorspar mined in southern Newfoundland, is used as an electrolyte together with small amounts of aluminum and calcium fluorides. Soda ash and lime are used to manufacture the caustic soda necessary in processing bauxite to alumina. The availability of these materials and the ease of assembling them at reasonable cost are factors in the location of reduction plants.

World Trends

Estimates prepared by the United States Bureau of Mines indicate that world production in 1958 increased to 3,881,000 tons from the 3,725,000 tons produced in 1957. It became evident during the year that, after nearly a decade of growth and periodic shortages of the metal, world production capacity had exceeded demand. This situation, undoubtedly temporary, arose because new reduction facilities in many countries were simultaneously completed or brought near completion in a period of business decline. As a result countries and companies that are normally net importers of the metal became exporters. During the year, a trend towards vertical integration continued and, under prevailing conditions, the companies so integrated fared better than the others.

In recent years the Caribbean area has been developed to provide the greater part of North American bauxite supplies. Alumina plants situated close to bauxite deposits in Jamaica and British Guiana are designed to fill part of Canadian and European requirements. In the United States, the trend is to set up alumina plants along the Gulf of Mexico, where they can receive and process the bauxite and then ship their product to reduction plants. Certain of the newer reduction plants are close to markets and depend on coal- or gas-fired generating plants for electrical power rather than on the more usual hydroelectric plant, with its lower operating costs but remote location. Expansion in France is also to be based on natural gas.

The proximity of undeveloped water resources close to large bauxite deposits in African countries, such as the Belgian Congo, Ghana, Guinea and adjacent territories, may permit future development of an aluminum complex. The only reduction plant so far in operation is in the French Cameroons, but projects of various magnitudes at other localities are in the planning or early development stages. Among the many factors that will determine the pattern of development of this area are its relationship to the European Common Market and the rate of increase of world demand for aluminum.

Accessible reserves of bauxite are sufficient to permit a great expansion in world production of aluminum. The stable pricing system, coupled with the continuing research in many fields for which the industry is noted, has in the past resulted in expanded use of the metal, often at the expense of competing materials. Of particular interest in 1958 was the accentuation of structural and electrical uses. Illustrative of the development of aluminum technology is ALCAN's successful testing of an aluminum railroad car. In France a continuous rod-casting and wire-rolling installation has been completed, and in the United States a method has been devised whereby molten metal may be rolled directly into sheet. Developments along these lines may help to reduce the cost of semifabricated products. Under another system, which cuts handling and remelt costs, hot metal is directly transferred from the smelter to adjacent casting facilities.

Uses and Consumption

The properties of aluminum and the wide dissemination of technical data relating to its use contribute towards increased industrial acceptance. The metal and its alloys can be cast, rolled, stamped, spun, drawn, extruded and forged. The lightness of aluminum and its resistance to corrosion, in combination with the mechanical properties obtainable by alloying and tempering, make the metal structurally usable. Weight for weight, aluminum is a better conductor of electricity than copper. This, coupled with a stable pricing system for the metal, accounts for its use by manufacturers of electrical equipment, particularly in transmission cables. Another property, good heat conductivity, has encouraged acceptance in cooking utensils. Other uses, such as the deoxidation of iron and steel and the reduction of calcium, depend on chemical properties. Finely divided flakes of metal form an excellent pigment for paints.

End-use statistics are not available for publication. Independent fabricators use aluminum, including secondary ingot, in the following, given here in the order of their importance: household and commercial supplies; building and construction; electrical, transportation and automotive equipment; aircraft; canning and packaging; hardware; food preparation and farming; the chemical industry; paints; and plumbing and heating.

Prices

The Canadian price of aluminum ingot was 24.5 cents a pound in the first three months of 1958. It was reduced to 22.5 cents on April 1 and remained at this price for the rest of the year.

Tariffs

Canada

	British Preferential	Most Favoured Nation	General
Alumina	free	free	free
Bauxite	"	"	"
Cryolite	"	"	"
Aluminum pigs, ingots, block, 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

Tariffs

Canada (cont'd)

	British Preferential	Most Favoured Nation	General
Angles, channels, beams, tees and other rolled, drawn or extruded sections and shapes	free	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 or foil less than .005 inch in thickness, plain or embossed, with or without backing	"	30%	30%
Aluminum powder	"	27 1/2%	30%
Aluminum leaf less than .005 millimetre in thickness	"	free	free
Aluminum scrap	"	"	"
Manufactures of aluminum not otherwise provided	15%	22 1/2%	30%
Kitchen or household hollow ware of aluminum not otherwise provided	20%	22 1/2%	30%

United States

Bauxite (until July 1960)			
Refractory grade			free
Crude			"
Aluminum scrap (until June 1959)			"
Aluminum and 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		
Table, household, kitchen and hospital utensils, and hollow or flat ware, not specially provided for, whether or not containing electrical heating elements as constituent parts, wholly, or in chief value, of aluminum	17% plus 3 1/2¢ per lb		

ANTIMONY

D.B. Fraser

Antimony is produced in Canada as a by-product of lead refining. The Consolidated Mining and Smelting Company of Canada Limited (Cominco), at Trail, British Columbia, is the only producer.

Cominco began to produce antimony in 1938 in an electrolytic antimony refinery at Trail. Since 1944, when the refinery was closed, its production has been in the form of antimonial lead alloy, which normally contains about 25 per cent antimony, though other grades are also produced.

The antimonial lead produced at Trail is derived from lead concentrates obtained from ores of the company's Sullivan mine at Kimberley, British Columbia, and from lead-silver ores and concentrates shipped by other mines to Trail for treatment. The lead bullion produced from the smelting of these ores and concentrates contains about 1 per cent antimony, which is recovered in anode residues and furnace drosses formed in the electrolytic refining of the bullion. The residues and drosses are further refined to yield antimonial lead alloy.

During 1958, the market demand for antimonial lead was less than in previous years and output at Trail was correspondingly reduced.

World production of antimony in 1958, as reported by the Bureau of Mines, United States Department of the Interior, was an estimated 44,000 tons. The principal producing countries, on a mine basis, were: China, 16,500 tons; the Union of South Africa, 7,904 tons; Bolivia, 5,818 tons; and Mexico, 3,029 tons. In 1958, the United States, the principal consumer, used 11,880 tons of primary antimony, of which 705 tons were derived from domestic sources. In addition, 19,515 tons were recovered in the United States from secondary material.

Because of the variable demand for primary antimony, output in Canada has varied considerably in past years, as shown in the graph on page 47. Peak production was reached in 1951.

Antimony - Production, Trade and Consumption

	1958 Pounds	1958 $	1957 Pounds	1957 $
Production				
Antimony content of antimonial lead alloy	858,633	284,208	908,547	332,508
Antimony content of flue dust and dore slag	-	-	452,184	37,934
Total	858,633	284,208	1,360,731	370,442
Imports				
Regulus				
China	249,671	40,332	1,041,241	185,177
United Kingdom	85,360	16,045	355,115	88,009
Belgium	117,793	23,194	92,303	20,877
Yugoslavia	44,000	7,868	-	-
Hong Kong	22,046	3,869	198,614	35,132
Other countries	289,183	49,488	107,573	20,270
Total	808,053	140,796	1,794,846	349,465
Antimony oxide				
United Kingdom	184,000	40,742	246,760	56,224
Belgium	67,781	13,815	20,160	4,299
United States	71,200	16,103	54,937	14,913
West Germany	-	-	44,090	11,520
Total	322,981	70,660	365,947	86,956
Antimony salts				
United States	42,451	20,253	23,030	15,518
West Germany	-	-	2,205	1,111
Total	42,451	20,253	25,235	16,629
Exports				
Antimony content of antimonial lead alloy	630,140		674,060	
Consumption				
Antimony regulus in production of:				
Antimonial lead alloys	705,992		891,174	
Type metal	140,510		175,308	
Babbitt	126,982		169,895	
Solder	34,216		78,295	
Cable alloys	1,420		1,000	
Antimonial oxide	511		1,103	
Batteries	140		7,148	
Other commodities	17,047		76,659	
Total	1,026,818		1,400,582	

Antimony - Production, Imports and Consumption, 1948-58

(pounds)

	Production[1] (all forms)	Imports (regulus)	Consumption[3] (regulus)
1948	310,062	1,093,835	1,624,000
1949	158,288	2,583,635	1,534,000
1950	643,540	3,212,784	1,994,000
1951	6,702,164[2]	1,362,260	1,480,000
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

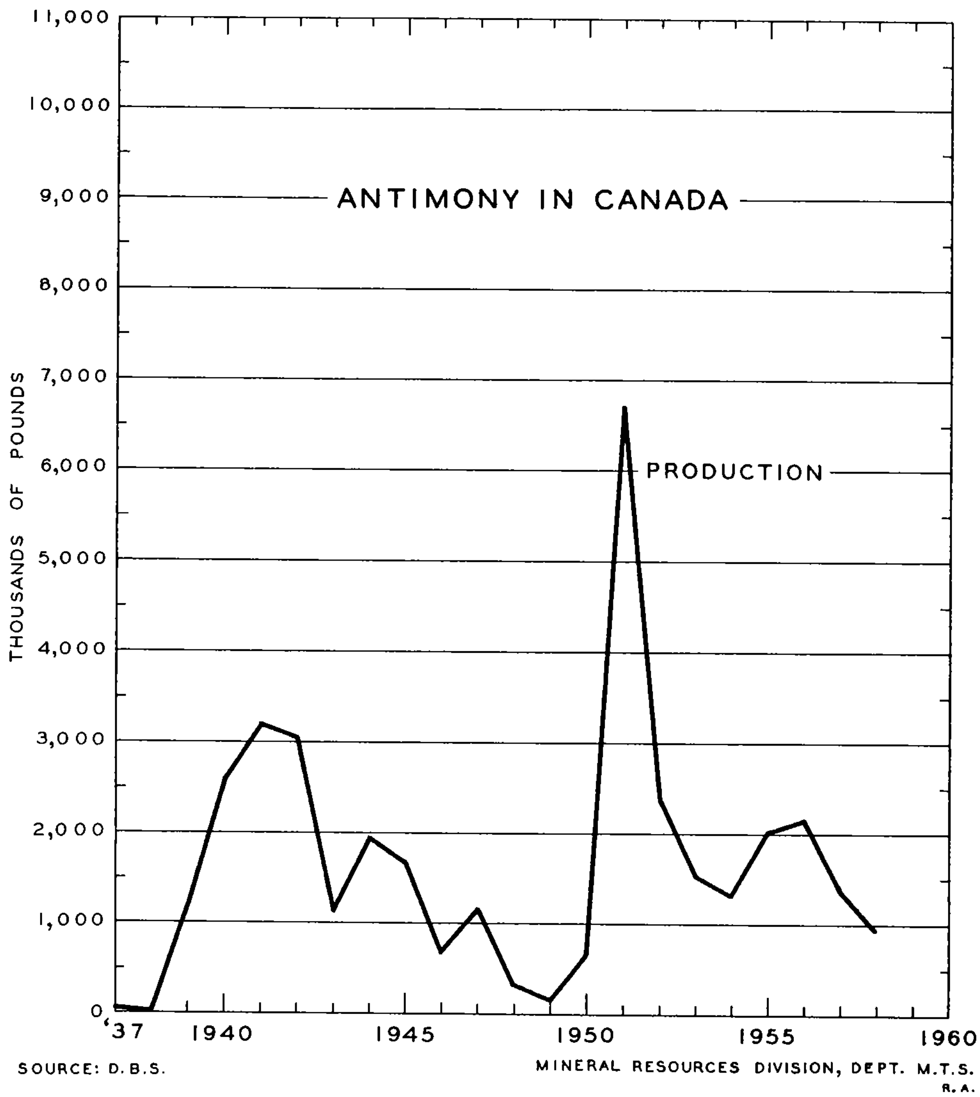
(1) Antimony content of antimonial lead alloys and antimony recovered from flue dust and dore slag. All derived from Canadian ores.
(2) Includes antimony in flue dust and dore slag produced in 1949 and 1950 but not previously recorded.
(3) Consumption of antimony regulus as reported by consumers. Does not include antimony in antimonial lead produced by The Consolidated Mining and Smelting Company of Canada Limited.

Occurrences

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: Mortons Harbour mine, New World Island, Notre Dame Bay, Newfoundland; West Gore deposits, Hants county, Nova Scotia; Lake George property, Prince William parish, York county, New Brunswick; South Ham deposit, Wolfe county, Quebec; Gray Rock property, near Bralorne in the Bridge River district, Stuart Lake mine, near Fort St. James, and the Caroline property, near Slocan City in the West Kootenay district, British Columbia; Highet Creek deposit, Mayo district, and the Wheaton River deposits near Whitehorse, Yukon Territory.

Uses and Consumption

Antimony is used chiefly to impart hardness and mechanical strength to lead. Electric storage batteries absorb large amounts of antimonial lead with an antimony content ranging from 3 to 12 per cent. Antimony is also an important constituent in lead cable covering, type metal, bearing metal and solders.



Transistors and rectifiers made of an aluminum-antimony alloy are used in electronics. Sulphides of antimony are used as pigments in paint and rubber manufacture. Antimony oxide is employed for the flameproofing of paints, plastics and textiles.

Prices and Tariffs

The price of antimony, boxed New York, as quoted by E & M J Metal and Mineral Markets, was 36.59 cents a pound on January 1, 1958. By February 14, it had declined to 32.59 cents a pound, and it remained at this level for the rest of the year. Bulk prices, f.o.b. shipping point, declined from 33 to 29 cents a pound between the same dates and continued at this level until the year-end.

Antimony metal and antimony salts enter Canada free of duty. Ad valorem duties of 12 1/2 per cent (most favoured 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, 1 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.

BISMUTH

D.B. Fraser

Bismuth was produced at Trail, British Columbia, by The Consolidated Mining and Smelting Company of Canada Limited (Cominco), whose entire output was refined metal; and by Molybdenite Corporation of Canada Ltd. at Lacorne, in western Quebec, and Gaspe Copper Mines Limited at Murdochville, Quebec, both of which produced semirefined metal. In addition, a silver-lead-bismuth bullion was recovered by Deloro Smelting and Refining Co. Ltd. at Deloro, Ontario, in the refining of silver-cobalt ores from the Cobalt-Gowganda area of northern Ontario.

Total production increased by 29 per cent in 1958, mainly because of an increase in output at Gaspe Copper Mines Limited, which, in 1958, operated its bismuth plant for the first full year.

In general, Canada's annual production of bismuth, illustrated in the graph on page 52, has been erratic owing to the small and variable demand for the metal. Since World War II the price of bismuth has been relatively stable and a steadier production trend has developed. World output in 1958, as reported by the United States Bureau of Mines, was 2,300 tons, with Peru, Mexico, Canada and Bolivia, in that order, as the leading primary producers. United States production is not reported separately.

Domestic Sources

British Columbia

Bismuth produced at Trail originates for the most part in the lead-zinc-silver ores from Cominco's Sullivan mine at Kimberley. Lead bullion produced at the Trail smelter contains about 0.05 per cent bismuth. The residue resulting from the electrolytic refining of the bullion is treated for the recovery of contained precious metals, bismuth and antimony. The refined bismuth is more than 99.99 per cent pure.

Quebec

In ores from the Lacorne mine, which is 23 miles northwest of Val d'Or and is operated by Molybdenite Corporation of Canada Ltd., both molybdenite and bismuth are of economic importance. The flotation process produces a concentrate containing 7 per cent bismuth. This is separated by leaching to form bismuth oxychloride, which is smelted in electric-arc

Bismuth - Production, Trade and Consumption

	1958		1957	
	Pounds	$	Pounds	$
Production				
All forms (1)				
Quebec	240,177	436,420	160,093	267,908
British Columbia	154,034	308,068	145,634	295,637
Ontario	18,581	26,779	14,214	21,372
Total	412,792	771,267	319,941	584,917
Refined metal(2)	171,622		145,634	
Imports				
Bismuth metal and residues				
Peru	7,856	15,655	-	-
United States	4,450	9,417	9,614	20,287
West Germany	551	1,106	-	-
Other countries	-	-	-	-
Total	12,857	26,178	9,614	20,287
Bismuth salts				
United Kingdom		17,824		22,340
United States		2,717		2,399
Total		20,541		24,739
Exports				
Refined metal	352,000(3)		142,769	
	1957		1956	
Consumption				
Metal (by industries)				
Medicinals and pharmaceuticals	8,544		42,000	
White-metal foundries	34,871		38,000	
Miscellaneous	12,000		10,000	
Total	55,415		90,000	
Bismuth salts				
Chemical and allied-products industries	18,811		21,185	

(1) Refined metal from Canadian ores, plus bismuth content of bullion and concentrates exported.
(2) From domestic and imported ores 99.99% pure.
(3) Bismuth metal refined 99.99% and semirefined metal.

Bismuth - Production, Exports and Consumption
(pounds)

	Production		Exports(4)	Consumption(2)
	All Forms(1)	Refined Metal(3)		
1948	240,242	240,000	158,000	88,000
1949	102,913	210,000	178,000	36,000
1950	191,621	194,000	114,000	66,000
1951	230,298	208,000	90,000	108,000
1952	162,373	142,000	34,000	106,000
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	134,000	131,000
1957	319,941	146,000	143,000	55,000
1958	412,792	172,000	352,000	

(1) Refined metal from Canadian ores plus bismuth content of bullion and concentrates exported.
(2) Refined metal reported by consumers.
(3) Refined metal 99.99% pure.
(4) Includes refined metal 99.99% pure and also semirefined metal for 1958.

furnaces to produce a bullion containing about 97 per cent bismuth. In 1958, the milling of 191,645 tons of ore gave 141,206 pounds of bullion containing 136,671 pounds of bismuth.

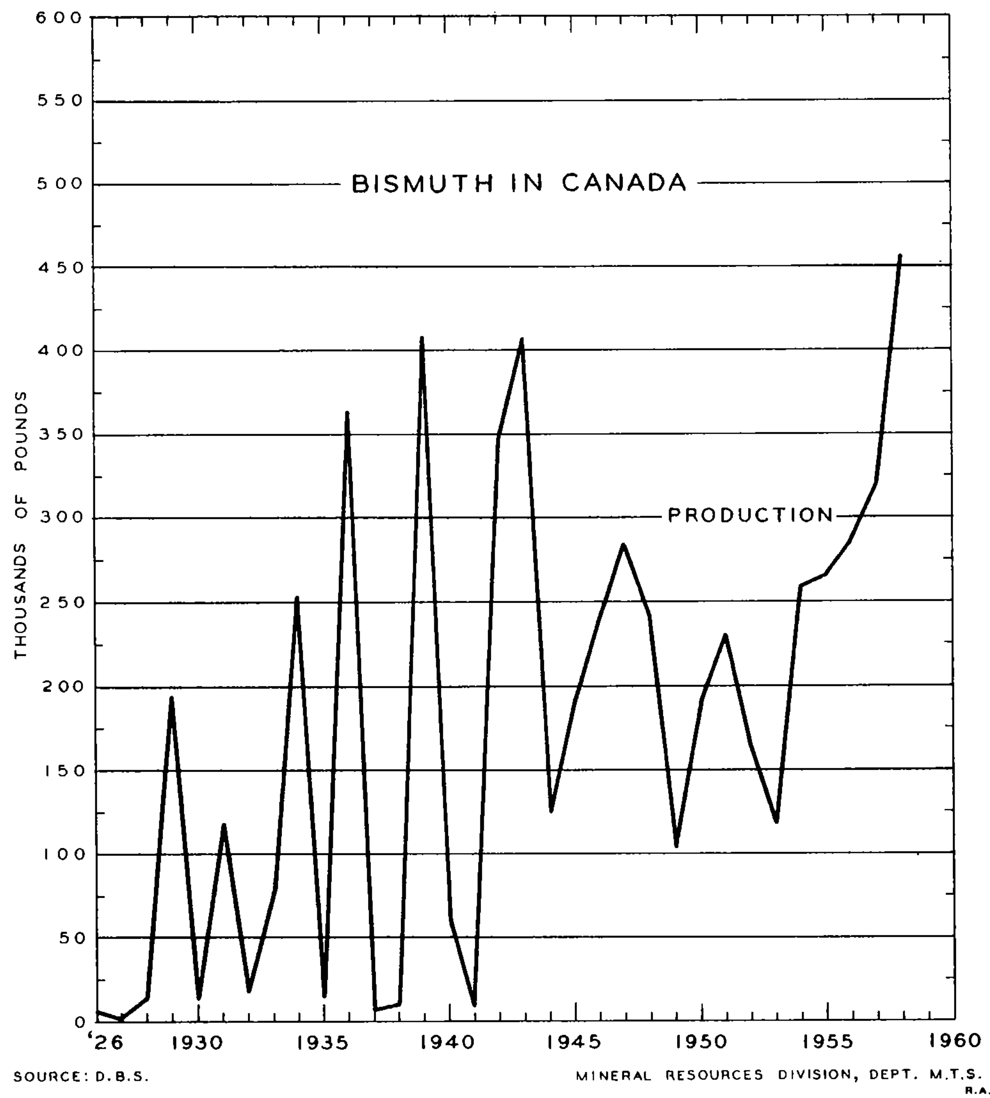
From the treatment of cottrell dust recovered in copper-smelting operations, Gaspe Copper Mines Limited produced semirefined ingots containing 87,846 pounds of bismuth. The bismuth plant, opened in the latter part of 1957, operated for the full year in 1958.

Ontario

Deloro Smelting and Refining Co. Ltd., at Deloro, in southeastern Ontario, recovered bismuth in silver-lead-bismuth bullion from the refining of silver-cobalt ores originating in the Cobalt-Gowganda district. The bullion so produced, which contains about 20 per cent bismuth, is shipped from time to time to a custom smelter for treatment.

Uses and Consumption

Bismuth, in amounts up to 50 per cent, is used with tin, lead and cadmium to make various low-melting-point alloys that find application in fire-protection devices, electrical fuses and solders. Because bismuth expands on solidification and imparts this property to its alloys, it is used in making type metal.



Permanent magnets of very high energy potential are made from finely pulverized manganese-bismuth mixtures.

In the field of atomic energy, there has been considerable research on the use of low-melting-point bismuth alloys with low neutron-capture qualities as coolants in atomic piles.

Bismuth salts have wide application in the preparation of pharmaceutical and cosmetic products, but in recent years kaolin-base preparations have, to some extent, replaced bismuth compounds for pharmaceutical purposes.

Bismuth - United States Consumption, by Principal Uses, 1958

	Pounds
Fusible alloys	488,400
Other alloys	208,400
Pharmaceuticals	422,600
Other uses	123,300
Total	1,242,700

Source: U.S. Bureau of Mines, Mineral Industry Surveys (final).

Prices and Tariffs

Bismuth metal sold at $2.25 a pound, in ton lots, throughout 1958.

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 35-per-cent ad valorem duty on bismuth chemical compounds, mixtures and salts.

CADMIUM

D.B. Fraser

Cadmium, a minor constituent of most zinc ores in Canada, is recovered as a by-product in the refining of zinc. There are two cadmium refineries in Canada, one at Trail, British Columbia, operated by The Consolidated Mining and Smelting Company of Canada Limited (Cominco), the other at Flin Flon, Manitoba, operated by Hudson Bay Mining and Smelting Co. Limited. These companies produce refined cadmium from the treatment of zinc concentrates derived from their own and custom ores. Other amounts of cadmium, not all of which are reported, are recovered by foreign smelters from the treatment of zinc concentrates exported from Canada.

The cadmium recovered at Trail and Flin Flon comes from cadmium-rich precipitates formed in purifying the zinc-bearing solutions from which metallic zinc is produced by electrolysis. The precipitates, containing about 55 per cent cadmium, are leached, and the cadmium is extracted electrolytically. About 70 per cent of the cadmium in zinc concentrates is recoverable, and metal not less than 99.95 per cent pure is produced in the form of balls, sticks or slabs.

Canada's cadmium output has increased in proportion to the growth in zinc production, but the 1,756,050 pounds produced in 1958 were well below the record level reached in 1957. The reason for the decrease was the reduced market demand for cadmium and the consequent reduction in its output at Trail.

World production of cadmium in 1958, on a mine basis, was 19,900,000 pounds. The United States, South West Africa and Canada were the leading producers. Most of Canada's production is exported to the United States and the United Kingdom.

Domestic Sources

British Columbia

Cominco, Canada's chief producer of cadmium, recovered 643 tons of metallic cadmium at its Trail refinery, mainly from zinc concentrates from the Sullivan mine at Kimberley, which average about 0.14 per cent cadmium. The company's H.B. mine near Salmo, its Bluebell mine on Kootenay Lake, and numerous custom shippers supplied other amounts in zinc concentrates treated at Trail.

Cadmium – Production, Exports and Consumption

	1958		1957	
	Pounds	$	Pounds	$
Production				
All forms(1)				
British Columbia	1,252,724	1,904,140	1,956,028	3,325,248
Saskatchewan	302,593	459,941	187,439	318,646
Yukon Territory	160,739	244,323	185,754	315,782
Manitoba	39,994	60,791	38,909	66,145
Total	1,756,050	2,669,195	2,368,130	4,025,821
Refined(2)	1,634,209		2,018,463	
Exports				
United States	691,480	948,470	1,117,877	1,647,608
United Kingdom	571,920	783,915	818,803	1,262,256
Other countries	217	750	5,000	8,781
Total	1,263,617	1,733,135	1,941,680	2,918,645
Consumption (by industries)				
Aircraft	5,890		9,497	
Automotive	22,648		24,761	
Electrical	33,377		37,831	
Hardware	52,079		42,507	
Solders	2,714		10,626	
Miscellaneous	53,184		51,376	
Total	169,892		176,598	

(1) Production of refined cadmium from domestic ores plus cadmium content of ores and concentrates exported.
(2) Includes some metal derived from foreign ores.

Canadian Exploration Limited recovered 231,762 pounds of cadmium in zinc concentrates produced from the Jersey mine near Salmo. Reeves MacDonald Mines Limited, at Remac, recovered 155,937 pounds in zinc concentrates. Cadmium was also recovered by Sheep Creek Mines Limited, Lake Windermere district.

A number of lead-zinc mines which produced by-product cadmium were closed during the year. These, with their 1957 cadmium production, were: Britannia Mining and Smelting Company Ltd., on Howe Sound (97,044 pounds); Silver Standard Mines Limited, near Hazelton (21,584 pounds); and Sunshine Lardeau Mines Limited, near Camborne (29,409 pounds).

Cadmium - Production, Exports and Consumption, 1948-58
(pounds)

	Production		Exports	Consumption(3)
	All Forms(1)	Refined(2)		
1948	766,090	766,000	596,098	184,000
1949	846,541	846,000	633,607	222,000
1950	848,406	838,000	676,005	232,000
1951	1,326,920	1,266,000	824,850	290,000
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

(1) Production of refined cadmium from domestic ores plus cadmium content of ores and concentrates exported.
(2) Includes cadmium recovered from foreign ores from 1950 on.
(3) 1948 to 1951, inclusive: producers' domestic shipments of refined metal; 1952 to 1958, inclusive: consumption as reported by consumers.

Yukon Territory

United Keno Hill Mines Limited, in the fiscal year ended on September 30, 1958, recovered 229,308 pounds of cadmium in zinc concentrates that were shipped to Trail for treatment. Zinc concentrates produced from the company's Mayo district mines averaged 0.8 per cent cadmium.

Saskatchewan and Manitoba

The refined cadmium production of Hudson Bay Mining and Smelting Co. Limited, amounting to 342,587 pounds, came from copper-zinc ores from the Flin Flon mine on the provincial boundary, and from the Schist Lake mine 3 1/2 miles southeast of Flin Flon. The increase from the 226,348 pounds produced in 1957 was due to treatment of dust from the smelter-stack baghouse, which was in operation for its first full year. Zinc concentrate produced from Flin Flon ores averages about 0.12 per cent cadmium.

Eastern Canada

Zinc concentrates exported by mines in eastern Canada contain an average of about 0.2 per cent cadmium. No payment is received for the cadmium contained in these concentrates, nor is the amount recovered reported.

Uses

Cadmium is used chiefly as an electrodeposited protective coating for iron and steel products and, to a lesser extent, for copper-base alloys. Where cost is not of prime significance, cadmium is preferred to zinc as a coating because it can be deposited more uniformly in the recesses of intricately shaped parts, because it is more ductile than zinc, because it has a slightly higher resistance to atmospheric corrosion and because it has a higher rate of deposition per unit of electric power.

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

A second important use is in cadmium-base bearing alloys in internal combustion engines specially designed for high speeds and temperatures. These alloys are of two types - the cadmium-nickel alloy composed 98.65 per cent of cadmium and 1.35 per cent of nickel, and the cadmium-silver-copper alloy containing 98.3 per cent or more cadmium, 0.7 per cent silver and 0.6 per cent copper.

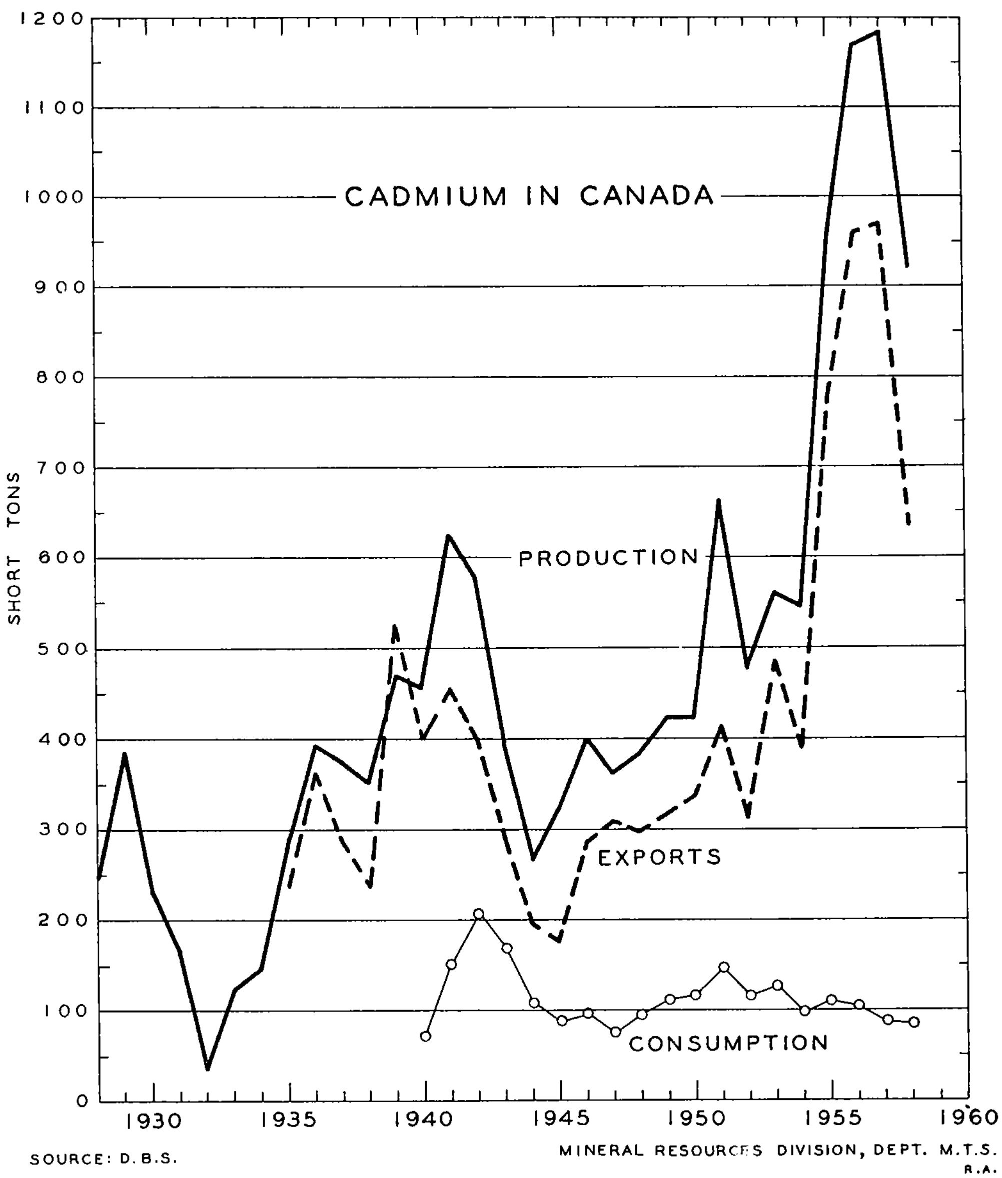
Cadmium is also used in making solders, particularly of the cadmium-silver type. Low-melting-point fusible alloys of the cadmium-tin-lead-bismuth type are used in automatic sprinkler systems, fire-detection apparatus and valve seats for high-pressure gas containers. The addition of about 1 per cent of cadmium considerably strengthens copper wire without seriously reducing its conductivity or ductility. In the field of atomic energy, the metal is used in devices to control the fissionable elements in reactors.

Cadmium is used also, in relatively small amounts, in nickel-cadmium storage batteries. Containing up to 7 pounds of cadmium per unit, these batteries have a longer life period than the standard lead-acid battery and are relatively much smaller although more expensive. This type of battery is especially suitable in low-temperature operating conditions.

Cadmium sulphide and cadmium sulphoselenide are used where bright, high-quality, yellow or red colours are required for paints, inks, ceramic glazes, paper, rubber and glass. Cadmium oxide, cadmium hydrate and cadmium chloride are used 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

The United States price of cadmium commercial sticks, according to E & M J Metal and Mineral Markets, was $1.55 a pound from the beginning of 1958 until the first week of October, when it dropped to $1.45 a pound. This price prevailed for the rest of the year.



In 1958, the Canadian price of cadmium, as estimated by the Dominion Bureau of Statistics, averaged $1.52 a pound.

The United States duty on cadmium metal during 1958 was 3 3/4 cents a pound. Cadmium flue dust was duty-free.

CALCIUM

W.H. Jackson

Calcium, a common element in the earth's crust, was first isolated and named by Sir Humphrey Davy in 1808. Being extremely reactive in the presence of water, the metal does not occur in the free state in nature, but its compounds are widely distributed. Limestones and brines containing calcium chloride are commercially used as raw materials for the production of the metal, which may be obtained by thermal methods, as in Canada, or by the electrolysis of fused calcium chloride.

Production

Dominion Magnesium Limited

This company is the sole producer of calcium metal in Canada and the largest producer in the world. Its plant is at Haley Station, Ontario, where part of the magnesium reduction works is used exclusively for the production of calcium. The process, involving vacuum reduction and distillation under high temperatures, is similar to that used for the production of high-purity magnesium and is described in the magnesium review. The difference is that lime obtained by calcining limestone is the raw material and aluminum the reducing agent.

Four grades of metal are produced. They range in purity from the Chemical Standards Grade, nominally 99.9 per cent calcium, to the Commercial Grade, which contains 98 to 99 per cent. The Chemical Standards Grade is available only as granules in minus 4 plus 80 mesh size. Other grades may be produced as granules but are also available in crystalline lumps and as extruded forms, billets and ingots. Wire, tubes or shapes, and strip are manufactured in some grades.

Trade and Consumption

Canada was an important producer and exporter of calcium metal in the postwar years, but, as markets that formerly required large amounts no longer have a pressing need, output has declined. In 1958, production amounted to only 25,227 pounds. The accompanying tables permit comparison of this low production with that of previous years and show Canada's trade in calcium metal and compounds. Certain production figures for the years from

Calcium - Production and Trade

	1958		1957	
	Pounds	$	Pounds	$
Production (metal)	25,227	31,256	221,225	282,378
Exports (metal)				
Belgium		25,110		17,634
United States		22,067		24,784
West Germany		14,936		-
United Kingdom		13,488		7,887
India		3,427		54
France.............		-		20,338
Sweden		-		6,795
Total		79,028		77,492
Calcium compounds				
United States	38,516,400	1,673,438	73,418,400	3,182,982
United Kingdom	37,742,700	1,419,148	45,995,100	1,781,287
Mexico	5,007,200	254,301	4,041,400	225,432
Cuba	3,996,200	186,651	7,150,500	320,762
Australia	3,912,200	174,003	4,028,400	243,388
Philippines	3,116,700	171,675	3,422,200	188,244
Venezeula	2,920,400	140,037	6,231,000	294,630
Colombia	2,266,000	110,864	3,104,300	151,917
Peru	1,821,600	94,629	2,473,800	121,358
Other countries	12,752,500	669,120	14,286,200	693,438
Total	112,051,900	4,893,866	164,151,300	7,203,438
Imports				
Calcium arsenate				
United States	85,500	6,142	81,000	4,952
Calcium chloride				
United States	68,167,900	1,016,210	90,793,200	1,334,624
Belgium	154,500	4,931	-	-
Other countries	20,200	2,078	32,600	2,152
Total	68,342,600	1,023,219	90,825,800	1,336,776
Chloride of lime				
United Kingdom	2,084,800	84,303	1,837,300	71,093
United States	786,600	149,937	743,900	136,081
Japan	116,000	17,364	39,600	4,922
Other countries	60,600	2,153	11,000	341
Total	3,048,000	253,757	2,631,800	212,437
Calcium compounds				
United States	7,771,850	680,098	5,843,534	569,238
United Kingdom	181,319	36,473	224,447	38,806
Japan	122,498	4,880	-	-
Switzerland	109,896	49,394	37,771	39,286
Netherlands	100,171	21,657	249,787	54,592
Norway	72,000	1,979	60,000	1,604
Other countries	30,490	7,296	14,515	12,001
Total	8,388,224	801,777	6,430,054	715,527

Calcium-metal Production, 1948-58

	Pounds	$
1948	895,203	1,723,266
1949	520,069	1,040,138
1950 to 1955 inclusive	(not available for publication)	
1956	394,900	515,305
1957	221,225	282,378
1958	25,227	31,256

Note: 1948 to 1955, producers' shipments; 1956 onward, production.

1950 to 1955 inclusive have not been released for publication. No data are available on domestic consumption. For some years the United Kingdom was the largest importer of Canadian calcium, which it used in its nuclear program. In the year under review, more than half of the calcium exports went to Belgium and the United States. Exports to India showed a marked improvement primarily owing to the need for calcium granules for the reduction of uranium tetrafluoride at a new plant producing uranium metal in Bombay.

Uses

Calcium and its alloys can be readily worked with only slight modifications of existing processes. Extrusions are made at about 420°C. Owing to low strength and chemical reactivity, however, calcium finds little use as a structural material. The metal tarnishes quickly in the presence of oxygen or nitrogen and therefore, because of its rapid oxidation at or above the melting point of 850°C, there must be no air present when it is cast. Casting may take place under protective fluxes, in the presence of inert gases or in vacuum.

Calcium, a powerful reducing agent, is used mainly in the production of such metals as uranium, thorium, titanium, zirconium and chromium from their oxides or fluorides. It may also be used as a deoxidant, desulphurizer or degasifier for steel and other ferrous or nonferrous alloys. For the deoxidation of certain steels or high-tensile cast irons, it may be added in the form of calcium-silicon or, as in the production of steel castings, in the form of calcium-manganese-silicon. Calcium forms useful alloys with aluminum, copper, magnesium, nickel, silver and platinum. Lead alloys containing calcium are becoming increasingly important, particularly for storage battery use, where 0.1 per cent calcium produces an alloy equivalent and, in some respects, superior to 9 per cent antimony. Other uses include the removal of water from alcohol, the separation of argon from nitrogen and the desulphurization of petroleum fractions.

Prices

Canadian prices vary with the grade of metal produced and are subject to inquiry. The average value of the year's production was $1.22 a pound.

The price of calcium metal in the United States, as quoted by E & M J Metal and Mineral Markets throughout 1958, was $2.05 a pound for slabs, in ton lots.

CHROMIUM

V.B. Schneider

Canadian imports of chrome ore (chromite) in 1958 decreased to 38,136 tons valued at $812,286 from the 1957 total of 111,453 tons valued at $2,751,372. A decline in the demand for ferrochrome, which provides the main use for chromite in Canada, reflected a decrease in the output of stainless steels. Because most chromium is used in stainless steel and alloy steels, chromite consumption is quickly and materially affected by changes in the output of these materials. Canadian consumption of chromite decreased from 70,971 tons in 1957 to 36,297 tons in 1958. Exports of ferrochrome in 1958 rose to 10,460 tons from the 10,332 tons exported in 1957.

Canada has no known deposits of commercial-grade chromite ores. During World War II, some chromite was produced in Quebec province, but no shipments have been made from this source since 1949. The Bird River deposits in the Lac du Bonnet district in southeastern Manitoba are large but of low grade. Strategic-Udy Metallurgical and Chemical Processes Limited, Niagara Falls, Ontario, has improved its technique for producing ferrochrome from low-grade ores, and early in 1959 it is planned to test the economic feasibility of producing ferrochrome from the Bird River ores.

Chromite is consumed in Canada by Electro Metallurgical Company, Division of Union Carbide Canada Limited, at Welland, Ontario, where high-carbon ferrochrome and ferrochrome-silicon are produced; by Chromium Mining and Smelting Corporation Limited at Beauharnois, Quebec, where exothermic chromium alloys and ferrochrome are produced; and by Canadian Refractories Limited at its refractories plant at Marelan, about 50 miles west of Montreal.

During the latter half of 1958, Chromium Mining and Smelting closed its Sault Ste Marie, Ontario, alloy plant and moved its operations to Beauharnois, Quebec, to the site of Electro-Reagents (Quebec) Limited.

World Production and Trade

World production in 1958, according to the United States Bureau of Mines, was estimated at 4,165,000 tons. The leading producing countries were the Union of Soviet Socialist Republics (880,000 tons, estimated), the Union of South Africa (696,057 tons), Southern Rhodesia (618,841 tons), Turkey (574,194 tons, estimated) and the Philippines (458,903 tons). Their production amounts to 78 per cent of the world's total.

Trade and Consumption

	1958		1957	
	Short Tons	$	Short Tons	$
Imports, chrome ore				
Philippines	33,118	629,935	28,000	493,650
United States	3,889	149,575	6,050	233,558
Rhodesia and Nyasaland	1,129	32,776	12,402	330,259
U.S.S.R.	-	-	34,423	1,143,576
Union of South Africa	-	-	23,978	306,804
Turkey	-	-	5,600	215,775
Cuba	-	-	1,000	27,750
Total	38,136	812,286	111,453	2,751,372
Exports, ferrochrome				
United States	10,206	2,306,199	9,984	2,213,457
United Kingdom	210	49,915	225	60,261
Mexico	29	11,241	34	13,160
Other countries	15	3,968	89	25,012
Total	10,460	2,371,323	10,332	2,311,890
Consumption, chromite	36,297		70,971	

Minor amounts are produced in Cuba, the United States, Albania and India. For the five-year period 1954-58 world production of chromite increased 28 per cent over that of the five-year period 1949-53. Canadian consumption of ferrochrome increased approximately 27 per cent in the corresponding periods.

The United States, which consumes annually about 35 per cent of the world output, is the world's largest importer and consumer of chromite. United States consumption of chrome ore for the 1954-58 period increased about 38 per cent over that of the 1949-53 period. Consumption might have increased even more rapidly but for the shortage of nickel that hampered the production of stainless steel. During these years, aluminum permanently replaced stainless steel in many industries, but with nickel shortages now over, stainless steel consumption will probably increase despite continuing competition from aluminum.

Uses

Chromite is consumed in industry, as indicated by the traditional trade descriptions of the ore as metallurgical, refractory or chemical. These grades are based on physical and chemical properties, but technological advances have made them interchangeable to a certain extent. In the United States over the last five years, the metallurgical industry has accounted for 64 per cent of all chromite consumed, the refractory industry for 26 per cent and the chemical industry for 10 per cent.

Trade and Consumption, 1948-58

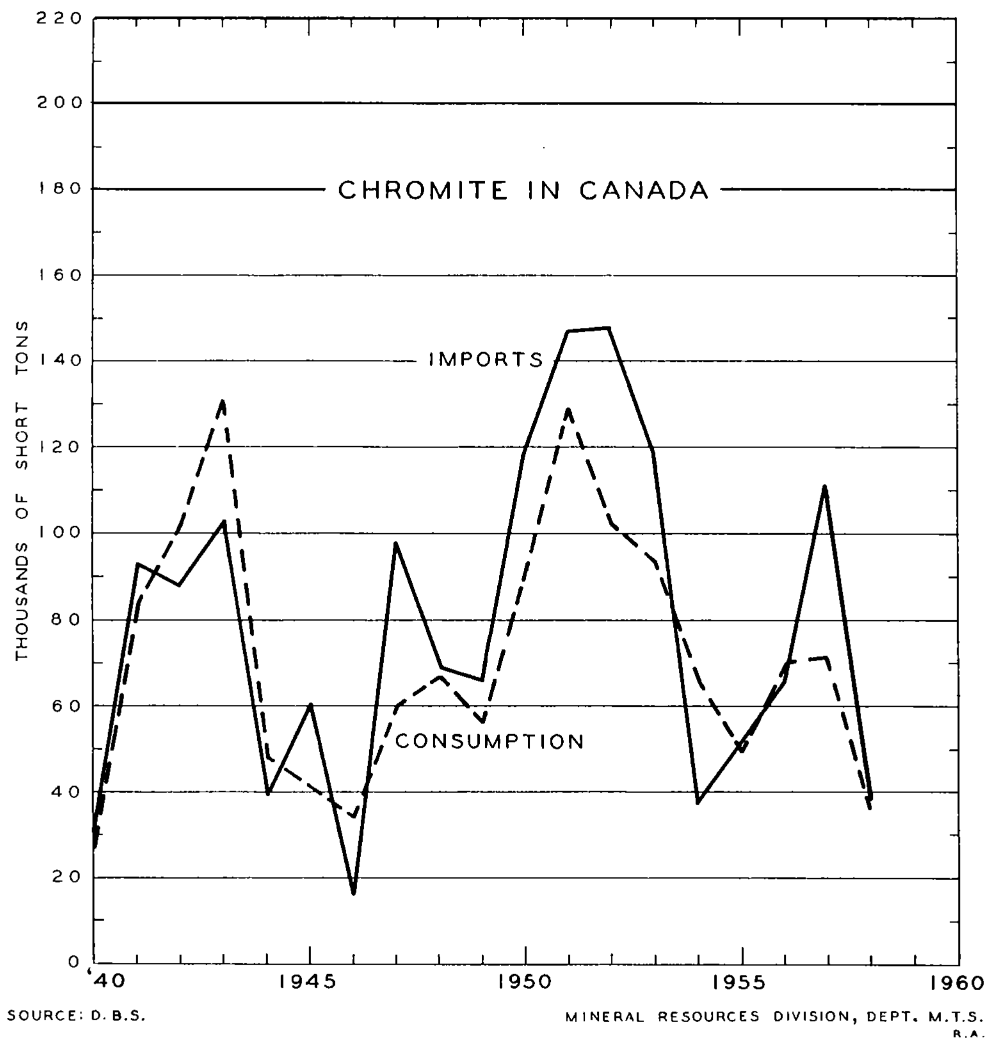
	Imports	Exports	Consumption	
	Chromite	Ferrochrome	Chromite	Ferrochrome
		(short tons)		
1948	69,183	22,515	67,345	2,421
1949	66,246	18,149	55,793	2,587
1950	119,325	32,916	90,798	3,589
1951	146,998	43,731	128,570	5,100
1952	148,343	44,290	101,919	6,362
1953	118,092	33,824	92,678	4,986
1954	37,517	15,304	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

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 ferrochrome alloys made by electric smelting processes. Manufacturers of chrome exothermic additives may use chrome ores of less rigid specifications than those outlined.

Several grades of ferrochrome are made, the most important being distinguished by their carbon and silicon content. Low-carbon ferrochrome of various grades ranging from 0.02 to 2 per cent maximum is used in stainless and heat-resistant steels because of its low carbon content. High-carbon ferrochrome, in which the carbon content varies from 4 to 9 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 bronzes, hard-facing alloys, welding-electrode tips and certain high-strength aluminum alloys. High-temperature alloys contain from 18 to 28 per cent chromium, together with varying amounts of cobalt, tungsten, molybdenum, nickel, titanium and columbium. High-temperature alloys are used mainly in the jet- and gas-turbine-engine industry for such parts as nozzle guides, vanes and turbine blades. They are also used in heat exchangers, boiler superheaters and superchargers.



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 wearing qualities and performance.

Refractory-grade Chromite

For refractory manufacture, specifications call for a 57-per-cent minimum of combined chromic oxide and alumina with as little iron and silica as possible, usually around 10 and 5 per cent respectively. The chromium-iron ratio is of no consequence in this grade, but 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. Because of its high melting point and chemical inactivity, chromite is widely used where contact with acid or basic fluxes is involved. Hence, it is common practice to use chromite bricks near the slag line in open-hearth furnaces and between the silica bricks of the roof and of the sides. Chrome refractory materials are 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 44 per cent Cr_2O_3, and iron is not a problem within reasonable limits. The ores should not contain more than 15 per cent Al_2O_3, 20 per cent FeO, and 3 per cent SiO_2; the sulphur must be low. The chromium-iron ratio is usually about 1.5:1. Fines are preferred because the ore is ground in processing to sodium and potassium chromates and bichromates.

Sodium bichromate or its derivatives are widely used in the tanning of leather, as pigments in the paint and dye industries, in the surface treatment of metals and as a source of electrolytic chromium metal.

Prices

United States chrome prices quoted in E & M J Metal and Mineral Markets of December 25, 1958, were as follows:

Chrome metal	Per lb delivered, electrolytic, 99.8%, according to size of lot	\$ 1.15 to \$ 1.19
Chrome ore	Per long ton, dry basis, subject to penalties if guarantees not met, f.o.b. Atlantic ports	
Rhodesian	Term contracts	
	48% Cr_2O_3, 3:1 ratio	\$42 to \$44 (nominal)
	48% Cr_2O_3, 2.8:1 ratio	\$39 " \$41 (")
	48% Cr_2O_3, no ratio	\$29 " \$31 (")
South African	Transvaal	
	48% Cr_2O_3, no ratio	\$30 " \$32
	44% Cr_2O_3, no ratio	\$22 " \$23

Turkish	Basis 48%, 3 to 1	
	48% Cr_2O_3, 3:1 ratio, lump and concentrates	nominal
	46% Cr_2O_3, 3:1 ratio, lump and concentrates	nominal
Ferrochrome	Per lb contained Cr, carload lots, delivered, lump, continental U.S.	
	High-carbon, 4 to 9% C, 65 to 70% Cr	28.75¢
	Low-carbon, 0.10% C, 67 to 72% Cr	38.50¢
	Special, 0.01% C, 63 to 66% Cr	37.75¢

Tariffs

Canada

	British Preferential	Most Favoured 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	"	"	"
Ferrochrome	"	5% ad valorem	5% ad valorem
Materials for use in the manufacture of chromium oxide	"	free	20% ad valorem

United States

Chrome ore	free
Chromium metal	10 1/2% ad valorem
Ferrochrome	
Less than 3% C	10 1/2% " "
3% or more C	5/8¢ per lb on Cr content
Chromic acid	12 1/2% ad valorem

COBALT

V. B. Schneider

Cobalt production in Canada during 1958 dropped to 2,710,249 pounds valued at $5,308,298 from the 1957 all-time level of 3,922,649 pounds valued at $7,784,423. This decreased output, derived from ore of Canadian origin, represented the metal and oxide shipped and the concentrates exported.

Domestic consumption of cobalt metal and cobalt contained in oxides and salts was 303,433 pounds - 88,081 pounds more than in 1957.

No cobalt ores were mined in Canada during 1958. Production was obtained as a by-product from the silver ores of the Cobalt Gowganda area of Ontario and from the smelting and refining of nickel-copper ores of the Sudbury, Ontario, and Lynn Lake, Manitoba, areas.

Producers

Ontario

Sudbury Area

The International Nickel Company of Canada Limited recovers cobalt from its refinery operations at Port Colborne, Ontario, and Clydach, Wales. At Port Colborne in 1947 the company began to recover an impure cobalt oxide, which it shipped to Clydach for the production of black and grey oxides and an extensive range of cobalt salts; and in October 1954, at the Port Colborne refinery, it began its first production in Canada of high-purity electrolytic cobalt. Since 1940, besides the cobalt from impure oxides from Port Colborne, the Clydach refinery has been producing cobalt from the nickel oxide it processes, but this has never been included as Canadian production in Canadian Government statistics. In 1958, the company reported that deliveries of contained cobalt in all forms had decreased to 2,170,000 pounds from the 1957 high of 2,400,000.

Falconbridge Nickel Mines Limited produces electrolytic cobalt from nickel-copper matte exported to its nickel refinery at Kristiansand, Norway. For 1958, the company reported that metal deliveries had dropped to 756,000 pounds from the high of 777,000 reached in 1957.

Cobalt - Production, Trade and Consumption

	1958		1957	
	Pounds	$	Pounds	$
Production(1)				
All forms cobalt content ...	2,710,429	5,308,298	3,922,649	7,784,423
Exports				
Cobalt contained in ores and concentrates				
United States.............	-	-	15,100	16,477
Cobalt metal				
United States.............	993,517	1,811,671	2,075,931	3,956,046
Brazil....................	17,600	33,968	25,942	50,068
France	7,350	14,100	-	-
Other countries	6,200	12,310	53,869	96,097
Total....................	1,024,667	1,872,049	2,155,742	4,102,211
Cobalt alloys (2)				
France	6,985	36,621	11,685	50,098
Brazil	2,617	8,250	146	950
Other countries	110	1,266	569	2,772
Total....................	9,712	46,137	12,400	53,820
Cobalt oxides and salts (2)				
United Kingdom	401,571	706,766	618,842	1,101,082
United States.............	64,334	85,903	-	-
Brazil....................	25,434	33,938	-	-
France	21,000	28,819	-	-
Other countries	9,805	13,900	1,200	1,820
Total....................	522,144	869,326	620,042	1,102,902
Imports				
Cobalt concentrates (2)				
United States.............	-	-	800	563
Oxides (2)				
United States.............	12,050	24,602	8,340	16,830
United Kingdom...........	4,180	6,014	2,000	2,764
Total....................	16,230	30,616	10,340	19,594

Cobalt - Production, Trade and Consumption (cont'd)

	1958		1957	
	Pounds	$	Pounds	$
Consumption(3)				
Cobalt metal and cobalt contained in oxides and salts	303,433		215,352	

(1) Production of cobalt metal from domestic ores and production of cobalt contained in alloys, oxides, salts and concentrates. Excludes cobalt content of nickel matte shipped to the United Kingdom by International Nickel, but includes cobalt content of Falconbridge shipments of nickel-copper matte to Norway.
(2) Gross weight.
(3) Consumption as indicated by cobalt content of producers' domestic shipments.

Cobalt-Gowganda Area

Silver ore shipped via the Temiskaming Testing Laboratories in 1958 contained 248,087 pounds of cobalt; in 1957, 380,001 pounds of cobalt were shipped. These concentrates, from companies in the Cobalt-Gowganda area, were shipped mainly to Deloro Smelting and Refining Co. Ltd. The more important shippers were Agnico Mines Limited, Langis Silver & Cobalt Mining Company Limited, Silver-Miller Mines Limited, Nipissing-O'Brien Mines Limited, and Siscoe Metals of Ontario Limited. In May 1958, Nipissing-O'Brien sold its property in the Cobalt area to Agnico Mines Limited, which is continuing to operate the mine.

Deloro Smelting and Refining Co. Ltd.

Deloro Smelting and Refining Co. Ltd., Deloro, which supplies the domestic market with cobalt metal, alloy, oxides and salts, reported production of 598,709 pounds of contained cobalt in 1958. Besides the cobalt contained in the Cobalt-Gowganda ore, some 201,443 pounds of contained cobalt were received from northern Ontario cobalt ore which had been mined some years previously. This cobalt was delivered to the United States stockpile.

Deloro's 1958 production of cobalt in various forms was: metal 71.7 per cent; oxide 27.3 per cent; and carbonates, 1 per cent.

Manitoba-Alberta

Production of refined cobalt and mixed nickel-cobalt powder by Sherritt Gordon Mines Limited from its Lynn Lake, Manitoba, nickel-copper ores began in June 1955 at the company's nickel refinery at Fort Saskatchewan, Alberta. Cobalt production for 1958 was 274,365 pounds, 102,312 pounds more than in 1957.

Cobalt - Production, Trade and Consumption 1948-58

(pounds)

	Production[1]	Exports				Imports		Consumption[3]
	All Forms	Cobalt in Ores and Concentrates	Metallic Cobalt	Cobalt Alloys	Cobalt Oxides and Salts	Cobalt Ore	Cobalt Oxide	Metal
1948	1,544,852[2]	871,000	31,410	88,734	876,895	848,100	100	74,000
1949	619,065	49,300	12,000	34,179	590,538	81,400	1,000	32,000
1950	583,806	16,700	-	1,011	388,203	3,912,500	25,880	54,000
1951	951,607	35,300	192,260	730	659,486	3,687,800	-	114,000
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

(1) Metallic cobalt from Canadian ores and cobalt content of oxides, alloys and salts sold and concentrates exported.
(2) Includes shipments from stockpiled ores mined in earlier years.
(3) Producers' domestic shipments, metal only.

World Mine Production

The United States Bureau of Mines reports:* "World production of cobalt decreased for the second successive year to about 14,600 short tons in 1958." It also reports: "Production of cobalt by Canada and Belgian Congo sharply decreased in 1958, but these losses were partially offset by increases in Northern Rhodesian and United States production. Output of recoverable cobalt in the United States was 2,012 short tons in 1958 compared with 1,651 tons in 1957."

For 1958 the United States Bureau of Mines reports the following cobalt production: Belgian Congo, 7,166 tons;** Northern Rhodesia, 1,774 tons; and Morocco, 1,021 tons.

Canadian production of cobalt, which has ranked second to that of the Belgian Congo for some years, dropped to a lower position in 1958. The Belgian Congo, however, is by far the world's largest producer. Its production since 1949 has been approximately 64 per cent of the world total, averaging about 7,810 tons annually over that period. Production in the Belgian Congo is derived from the mines of Union Minière du Haut-Katanga.

Production from the nickel-cobalt deposits at Moa Bay, Cuba, is scheduled to begin in 1959 at an annual rate of 2,200 tons of cobalt. Construction of a concentrating plant in Cuba and a refinery in Louisiana, U.S.A., was carried on according to schedule by Freeport Nickel Company, subsidiary of Freeport Sulphur Company.

Production in French Morocco is derived from the Mines of La Société Minière de Bou-Azzer et du Graara.

In Northern Rhodesia, Rhokana Corporation Ltd. and Chibuluma Mines Ltd. recover cobalt as a by-product of copper production.

Consumption and Use

World consumption of cobalt has not kept pace with the increase in mine production. The table on page 6 shows how cobalt was consumed in the United States in 1957-58.

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 the jet- and gas-turbine-engine industry 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' for the treatment of cancer.

*U.S. Bureau of Mines, Minerals Yearbook, 1958, Cobalt (preprint).
**Short tons (2,000 pounds) unless otherwise specified.

Cobalt Consumption in the United States, by Use

(thousands of pounds of contained cobalt)

	1958	1957
Metallic		
High-speed steel....................	88	237
Other steel..........................	100	109
Permanent-magnet alloys............	2,340	2,927
Soft-magnet alloys	-	-
Cast cobalt - chromium-tungsten molybdenum alloys.................	2,354	3,019
Alloy hard-facing rods and materials..	361	501
Cemented carbides..................	148	249
Other metallic......................	252	237
Total metallic......................	5,643	7,279
Nonmetallic (other than salts and driers)		
Ground-coat frit	457	474
Pigments	251	205
Other nonmetallic...................	161	188
Total nonmetallic	869	867
Salts and driers (lacquers, varnishes, paints, inks, pigments, enamels, glazes, feed, electroplating, etc., est)	1,030	1,011
Grand total	7,542	9,157

Sources: U.S. Bureau of Mines, Minerals Yearbook, 1958, and Minerals Yearbook, 1957.

Cobalt oxide is used in ground-coat frit for bonding porcelain enamel to a metal base. It is also used as a colouring agent in making glass and ceramics.

Cobalt organic salts are used as driers in paint, varnish, enamel, ink, etc. The use of inorganic salts such as cobalt sulphate is increasing in animal-feed nutrition.

Canadian consumers of cobalt include: Deloro Smelting and Refining Co. Ltd., Deloro and Belleville; Canadian General Electric Company Limited and Nuodex Products of Canada, Limited (driers), both of Toronto; Ferro Enamels (Canada), Limited, Oakville; Atlas Steels Limited, Welland - all in Ontario - and Dominion Glass Company, Limited, Montreal, Quebec.

Prices

Cobalt prices in the United States at the end of 1958, according to E & M J Metal and Mineral Markets, were as follows:

Cobalt metal

Per lb, f.o.b. New York	
500-lb lots	$2.00
100-lb "	$2.02
Less than 100 lb	$2.07
Fines	$2.00

Cobalt ore

Per lb contained Co. f.o.b. shipping point	
10%	$0.60
11%	$0.70
12%	$0.80

Cobalt oxide
(ceramic grade, 350-lb containers)

Per lb, 72 1/2 to 73 1/2% Co.	
East of Mississippi	$1.52
West of Mississippi	$1.55
Per lb, 70 to 71% Co.	$1.48 to $1.51

Tariffs

Canada

Ore	free

Cobalt metal

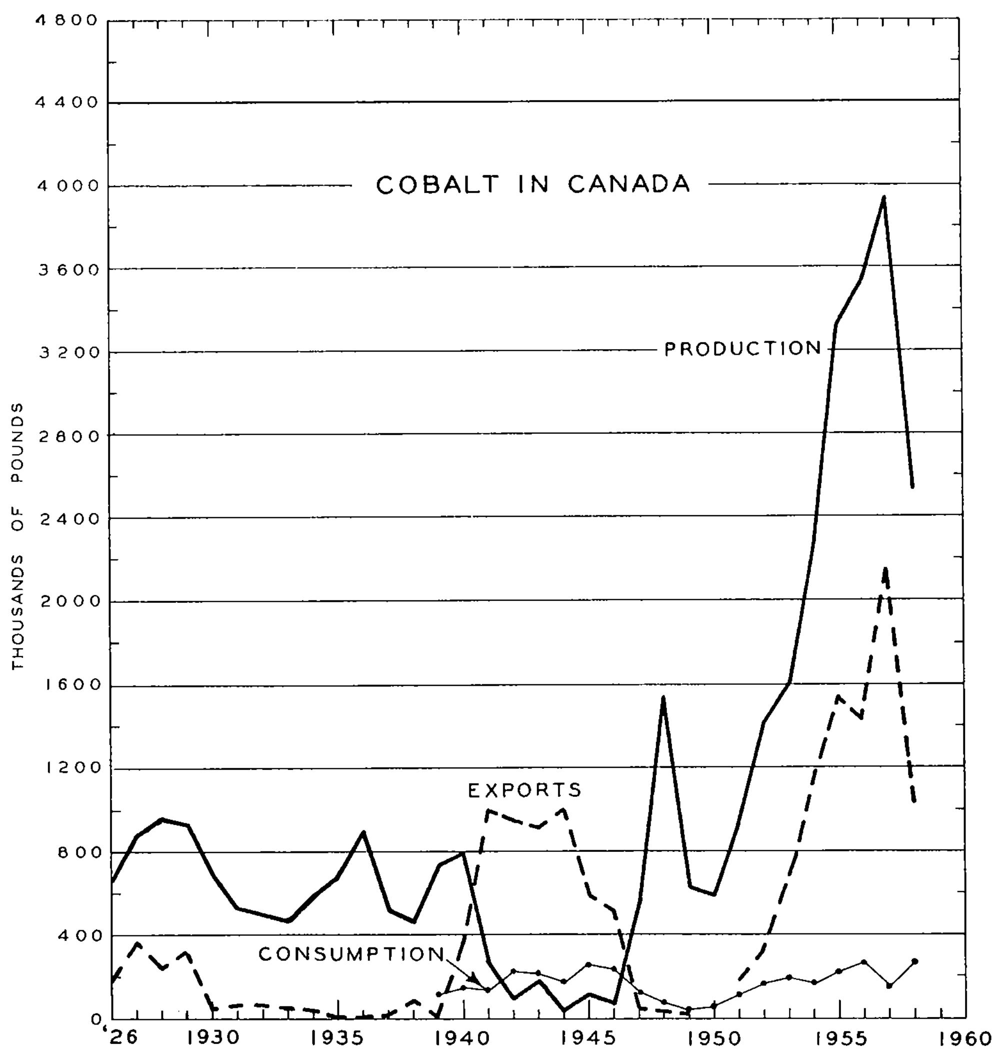
British preferential	free
Most favoured nation	10% ad valorem
General	25% " "

Cobalt oxide

British preferential	free
Most favoured nation	10% ad valorem
General	10% " "

United States

Ore	free
Metal	"
Cobalt oxide	4 ¢ lb
Cobalt sulphate	2 1/2¢ lb
Cobalt linoleate	5 ¢ lb
Other cobalt compounds and salts	15% ad valorem



SOURCE: D.B.S. MINERAL RESOURCES DIVISION, DEPT. M.T.S.
R.A.

COPPER

A. F. Killin

Copper production in 1958 was influenced by several factors. World oversupply coupled with a lack of demand in the United States caused many of the major producers to curtail production and held prices at low levels in the first part of the year. In the latter part of the year, the supply-demand situation was brought more nearly into balance by sustained demand in Europe, increased demand in the United States and the decrease in production brought about by cutbacks and strikes.

In Canada, despite some mine closures, production in the first eight months of the year was higher than in the corresponding period of 1957. A strike at the mines of The International Nickel Company of Canada, Limited, which started on September 24 and lasted until December 22, reduced production to such an extent that Canada's total production for the year was lower than that of 1957. Because of a production decrease of 13,995 tons and lower prices, the value of copper output dropped $32,467,058 - 15.7 per cent below its 1957 value. The decrease in exports of refined copper shapes was due mainly to a decrease in shipments to the United States.

Domestic Smelter and Refinery Production

Six smelters for the reduction of copper and copper-nickel ore were operated in Canada during 1958. The International Nickel Company of Canada Limited operated two smelters, one at Copper Cliff and the other at Coniston, both in Ontario, which treated company ores until closed by the strike in September. Noranda Mines, Limited, operated its smelter at Noranda, Quebec, on ore and concentrate from its Horne mine and from most mines in eastern Canada. The smelter operated at capacity all year, treating 1,503,000 tons of ore, concentrate, refinery slag, scrap copper and brass, from which 139,812 tons of anodes were produced. Toll shipments to the Noranda smelter amounted to 749,400 tons of copper-bearing materials. The smelter of Gaspe Copper Mines Limited, at Murdochville, Quebec, operated at capacity for the year, treating concentrates from the Gaspe copper mine and, on a toll basis, the Tilt Cove, Newfoundland, mine of Maritimes Mining Corporation Limited. During the year, 247,670 tons of concentrate and fluxing ore were treated, from which 43,590 tons of anodes were produced. Anodes from the Noranda and Gaspe smelters were shipped to Canadian Copper Refiners Limited, Montreal East, Quebec, for treatment. Hudson Bay Mining and Smelting Co. Limited

(text continued on page 81)

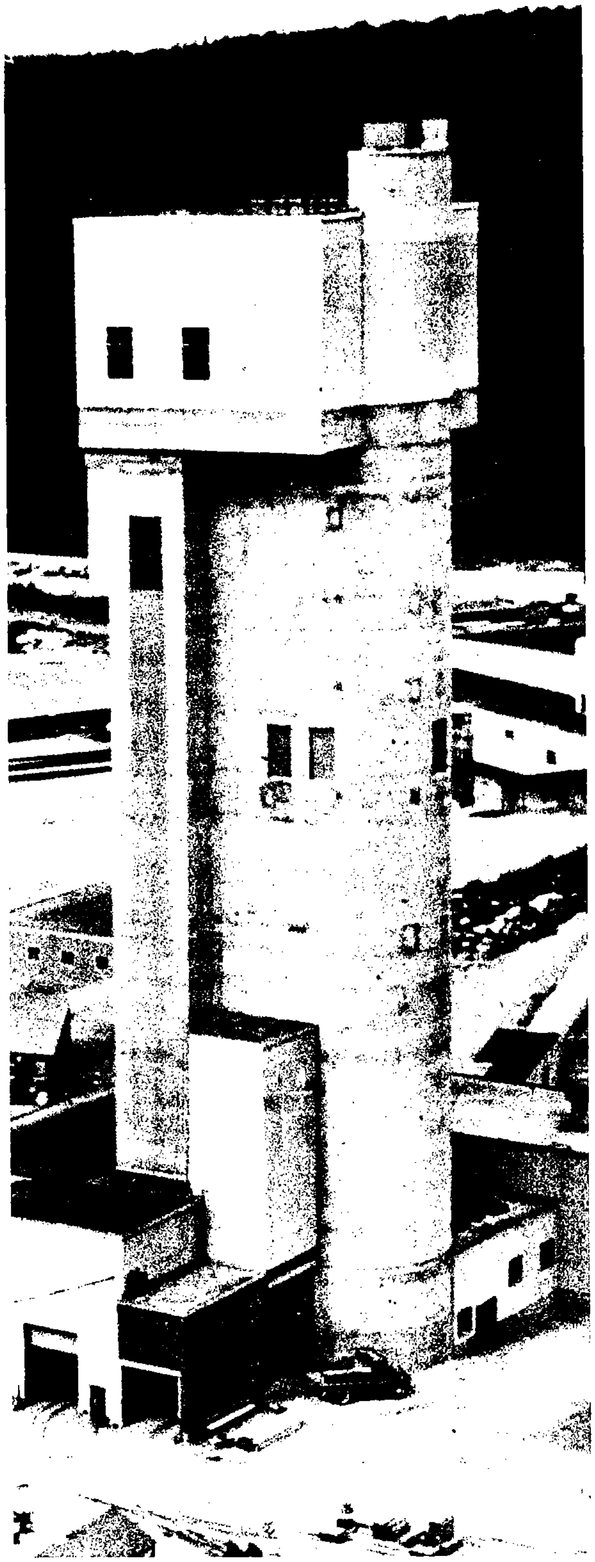
Copper - Production, Exports and Consumption

	1958		1957	
	Short Tons	$	Short Tons	$
Production(1)				
All forms				
Ontario	142,035	71,267,895	171,704	98,488,877
Quebec	131,445	66,826,788	112,409	65,084,941
Saskatchewan	37,510	19,070,139	30,597	17,715,571
Manitoba	12,601	6,383,403	18,551	10,686,798
New Brunswick	328	166,683	5,738	3,322,400
Newfoundland	14,751	7,499,372	4,535	2,625,986
British Columbia	6,010	2,995,902	15,410	8,877,743
Northwest Territories	434	220,748	165	95,672
Total	345,114	174,430,930	359,109	206,897,988
Refined	329,239		323,540	
Exports				
In ore and matte				
Norway	14,876	6,631,682	13,818	7,197,273
United States	10,704	4,801,669	30,482	15,853,508
Japan	2,208	1,051,222		
United Kingdom	1,253	547,167	1,103	570,659
Belgium	692	311,988	456	233,686
West Germany	582	259,728	343	175,464
Other countries			346	171,032
Total	30,315	13,603,456	46,548	24,201,622
Ingots, bars, slabs, etc.				
United Kingdom	90,927	45,448,305	84,672	57,644,005
United States	63,865	32,902,035	86,300	50,409,325
France	20,807	9,862,680	12,502	7,492,252
West Germany	14,051	6,810,006	1,315	745,368
India	11,652	5,684,978	3,968	2,803,617
Netherlands	9,089	4,490,159	341	177,902
Italy	6,137	2,896,736	1,092	601,703
Other countries	8,110	3,901,471	8,604	5,067,302
Total	224,638	111,996,370	198,794	124,941,474

Copper - Production, Exports and Consumption (cont'd)

	1958		1957	
	Short Tons	$	Short Tons	$
In scrap, slag and skimmings				
United States	5,199	1,858,518	3,917	1,529,110
West Germany	3,931	1,682,284	2,158	1,104,806
Netherlands	670	256,821	450	224,816
France	347	145,682	39	16,649
Japan			4,085	2,553,105
Other countries	940	379,967	1,632	893,403
Total	11,087	4,323,272	12,281	6,321,889
Rods, strips and sheets				
Switzerland............	4,006	1,710,842	4,372	2,740,825
United States	3,881	3,189,684	2,312	2,044,618
United Kingdom	3,327	1,834,889	2,411	1,344,643
New Zealand...........	395	310,192	183	174,991
Other countries	179	144,150	405	338,837
Total	11,788	7,189,757	9,683	6,643,914
Copper tubing				
Cuba	794	712,290	855	932,421
Venezuela.............	487	391,521	258	268,837
New Zealand	398	382,761	287	319,132
Other countries	905	912,351	710	874,896
Total	2,584	2,398,923	2,110	2,395,286
Wire and cable, screening and other copper manufactures				
United States		778,081		1,682,816
Venezuela.............		413,125		822,139
Philippines		223,806		630,200
Dominican Republic		137,066		196,602
Other countries		724,678		1,382,182
Total..................		2,276,756		4,713,939
Consumption(2)				
Refined	122,893		118,225	

(1) Blister copper, plus recoverable copper in matte and concentrate exported.
(2) Producers' domestic shipments.



Courtesy of Geco Mines, Limited

The 220-foot-high concrete tower at the Geco mine is one of the most unusual headframes in Canada. The hoistroom at the top of the tower is equipped with friction hoists—the first of this type built in Canada.

Copper - Production, Trade and Consumption 1948-58
(short tons)

	Production		Exports			Imports	Consumption
	All Forms(1)	Refined	In Ore and Matte	Refined	Total	Refined	Refined
1948	240,732	221,275	28,556	116,169	144,725	--	109,844
1949	263,457	226,083	37,058	127,160	164,218	9	100,905
1950	264,209	238,204	32,299	134,244	166,543	122	106,876
1951	269,971	245,466	36,853	101,832	138,685	1,511	134,174
1952	258,038	196,320	34,437	113,675(2)	148,112	12,973	130,347
1953	253,252	236,966	51,158	131,994(2)	183,152	5,515	105,482
1954	302,732	253,365	47,411	156,130(2)	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

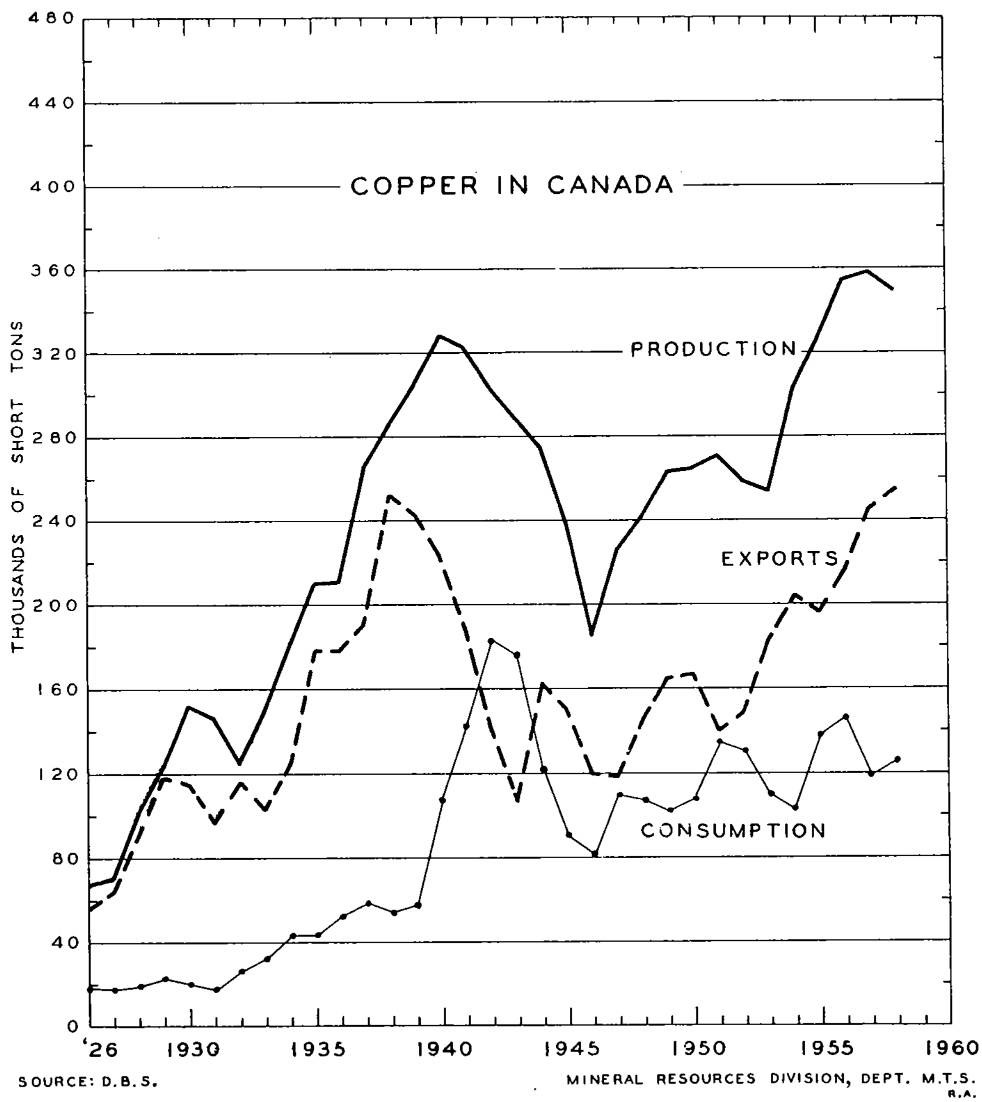
(1) Blister copper, plus recoverable copper in matte and concentrates exported.
(2) Includes blister and anode copper exported for refining as follows:

1952 ..... 27,974 short tons
1953 ..... 3,527 " "
1954 ..... 4,712 " "

-- Less than 1 ton.

operated its smelter at Flin Flon, Manitoba, on concentrates from the company's mines in Manitoba and Saskatchewan. Blister copper produced and shipped to Montreal East for refining amounted to 45,685 tons. Falconbridge Nickel Mines Limited treated 661,101 tons of ore and concentrate in its smelter at Falconbridge, Ontario. The resulting copper-nickel matte was shipped to Kristiansand, Norway, for refining.

Two refineries operating in Canada in 1958 produced 329,239 tons of refined copper. At Copper Cliff, Ontario, the International Nickel refinery treated blister copper from the company smelter. The Montreal East refinery of Canadian Copper Refiners Limited produced 239,000 tons of refined copper, 64,000 tons more than in 1957. The increase is attributed mainly to increased production at Gaspe Copper Mines Limited, Geco Mines, Limited, and mines in Quebec's Chibougamau district.


COPPER IN CANADA
PRODUCTION
EXPORTS
CONSUMPTION
THOUSANDS OF SHORT TONS
480
440
400
360
320
280
240
200
160
120
80
40
0
'26
1930
1935
1940
1945
1950
1955
1960
SOURCE: D.B.S.
MINERAL RESOURCES DIVISION, DEPT. M.T.S.
R.A.

Domestic Mine Production

Ontario

In 1958, Ontario's mines produced 140,735 tons of copper, and, as in former years, most of the output came from the mines of the Sudbury area. This proportion was not as high in 1958 because of the strike at International Nickel and the increase in production at the mines in the Manitouwadge area. The effect of the strike was that Ontario's mine production was 30,969 tons less in 1958 than in the preceding year.

The International Nickel Company of Canada Limited maintained production from its five mines until the strike caused a shut-down of all its operations. Production was obtained from the Frood-Stobie, Murray, Garson, Creighton and Levack mines. Production from the Crean Hill mine was deferred, as was completion of the Levack mill. At the end of 1958 the company's proven ore reserves stood at 264,628,000 tons with a nickel-copper content of 7,960,300 tons.

Despite production lost owing to the strike, deliveries of refined copper amounted to 105,285 tons and ore mined totalled 9,457,000 tons, thus maintaining the company's position as Canada's largest copper producer. Deliveries of copper in 1957 amounted to 140,405 tons.

Falconbridge Nickel Mines Limited continued production from the East, Falconbridge, Longvack, McKim, Hardy and Fecunis Lake mines. In January, the new blast furnace was blown in and production increased to 15,448 tons of copper contained in a copper-nickel matte.

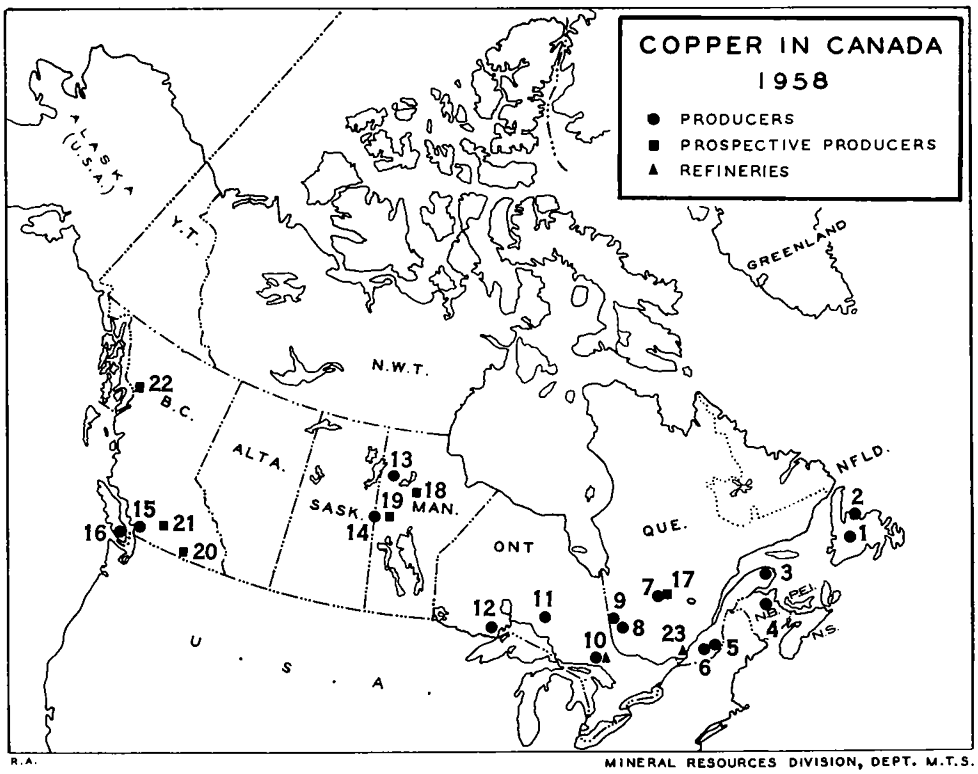
At the end of 1958, developed and indicated ore reserves totalled 43,892,750 tons, the grade averaging 1.45 per cent nickel and 0.81 per cent copper.

Geco Mines, Limited, in the Manitouwadge area, produced at a high rate during 1958 and was the fourth largest producer of copper in Canada. The mill treated 1,286,129 tons of ore assaying 2.48 per cent copper, 2.31 per cent zinc and 0.36 ounce of silver per ton. The copper concentrate produced amounted to 109,319 dry tons assaying 27.88 per cent copper and 13.72 ounces of silver per ton.

Ore reserves were reported as 16,011,200 tons containing 1.79 per cent copper, 3.71 per cent zinc, 1.84 ounces of silver per ton and 16.81 per cent pyrite.

Willroy Mines, Limited, which adjoins the Geco mine, produced 330,982 tons of ore with a copper content of 6,440 tons.

Ore reserves at the end of 1958 were reported at 2,800,000 tons averaging 1.2 per cent copper, 7 per cent zinc, 0.3 per cent lead and 2.5 ounces of silver per ton.



Producers

1. Buchans Mining Company, Limited
2. Maritimes Mining Corpoiation, Limited
3. Gaspe Copper Mines Limited (smelter)
4. Heath Steele Mines Limited
5. Weedon Pyrite & Copper Corporation Limited
6. Quebec Copper Corporation Limited
7. Opemiska Copper Mines (Quebec) Limited
   Campbell Chibougamau Mines Ltd.
   Merrill Island Mining Corporation, Ltd.
   Anacon Lead Mines Limited
   (Chibougamau operation)
8. Golden Manitou Mines Limited
   East Sullivan Mines, Limited
   Noranda Mines, Limited (smelter)
   Quemont Mining Corporation Limited
   Waite Amulet Mines Limited
9. Normetal Mining Corporation, Limited
10. The International Nickel Company of Canada, Limited (5 mines, 2 smelters, 2 refineries)
    Falconbridge Nickel Mines Limited
    (5 mines, 1 smelter)
11. Geco Mines, Limited
    Willroy Mines, Limited
12. Coldstream Copper Mines, Limited
13. Sherritt Gordon Mines Limited
14. Hudson Bay Mining and Smelting Co. Limited
    (4 mines, 1 smelter)
15. Howe Sound Company (Britannia Division)
16. Cowichan Copper Co. Ltd.

Prospective Producers

17. Copper Rand Chibougamau Mines Ltd.
    Chibougamau Jaculet Mines Limited
    Portage Island (Chibougamau) Mines Limited
18. The International Nickel Company of Canada, Limited (smelter)
19. Hudson Bay Mining and Smelting Co. Limited
    (Chisel Lake, Stall Lake)
20. The Granby Mining Company Limited
    (Phoenix mine)
21. Bethlehem Copper Corporation Ltd.
    Craigmont Mines Limited
22. Granduc Mines, Limited

Refinery

23. Canadian Copper Refiners Limited

Quebec

Copper production from the mines in Quebec rose to 131,854 tons from the 1957 output of 112,409 tons. This increase is attributed mainly to steady production at the Murdochville mine of Gaspe Copper Mines Limited.

Gaspe Copper Mines Limited, with mine and smelter at Murdochville, is now Canada's third largest copper producer. Production from the mine amounted to 2,302,000 tons, and 43,500 tons of anodes were shipped to Canadian Copper Refiners Limited at Montreal East.

At year-end ore reserves amounted to 64,279,000 tons averaging 1.29 per cent copper.

Noranda Mines, Limited, continued to operate the Horne mine at Noranda. Production from this mine amounted to 1,333,476 tons of ore, which yielded 28,307 tons of copper.

Ore reserves at the end of the year amounted to 10,940,000 tons averaging 2.03 per cent copper and 0.183 ounce of gold per ton.

Quemont Mining Corporation Limited treated 859,170 tons of ore and produced 61,473 tons of copper concentrate containing 10,249 tons of copper, 121,929 ounces of gold and 392,865 ounces of silver.

Indicated ore reserves at the end of the year amounted to 7,120,000 tons averaging 1.33 per cent copper, 2.67 per cent zinc, 0.177 ounce of gold per ton, 1.06 ounces of silver per ton and 53 per cent pyrite.

Campbell Chibougamau Mines Ltd. continued production from its mine on Merrill Island, Doré Lake. Copper production to the end of the fiscal year, June 30, 1958, amounted to 11,498 tons derived from 591,944 tons of ore milled. From July 1 to December 31, production amounted to 332,273 tons of ore with a copper content of 5,884 tons. Gold and silver production during 1958 amounted to 44,755 and 250,656 ounces respectively. The Cedar Bay mine, on the north shore of Doré Lake, 6 miles from the main plant, started shipping ore in March, and a total of 96,849 tons was shipped by the end of the year.

Proven and probable ore reserves, as reported on June 30, 1958, amounted to 6,385,000 tons averaging 2.49 per cent copper and 0.072 ounce of gold per ton.

Normetal Mining Corporation, Limited, from its mine 55 miles northwest of Noranda, produced 355,374 tons of ore containing 10,762 tons of copper.

Ore reserves at the end of the year were 1,955,400 tons averaging 3.54 per cent copper and 5.05 per cent zinc plus some gold and silver. In addition, the company reported 1,096,400 tons of high-grade zinc ore containing 13.1 per cent zinc and 0.33 per cent copper.

East Sullivan Mines, Limited, 3 miles east of Val d'Or, milled 896,375 tons of ore at an average daily milling rate of 2,455 tons. The concentrate produced contained 6,104 tons of copper.

Ore reserves at year-end amounted to 3,050,000 tons averaging 1 per cent copper, 0.7 per cent zinc, 0.01 ounce of gold per ton and 0.4 ounce of silver per ton.

Opemiska Copper Mines (Quebec) Limited milled 352,984 tons at its property 25 miles west of Chibougamau and produced 53,551 tons of concentrate containing 12,971 tons of copper, 10,902 ounces of gold and 157,201 ounces of silver.

Proven and indicated reserves at the end of the year amounted to 5,060,900 tons averaging 3.17 per cent copper.

Waite Amulet Mines Limited, near Noranda, milled 288,206 tons averaging 3.47 per cent copper from the company mine and the mine of Amulet Dufault Mines Ltd. Concentrate produced amounted to 40,207 tons containing 9,390 tons of copper, 5,824 ounces of gold and 193,616 ounces of silver.

On December 31, 1958, the combined ore reserves of the Waite Amulet and Amulet Dufault mines amounted to 591,000 tons averaging 4.66 per cent copper, 3.7 per cent zinc, 0.03 ounce of gold per ton and 1 ounce of silver per ton.

Golden Manitou Mines Limited, 9 miles east of Val d'Or, milled 479,480 tons of copper ore containing 2,984 tons of copper plus silver and gold. A total of 11,158 tons of zinc was also produced.

Ore reserves at the year-end amounted to 515,800 tons of zinc ore and 711,500 tons of copper ore, the latter averaging 1.16 per cent copper, 0.02 ounce of gold per ton and 0.34 ounce of silver per ton.

Weedon Pyrite & Copper Corporation Limited, at its mine near Fontainebleau, 75 miles south of Quebec City, milled 138,594 tons of ore grading 1.7 per cent copper, 0.52 per cent zinc and 32.61 per cent sulphur. The mill produced 8,853 tons of copper concentrate assaying 24.11 per cent copper, 537 tons of zinc concentrate assaying 50.08 per cent zinc and 54,138 tons of pyrite concentrate assaying 50.95 per cent sulphur.

Ore reserves at the end of 1958 amounted to 168,177 tons averaging 2.14 per cent copper, 0.93 per cent zinc and 29.98 per cent sulphur. Exploration at depth is continuing.

Anacon Lead Mines Limited, at its copper-gold property, 26 miles south of Chibougamau, produced 170,156 tons of ore containing 717 tons of copper.

Ore reserves at year-end amounted to 354,000 tons averaging 0.38 per cent copper and 0.223 ounce of gold per ton.

Merrill Island Mining Corporation, Ltd., up to June 30, milled 77,875 tons of ore, from which 5,935 tons of concentrate containing 1,373 tons of copper were produced. This mine, located on Merrill Island, Doré Lake, became Canada's newest copper producer when milling commenced in February. Mill capacity is 650 tons a day.

Ore reserves at the end of June 1958 totalled 732,706 tons averaging 2.64 per cent copper, 0.01 ounce of gold per ton and 0.4 ounce of silver per ton.

Manitoba-Saskatchewan

Hudson Bay Mining and Smelting Co. Limited, the second largest producer of copper in Canada, milled 1,669,614 tons of ore from the Flin Flon, Birch Lake, North Star and Schist Lake mines. In addition, 5,035 tons of ore were shipped directly to the smelter. The smelter treated 448,362 tons of concentrate, residues and direct-shipping ore and produced 45,685 tons of blister copper containing 106,810 ounces of gold, 1,609,423 ounces of silver and 136,219 pounds of selenium. Returns of metals from the refinery amounted to 45,455 tons of copper, 105,208 ounces of gold, 1,593,329 ounces of silver and 104,000 pounds of selenium.

Mining operations ceased at the North Star mine on March 31 owing to exhaustion of the ore reserves. Mining development continued at the Coronation mine, in Saskatchewan, 13 1/2 miles southwest of Flin Flon; at the Chisel Lake mine, in Manitoba, 5 miles southwest of Snow Lake or 70 miles east of Flin Flon; and at the Stall Lake mine, 4 miles southeast of Snow Lake, Manitoba.

Ore reserves of the company's mines in the Flin Flon area amounted to 12,926,500 tons averaging 3.16 per cent copper, 3.5 per cent zinc, 0.066 ounce of gold and 0.94 ounce of silver per ton. Ore reserves of the mines near Snow Lake, Manitoba, totalled 5,319,000 tons averaging 1.37 per cent copper, 8.7 per cent zinc, 0.7 per cent lead, 0.051 ounce of gold and 1.51 ounces of silver per ton.

Sherritt Gordon Mines Limited continued to operate its two nickel-copper mines and the concentrator at Lynn Lake, Manitoba. At Fort Saskatchewan, Alberta, the company also operates a chemical-metallurgical refinery for treating nickel concentrates. The mill at Lynn Lake treated 892,423 tons of ore to produce a copper concentrate containing 4,945 tons of copper returnable from the Noranda smelter. Ore reserves at the end of the year totalled 14,600,000 tons averaging 0.9 per cent nickel and 0.48 per cent copper.

British Columbia

Production of copper in British Columbia continued to decline as more mines closed owing to high costs and depressed copper prices.

Cowichan Copper Co. Ltd. operated for the full year. An agreement was completed in January whereby total production over a three-year period would be purchased by Japanese interests. Production for the year amounted to nearly 10,600 tons of concentrate containing about 3,000 tons of copper.

Britannia Mining & Smelting Co. Limited, formerly a wholly owned subsidiary of Howe Sound Company of Salt Lake City, Utah, ceased operations at its mine on Howe Sound on March 1. Operating at a reduced rate in January and February, the mine and mill produced about 6,800 tons of copper concentrate containing approximately 2,000 tons of copper plus values in gold and silver. The property is equipped with a 6,000- to 7,000-ton-a-day concentrator, which has been operating at the rate of 4,500 tons a day for several years. In August, Britannia Mining & Smelting went into voluntary liquidation and all assets were transferred to Howe Sound Company.

Northwest Territories

The only base-metal-producing mine in the Northwest Territories is at Rankin Inlet on the east shore of Hudson Bay.

North Rankin Nickel Mines Limited milled 80,297 tons of ore averaging 4.18 per cent nickel and 0.9 per cent copper. The 250-ton-a-day concentrator produced 22,934 tons of nickel-copper concentrate containing 2,728 tons of nickel and 618 tons of copper. The concentrate is sold to Sherritt Gordon Mines Limited and is treated at the Fort Saskatchewan refinery.

Newfoundland

Buchans Mining Company, Limited, in central Newfoundland, milled 389,000 tons of ore averaging 1.14 per cent copper, 7.36 per cent lead, 12.69 per cent zinc, 0.039 ounce of gold per ton, 4.65 ounces of silver per ton and 3.62 per cent iron. Production of concentrate amounted to 9,274 tons containing 2,536 tons of copper, 519 tons of lead, 633 tons of zinc, 2,888 ounces of gold and 483,510 ounces of silver. The copper concentrate was shipped to the Tacoma, Washington, smelter of American Smelting and Refining Company, of which Buchans is a subsidiary. The circular, concrete-lined MacLean shaft was sunk still farther and, by the end of the year, had reached a depth of 2,146 feet. When completed, it will facilitate the exploitation and exploration of the deeper-seated orebody located in the extension of the favourable horizon that contains the Rothermere orebodies.

Ore reserves on December 31, 1958, were 5,126,000 tons averaging 1.21 per cent copper, 8.16 per cent lead, 14.19 per cent zinc, 0.044 ounce of gold per ton and 3.76 ounces of silver per ton.

Maritimes Mining Corporation, Limited, produced 730,486 tons of ore at its Tilt Cove mine, located on tidewater on the northwest coast of Notre Dame Bay. Operating at a daily capacity of 2,000 tons, the mill produced 63,927 tons of concentrate containing 12,562 tons of copper and 4,074 ounces of gold. The concentrate is shipped by water, to Gaspé, Quebec, where it is loaded on trucks for transportation to the Murdochville smelter of Gaspe Copper Mines Limited.

Ore reserves at the end of 1958 totalled 4,343,000 tons grading 2 per cent copper and 0.025 ounce of gold per ton.

Exploration and Development

Exploration for new deposits and development of known deposits were adversely affected by depressed base-metal prices in the first half of 1958. A gradual but steady rise in the price of copper in the latter half of the year brought renewed interest in prospecting and development.

British Columbia

Granduc Mines, Limited, 25 miles northwest of Stewart, suspended exploration early in the year. After studying the economics of bringing the property into production, The Granby Consolidated Mining, Smelting and Power Company, Limited, which controls it, issued a statement in which it declared that no plans to bring the mine into immediate production were being contemplated.

Bethlehem Copper Corporation Ltd. holds 123 mineral claims in the Highland Valley area, 25 miles southeast of Ashcroft, in the Kamloops mining division, where surface-trenching and diamond-drilling have indicated a large tonnage of low-grade-copper mineralization. Underground exploration was commenced in 1958 with the driving of an adit at the 4,600-foot elevation. This will facilitate bulk-sampling and diamond-drilling of the mineralized zone.

Craigmont Mines Limited holds 155 mineral claims 10 miles northwest of Merritt in the Nicola mining division. A program of surface-trenching and diamond-drilling has indicated a considerable tonnage of copper ore. Underground exploration is proceeding so that the property may be further evaluated. The work is being directed by Canadian Exploration Limited under an agreement to which it is a party together with Noranda Mines, Limited, Peerless Oil and Gas Company and Craigmont Mines Limited.

Phoenix Copper Company, Limited, employed a small crew to strip overburden from the top of the orebody at the old Granby property near Phoenix. The mine is equipped to produce when economic conditions warrant.

Western Nickel, Limited, closed its operation at Choate, near Hope, when European customers could not fulfill their contractual obligations. Operations ceased in August 1958.

Howe Sound Company (Britannia Division) announced in December 1958 that the mine at Britannia Beach would reopen in January 1959. The operating rate is scheduled at 1,200 tons a day.

Saskatchewan

Hudson Bay Mining and Smelting Co. Limited continued development of the Coronation mine 13 1/2 miles southwest of Flin Flon. The service shaft was completed to 1,057 feet below the surface. Haulage and stope development accounted for the remainder of the 8,947 feet of underground work completed during the year. Exploratory diamond-drilling at the Coronation mine amounted to 11,550 feet in 1958.

Manitoba

Hudson Bay Mining and Smelting Co. Limited continued development at its Chisel Lake mine, 5 miles southwest of Snow Lake. The work done consisted in shaft-sinking for a distance of 676 to a total of 1,163 feet below the surface, station-cutting on the 650-, 850- and 1,050-foot levels and completion of the loading pockets for all levels. Driving of the main haulages was started on the 250-, 650- and 1,060-foot levels.

At the company's Stall Lake mine, 4 miles southeast of Snow Lake, the shaft was deepened 872 feet to a point 1,585 feet below the surface and a permanent hoist and headframe were installed. Stations were cut at the 900-, 1,050-, 1,200-, 1,350- and 1,500-foot levels. Exploration drilling amounted to 1,326 feet.

The International Nickel Company of Canada Limited employed a force of 2,000 men to develop its new nickel-mining project at Thompson Lake. A 2,100-foot production shaft and a 1,057-foot development shaft were completed and related underground development was started. Among surface facilities constructed were a production-shaft headframe and mill and changehouse buildings; construction also included work on the smelter building and completion of the 500-foot smelter stack. Work on sewer, water and power-distribution facilities has also progressed.

Ontario

The Shield Development Company, Limited, suspended exploration at its property adjoining Coldstream Copper Mines, Limited, in the Shebandowan area, until the latter company should reopen its mine.

Coldstream Copper Mines, Limited, suspended operations in February at its copper mine and 1,000-ton-a-day concentrator 9 miles north of Kashabowie.

The International Nickel Company of Canada Limited suspended development of the Crean Hill mine.

Falconbridge Nickel Mines Limited obtained increased tonnages of development ore from the operations at the Fecunis mine. Plans for bringing the Fecunis orebody into production were delayed by the strike at the Levack mine of The International Nickel Company. Under agreement between the two companies, the ore at the Fecunis mine will be mined by International Nickel and delivered to the Fecunis shaft for treatment by Falconbridge.

Norduna Mines Limited produced and sold ore to Falconbridge Nickel Mines Limited in the latter part of the year.

Temagami Mining Co. Limited carried out a further program of development at its mine on Timagami island, near Timagami. Shipments of development ore to June 30, 1958, amounted to 19,081 tons averaging 24.3 per cent copper, 0.1 ounce of gold per ton and 0.99 ounce of silver per ton. On June 30, 1958, ore reserves amounted to 74,300 tons averaging 13.1 per cent copper.

Nickel Rim Mines Limited, 6 miles north of Falconbridge, suspended operations at its mine and 1,500-ton-a-day concentrator on May 31.

Quebec

Mattagami Lake Mines Limited was formed to take over management and development of the Watson Lake property of the Mattagami Syndicate. A program of diamond-drilling indicated 19,764,000 tons averaging 12.73 per cent zinc, 0.73 per cent copper, 0.02 ounce of gold per ton and 1.26 ounces of silver per ton. Participating companies are Noranda Mines Limited, McIntyre Porcupine Mines Limited and Canadian Exploration Limited.

Orchan Mines Limited continued exploration of its property south of Mattagami Lake Mines Limited. Diamond-drilling has indicated a substantial tonnage of copper-zinc mineralization.

New Hosco Mines Limited continued exploration of its copper-zinc orebody on the Allard River in the Mattagami area of northwestern Quebec.

Rainville Mines Limited suspended operations in March at its mine adjoining the Golden Manitou mine. The property has been developed by two shafts and a number of levels and is equipped with a 550-ton-a-day concentrator.

Quebec Copper Corporation Limited suspended operations in April at its Bolton township mine in southern Quebec. The property is equipped with an 800-ton-a-day concentrator.

New Brunswick

Brunswick Mining and Smelting Corporation Limited suspended operations in May. The property, in Gloucester county near Bathurst, has estimated reserves of 58 million tons of zinc-lead ore with a copper content of 0.5 per cent.

Heath Steele Mines Limited, 35 miles northwest of Newcastle, suspended operations in May. The property is equipped with a 1,500-ton-a-day concentrator. The ore contains values in lead, zinc and copper.

Newfoundland

Atlantic Coast Copper Corporation Limited is exploring a copper prospect at Little Bay, Notre Dame Bay, in northeastern Newfoundland. A shaft was sunk 1,050 feet and a drift extended 1,100 feet along the footwall of the mineralized zone. Diamond-drilling has indicated 2 million tons grading 2.1 per cent copper.

Maritimes Mining Corporation Limited did not do any work in 1958 at its Gullbridge mine, approximately 20 miles from Badger station on the Canadian National Railways. The property has been developed by a 560-foot shaft and levels at the 250-, 400- and 550-foot horizons. Indicated ore reserves are 4,350,000 tons averaging 1.24 per cent copper, of which, 1,958,770 tons average 1.93 per cent copper.

World Mine Production

World mine production decreased from the all-time high reached in 1957 primarily owing to production cutbacks in United States and African mines. The Copper Institute reports that world production in 1958 was down to 2,713,412 tons from the 2,897,719 tons produced in 1957. These figures exclude production from Russia, Japan, Australia, Yugoslavia, Norway, Sweden, Finland and the Messina mine in South Africa. World stocks of refined copper decreased from 458,340 tons at the end of 1957 to 262,544 tons at the end of 1958. This decrease was due partly to lowered production and partly to higher consumption in the latter half of 1958.

Domestic Consumption and Uses

Although the manufacture of wire and cable absorbed the largest portion of the 122,893 tons of refined copper consumed in Canada in 1958, new plants have been established for the utilization of copper in copper and brass pipe and tubing and copper and brass strip and sheet.

The principal wire-and-cable plants in operation are: Canada Wire and Cable Company Limited, Toronto, Ontario; Northern Electric Company Limited, Lachine, Quebec; Phillips Electrical Company Limited, Brockville, Ontario; and Western Wire and Cable Co. Ltd., Vancouver, British Columbia. The operators of the principal copper-and-brass mills are: Anaconda American Brass Limited, New Toronto, Ontario; Ratcliffs (Canada) Limited, Toronto, Ontario; and Noranda Copper and Brass Limited, Montreal East, Quebec. Two new tube mills have been established - Western Copper Mills Ltd., at Annacis Island, New Westminster, British Columbia, and the Wolverine Tube Division of Calumet & Hecla of Canada Limited, at London, Ontario. A number of foundries across Canada also use copper and copper alloys.

The following table gives a partial analysis, by industrial uses, of the 122,893 tons of copper consumed in 1958.

Refined Copper Used in 1958
(tons)

	As Metal	In Brass and Bronze	In Nickel-Silver	Total
Ammunition	23	3,782	-	3,805
Automotive equipment	3,544	3,552	4	7,100
Hardware	2,741	843	20	3,604
Plumbing and heating equipment...............	8,884	3,986	-	12,870
Screw-machine products.....	47	2,248	2	2,297
Silverware	142	-	439	581
Wire and cable	74,926	3,194	-	78,120
Electrical products (exclusive of wire, etc.)..	5,245	2,862	17	8,124
Industrial equipment.......	1,063	1,252	46	2,361
Other uses	1,890	3,833	275	5,998
Total	98,505	25,552	803	124,860

Prices

Except for a short period in November, domestic shipments by Canadian producers were priced at the United States producers' price less the premium on the Canadian dollar vis-à-vis the United States dollar. The price, which was 26.5 cents a pound on domestic shipments at the beginning of 1958, gradually declined and in June was down to 24 cents. In the latter half of the year the price rose in response to an increase in demand and an artificial shortage due to strikes. It reached a high of 29 cents in November, but by the end of the year it had declined to 28 cents.

The United States producers' price fluctuated during the year in response to the variations in the supply of and the demand for copper. When the year began, the price was at 27 cents, but in mid-January it dropped to 25 cents, where it remained until June. In the second half of the year, the price rose by successive steps to 29 cents, where it remained for the rest of the year.

The London Metal Exchange price, the sensitive index that forms the pricing basis for some overseas shipments, sank in February to a low of just over 20 cents, rose by successive steps and reached a high of 32.4 cents in November, and closed the year at 27.85 cents.

Tariffs

Copper in bars, rods, wire, semifabricated forms and fully processed products is subject to varying tariff rates. There is no Canadian tariff on copper ores or concentrates.

In the United States, the suspension of the import tax, which had amounted to 2 cents a pound, was not renewed and the tax was reimposed automatically on July 1. Under the General Agreement on Tariffs and Trade, however, the tariff has been subject to annual 5-per-cent reductions, the first of which went into effect on July 30, 1956. The 1958 reduction brought the reimposed tax to 1.7 cents a pound.

If the price of copper in the United States averages less than 24 cents a pound for a month, the import tax will return to 2 cents a pound of contained copper.

The following table summarizes the United States tariffs on contained copper entering that country:

Copper ore and concentrates Copper in ingots, bars, pigs and plates (not manufactured) Copper scrap and clippings from new copper Blister copper	1.7 ¢ lb on copper content
Copper in rods, rolls or sheets	1.25¢ plus 1.7¢ lb on copper content
Copper tubes	
Brazed	4.5 ¢ plus 1.7¢ lb on copper content
Seamless	3.5 ¢ plus 1.7¢ lb on copper content

GOLD

T.W. Verity

Conditions throughout Canada's gold-mining industry showed a general improvement over those of the few preceding years.

A more plentiful labour supply in the major gold camps made it possible to increase milled tonnage. This, together with the finding of new ore in some mines, the higher grade of ore worked, an increase in the Mint price of gold and a small increase in gold recovered from base-metal mines, resulted in an increase in both production and value. Final Dominion Bureau of Statistics reports for 1958 show a gold-production total of 4,571,347 fine troy ounces valued at $155,334,370. This production was the greatest since 1942, as shown in the graph on page 97, and this value was the highest since 1955. They were 3.1 and 4.4 per cent higher, respectively, than the production and value of 1957. Final figures for 1957 showed 4,433,894 ounces valued at $148,757,143.

The greater gold production was due mainly to increases in the major gold-producing provinces of Ontario and Quebec. Ontario was the principal producer, with more than 59 per cent of Canada's total. Quebec followed with 23 per cent, Northwest Territories with 7 1/2 per cent and British Columbia with 4 1/2 per cent.

Gold maintained fifth place in value among the minerals produced in Canada, following crude petroleum, uranium oxide, nickel and copper. In Free World output, Canada retained second place, following the Union of South Africa.

Lode gold mines operating in Canada at the end of 1958 were one fewer than at the beginning of the year. In Manitoba's Snow Lake area, the Nor-Acme, a lode gold mine under lease to the Britannia Mining and Smelting Company Ltd., closed in July with all known ore exhausted. A former gold producer in the Val d'Or area of Quebec, Sullivan Consolidated Mines Limited, reopened its mine and commenced milling in August. Another Quebec mine, Stadacona Mines (1944) Limited, ceased milling in December. Several potential gold mines were under development in various parts of Canada.

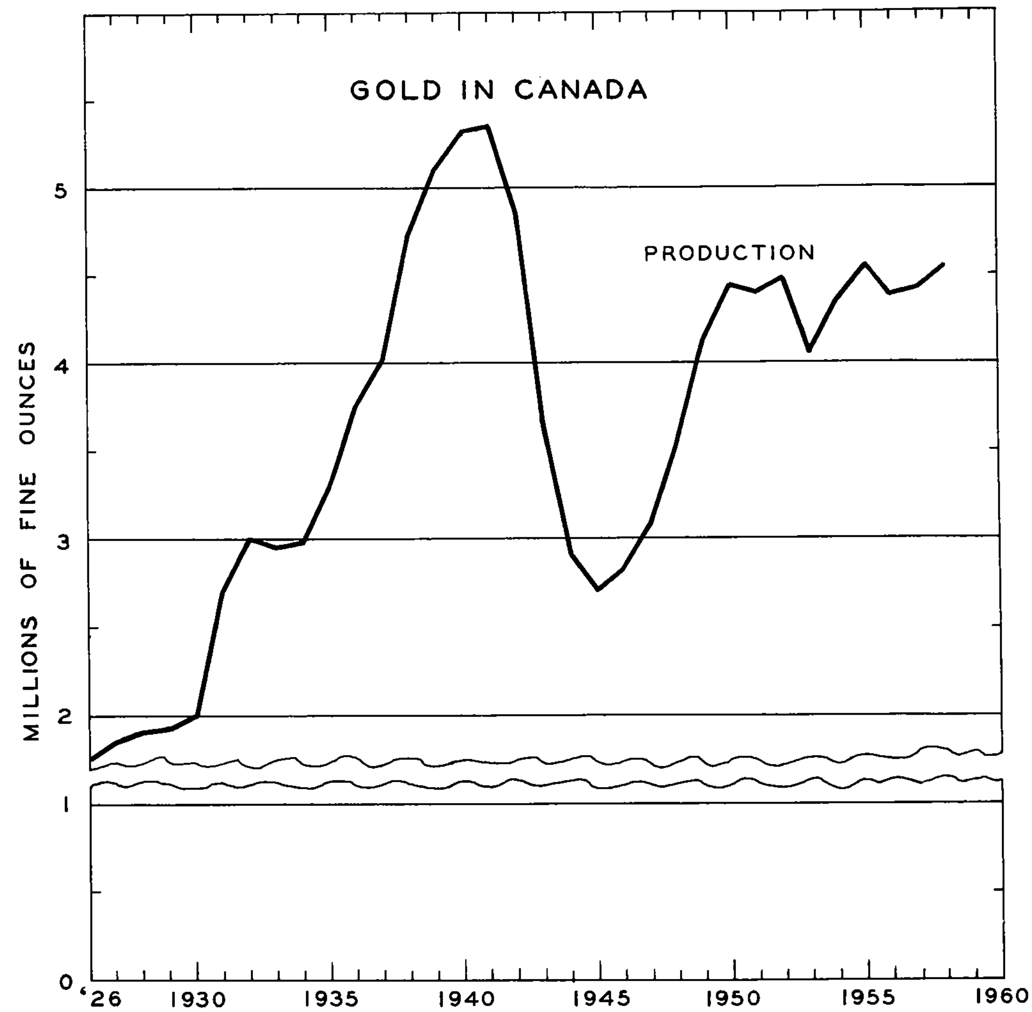
Production of Gold

(troy ounces)

		1958	1957
Yukon	Placer operations	67,745	73,709
	Base-metal mines	-	253
	Total	67,745	73,962
N. W. T.	Auriferous quartz	343,838	339,945
	Placer operations	-	73
	Total	343,838	340,018
B. C.	Auriferous quartz	193,225	186,495
	Placer operations	3,928	2,105
	Base-metal mines	13,459	40,513
	Total	210,612	229,113
Alta.	Placer operations	282	416
Sask.	Placer operations	-	-
	Base-metal mines	86,590	75,236
	Total	86,590	75,236
Man.	Auriferous quartz	67,889	97,156
	Base-metal mines	19,467	22,852
	Total	87,356	120,008
Ont.	Auriferous quartz		
	Porcupine	1,138,190	1,060,038
	Larder Lake	542,269	519,486
	Patricia	482,476	456,571
	Kirkland Lake	362,168	361,284
	Thunder Bay	107,124	103,312
	Sudbury	27,858	31,276
	Matachewan	-	176
	Miscellaneous	109	19
	Total	2,660,194	2,532,162
	Base-metal mines	56,320	46,044
	Total	2,716,514	2,578,206
Que.	Auriferous quartz		
	Cadillac-Malartic	308,574	293,911
	Bourlamaque-Louvicourt	247,137	230,470
	Noranda-Duparquet-Belleterre	71,146	86,101
	Chibougamau	35,252	-
	Miscellaneous	801	-
	Total	662,910	610,482
	Base-metal mines	381,936	396,413
	Total	1,044,846	1,006,895
N. B.	Base-metal mines	52	240
N. S.	Auriferous quartz	131	45
	Base-metal mines	-	-
	Total	131	45

Production of Gold (cont'd)
(troy ounces)

		1958	1957
Nfld.	Base-metal mines	13,381	9,755
Canada	Auriferous quartz	3,928,187	3,766,285
	Placer operations	71,955	76,303
	Base-metal mines	571,205	591,306
	Total..........................	4,571,347	4,433,894
Canada	Total value	$155,334,370	$148,757,143
	Average value per ounce	$33.98	$33.55



SOURCE: D.B.S.

MINERAL RESOURCES DIVISION, DEPT. M.T.S.
R.A.

Summary of Gold Production, 1948-58
(troyounces)

Year	Auriferous-quartz Mines	%	Placer Operations	%	From Base-metal Ores	%	Total Gold Production	Total Value in Canadian Dollars	Average Value per Ounce in Canadian Funds	Gold - % of All Mineral Production Value
1948	3,081,113	87.4	78,821	2.2	369,674	10.4	3,529,608	123,536,280	35.00	15.1
1949	3,566,152	86.3	96,614	2.4	460,752	11.3	4,123,518	148,446,648	36.00	16.5
1950	3,764,757	84.8	108,143	2.4	568,327	12.8	4,441,227	168,988,687	38.05	16.2
1951	3,709,601	84.5	96,441	2.2	586,709	13.3	4,392,751	161,872,873	36.85	13.0
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

Production of by-product gold from base-metal mining decreased to 571,205 ounces from the 591,306 ounces produced in 1957. The decrease was due to a drop in production from the base-metal mines of British Columbia and Quebec, with several mines closing in the former province.

There was a renewal of interest in placer gold operations in the Wells and Atlin areas of British Columbia and Yukon Territory. An increase in production from placer operations in British Columbia was more than offset by a decline in the output of some placer operations in Yukon Territory. This accounted almost entirely for the fact that gold recovered from placer operations in Canada dropped to 71,955 ounces in 1958 from 76,303 ounces in 1957.

With the exception of a one-week strike at one Quebec gold mine, no serious interruption of work in the gold-mining industry resulted from labour disputes. During the year, many mining companies, such as those in the Kirkland Lake area of Ontario and the Malartic area of Quebec, signed agreements with labour unions. In Canada's main gold camp, the Porcupine area of Ontario, union contracts expired and negotiations were still being carried on at the year's end.

The operation of the Emergency Gold Mining Assistance Act was extended to the end of the calendar year 1960 and the amount of assistance under the Act was increased by 25 per cent for the years 1958, 1959 and 1960. Ten lode gold mines in Canada were not eligible for cost assistance owing to low operating costs.

The improved outlook for the gold-mining industry and unfavourable conditions in the base-metal markets gave impetus to exploration for gold in various parts of Canada and encouraged a renewal of work on several gold prospects, especially on prospects in the Red Lake area of Ontario, the Malartic area of Quebec, the Northwest Territories and some sections of British Columbia.

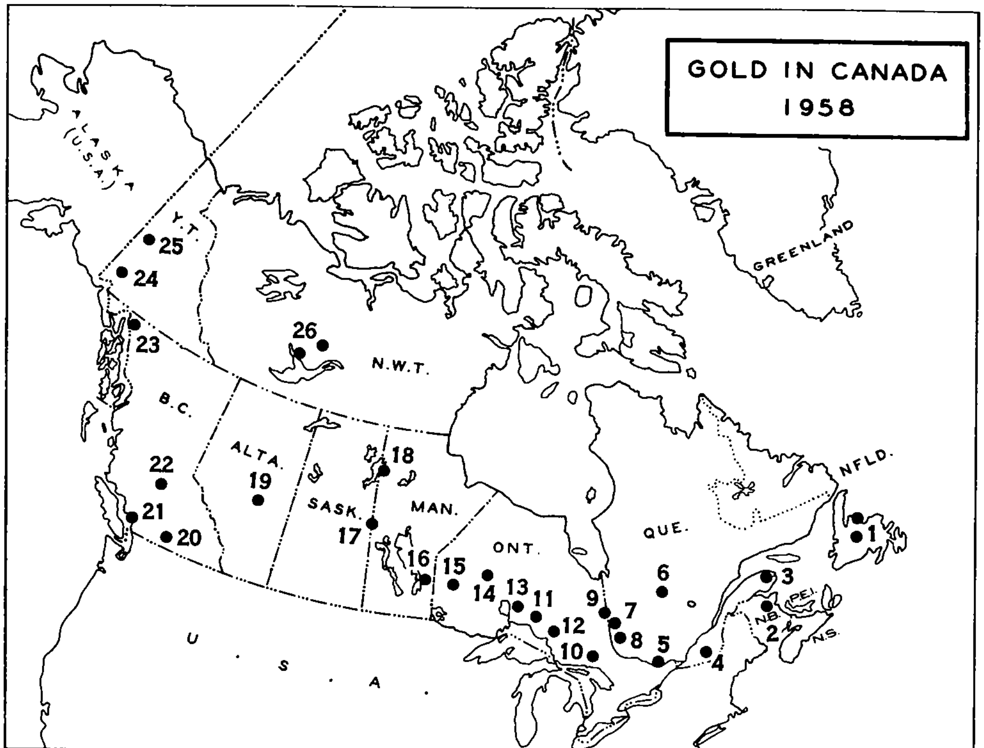
Operations at Producing Mines*

Newfoundland

Gold was recovered as a by-product from the silver-lead-zinc mine of the Buchans Mining Company Limited in the central part of the province and also from the new copper mine of the Maritimes Mining Corporation Limited at Tilt Cove on Newfoundland's northeast coast. With the opening of a second producer, the province's gold recovery increased by 37 per cent.

(text continued on page 102)

*See map on next page.



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MINERAL RESOURCES DIVISION, DEPT. M.T.S.

Producers and Prospective Producers

* - base-metal
** - auriferous quartz
*** - placer
**** - prospective producer

Newfoundland

1. Maritimes Mining Corp. Ltd. (Tilt Cove)*
   Buchans Mining Co. Ltd.*

New Brunswick

2. Bathurst District
   Heath Steele Mines Ltd.*

Quebec

3. Gaspe Copper Mines Ltd.*
4. Weedon Pyrite & Copper Corp. Ltd.*
   Chaudiere River Placers*** ****
5. New Calumet Mines Ltd.*
6. Chibougamau District
   Campbell Chibougamau Mines Ltd.*
   Anacon Lead Mines Ltd. (Chibougamau operation)**
   Copper Rand Chibougamau Mines Ltd.* ****
   Opemiska Copper Mines (Quebec) Ltd.*
   Merrill Island Mining Corp. Ltd.*
7. Rouyn-Noranda District
   Elder Mines Ltd.**
   Eldrich Mines Ltd.**
   Stadacona Mines (1944) Ltd.**
   Noranda Mines Ltd.*

Quemont Mining Corp. Ltd. *
Waite-Amulet Mines Ltd. *
Cadillac-Malartic District
Barnat Mines Ltd. **
Canadian Malartic Gold Mines Ltd. **
East Malartic Gold Mines Ltd. **
Malartic Gold Fields Ltd. **
Bourlamaque-Louvicourt District
Bevcon Mines Ltd. **
Lamaque Gold Mines Ltd. **
Sigma Mines (Quebec) Ltd. **
Sullivan Consolidated Mines Ltd. **
East Sullivan Mines Ltd. *
Golden Manitou Mines Ltd. *
Duparquet District
Normetal Mining Corp. Ltd. *
8. Belleterre Quebec Mines Ltd. **

Ontario

9. Larder Lake District
Kerr-Addison Gold Mines Ltd. **
Kirkland Lake District
Kirkland Minerals Corp. Ltd. **
Lake Shore Mines Ltd. **
Macassa Mines Ltd. **
Sylvanite Gold Mines Ltd. **
Teck-Hughes Gold Mines Ltd., The**
Upper Canada Mines Ltd. **
Wright-Hargreaves Mines Ltd. **
Porcupine District
Aunor Gold Mines Ltd. **
Broulan Reef Mines Ltd. **
Coniaurum Mines Ltd. **
Delnite Mines Ltd. **
Dome Mines Ltd. **
Hallnor Mines Ltd. **
Hollinger Consolidated Gold Mines, Ltd. **
Hollinger-Ross mine**
Hugh-Pam Porcupine Mines Ltd. **
McIntyre Porcupine Mines Ltd. **
Pamour Porcupine Mines Ltd. **
Paymaster Consolidated Mines Ltd. **
Preston East Dome Mines, Ltd. **
10. Sudbury District
International Nickel Co. of Canada Ltd., The*
Falconbridge Nickel Mines Ltd. *
11. Manitouwadge District
Geco Mines Ltd. *
Willroy Mines, Ltd. *
12. Renabie Mines Ltd. **
13. Thunder Bay District
Leitch Gold Mines Ltd. **
MacLeod-Cockshutt Gold Mines Ltd. **
Consolidated Mosher Mines Ltd. ** ****
14. Patricia District
Pickle Crow Gold Mines Ltd. **
15. Campbell Red Lake Mines Ltd. **
Cochenour Willans Gold Mines Ltd. **
Madsen Red Lake Gold Mines Ltd. **
McKenzie Red Lake Gold Mines Ltd. **
New Dickenson Mines Ltd. **

Manitoba

16. San Antonio Gold Mines Ltd. **
Forty-Four Mines Ltd. **
17. Nor-Acme mine of Britannia Mining and Smelting Co. Ltd. **
Hudson Bay Mining and Smelting Co. Ltd. *
18. Sherritt Gordon Mines Ltd. *

Alberta

19. Placer operations on Saskatchewan River***

British Columbia

20. Consolidated Mining and Smelting Co. of Canada Ltd., The (Kimberley)*
Sunshine Lardeau Mines Ltd. (Revelstoke)*
French Mines Ltd. **
21. Britannia Mining and Smelting Co. Ltd. * (Howe Sound Company)
22. Pioneer Gold Mines of B. C. Ltd. **
Bralorne Mines Ltd. **
Cariboo Gold Quartz Mining Co. Ltd., The**
Small placer operations***

23. Enterprise Placers and smaller operations***

Yukon Territory

24. Burwash Mining Co. Ltd.*** and smaller operations***
25. Yukon Consolidated Gold Corp. Ltd., The***
    Yukon Explorations Ltd.*** and smaller operations***

Northwest Territories

26. Consolidated Mining and Smelting Co. of Canada Ltd., The (Con and Rycon mines**)
    Giant Yellowknife Gold Mines Ltd.**
26. Consolidated Discovery Yellowknife Mines Ltd.**
    Akaitcho Yellowknife Gold Mines Ltd.** ****
    Taurcanis Mines Ltd.** ****

Maritime Provinces

In New Brunswick, low base-metal prices prevailing during 1958 resulted in a curtailment of development in the Bathurst area, and only 52 ounces of by-product gold were produced.

In Nova Scotia, Mint receipts showed only 131 ounces of gold recovered from auriferous-quartz ores and none from base-metal ores.

Quebec

In Quebec, 12 auriferous-quartz mines were producing, Sullivan Consolidated Mines Limited, closed since July 1956, having reopened in August 1958. Tons milled increased by 8 1/2 per cent and the average grade of ore milled remained unchanged at 0,164 ounce of gold per ton. Gold production from auriferous quartz increased by 8 1/2 per cent.

Cadillac-Malartic District

The four lode gold mines in the district all showed an increase in gold production. The leading producer and Quebec's second largest gold mine, East Malartic Mines Limited, milled less ore, but an increase in the grade of ore milled resulted in a small increase in gold production. Malartic Gold Fields Limited increased its milled tonnage while maintaining ore grade and raised its gold output by 12 per cent. Plans are under way to develop the Consolidated Marbenor Mines Limited and the properties of Norlartic Mines Limited to the north of Malartic Gold Fields. It was announced early in 1959 that Malartic Gold Fields and Consolidated Marbenor were being combined into a new company called Marban Gold Mines Limited. Barnat Mines Ltd. had considerable success in finding new orebodies during the year and increased gold output by 6 1/2 per cent. Barnat plans to more than triple its production, using the Malartic Gold Fields mill for custom treatment of the ore that cannot be handled in the small Barnat mill. Canadian Malartic Gold Mines Limited is now the only lode gold mine in the district not under the control of Little Long Lac Gold Mines Limited, a financing and exploration company, which controls directly or indirectly 10 of Canada's producing gold mines. During the year Canadian Malartic and the adjoining Barnat mine carried out a joint exploratory diamond-drilling program at the boundary of the two properties.

Bourlamaque-Louvicourt District

Gold production in the district increased by 7 per cent, mainly owing to the reopening of the mine of Sullivan Consolidated Mines Limited, at Val d'Or, in August. Lamaque Gold Mines Limited, Quebec's leading gold mine, increased its milled tonnage by 2 1/2 per cent, but the lower grade of ore worked gave only a 1 1/2-per-cent increase in production. Sigma Mines (Quebec) Limited increased its milled tonnage by 3 1/2 per cent and its gold output by 2 1/2 per cent. Sigma is planning a development program involving enlargement of the upper part of No. 2 shaft to four-compartment size and the sinking of a new winze from the 21st level to 1,000 feet below the present bottom level (the 24th). Bevcon Mines Limited maintained tonnage and grade approximately at the 1957 level. Bevcon bought the property of Lencourt Gold Mines Limited, which adjoins to the west, and plans to explore the property.

Noranda-Duparquet-Belleterre Districts

These showed a 17-per-cent decline in production. Stadacona Mines (1944) Limited, the only gold mine in the Noranda area having its own milling plant, ceased underground operations in November and milling operations in December. Mining and milling equipment was being sold early in 1959. Elder Mines Limited and its subsidiary, Eldrich Mines Limited, continued to ship gold ore to Noranda Mines Limited to be used as a flux ore in the Noranda smelter. The gold recovered from the two mines was 8 per cent less than in 1957. Belleterre Quebec Mines Limited, near Ville Marie, was on a salvage basis and is expected to close in April 1959.

Chibougamau District

Anacon Lead Mines Limited (Chibougamau Operation), 40 miles west of Chibougamau, Quebec, obtained more than 70 per cent of the value of its production from gold and is now considered an auriferous-quartz mine in which copper is recovered as a by-product.

Base-metal Mines

By-product gold from base-metal mines plays an important part in Quebec's gold production. In 1958, 36 1/2 per cent of the province's gold came from base-metal mines. Approximately 90 per cent of this gold is treated through the Noranda smelter and the Montreal East refinery of Canadian Copper Refiners Ltd., a Noranda subsidiary. Gold from base metals was 381,936 ounces in 1958, 4 per cent less than the 396,413 ounces derived from this source in 1957.

Ontario

The 30 lode gold mines that continued to operate in Ontario accounted for the province's contribution of more than 59 per cent to Canada's 1958 gold output. Tons milled increased by nearly 4 per cent and an increase from 0.282 to 0.285 ounce of gold per ton in the average grade of ore milled resulted in an increase of nearly 5 1/2 per cent in production.

All the gold-mining districts in Ontario except Sudbury showed an increase in gold production.

Porcupine District

Thirteen auriferous-quartz mines continued to operate in the Porcupine district, Canada's leading gold-producing area. Tons milled increased by 5 per cent and the average grade milled from 0.242 to 0.245 ounce of gold per ton, giving a 7-per-cent increase in gold production.

Hollinger Consolidated Gold Mines, Limited, the principal producer, regained its normal level after a poor year in 1957 and increased its production by 12 per cent. McIntyre Porcupine Mines Limited, the second producer, had a 4-per-cent increase and the largest production of any year since 1942. Dome Mines Limited, the next large producer reached its highest level of output since 1941. During 1958, Dome converted to backfilling its underground workings by hydraulic means, using mill tailings, and this resulted in greater efficiency in mining operations.

Aunor Gold Mines Limited had the best year in its history, with a 17-per-cent increase in gold production. Preston East Dome Mines, Limited, had a decrease but is planning to purchase the claims of the neighbouring Midcamp Mines Limited and explore the possible extension of Preston ore zones into the Midcamp property. Pamour Porcupine Mines, Limited, milled the highest tonnage in its history and increased its output by 17 per cent. Hallnor Mines Limited mined a higher grade of ore and had a 22-per-cent increase in output. Delnite Mines Limited milled a higher tonnage than ever before and increased production by 29 per cent. Delnite also completed the sinking of its No. 3 winze and began the opening of three new levels. Paymaster Consolidated Mines, Limited, increased production by 10 per cent, and in milled tonnage and output reached its highest level since 1942. Paymaster began to sink its No. 6 winze a further 400 feet in November to establish two new levels. Broulan Reef Mines Limited and its subsidiary, Hugh-Pam Porcupine Mines Limited, mined a lower grade of ore and had a drop in output. The tonnage milled by Coniaurum Mines Ltd. showed an increase, but the lower grade of ore milled resulted in a small reduction in recovery. The Ross mine of Hollinger Consolidated Gold Mines Limited, at Holtyre, maintained production near the 1957 level.

Larder Lake District

This continued to be the second largest gold-producing district in Ontario and all production came from Canada's largest gold producer, Kerr-Addison Gold Mines Limited. Once again this mine established a new high with an increase of more than 4 per cent in gold production resulting from an increase from 0.314 to 0.326 ounce of gold per ton in the grade of ore milled.

Patricia Portion

This district includes both the five gold mines in the Red Lake mining division and the Pickle Crow mine in the Patricia mining division. Tons milled dropped by 1 per cent, but an improvement in milled grade from 0.455 to 0.488 ounce of gold per ton gave a 6-per-cent increase in production.

Campbell Red Lake Mines Limited continued as the principal producer in the area and improved its gold output by 3 per cent by milling a higher grade of ore. Madsen Red Lake Gold Mines Limited milled a lower tonnage, but a higher grade gave a 20-per-cent increase in output. New Dickenson Mines Limited has a small increase in output and deepened its shaft to open four new levels. The adjoining Robin Red Lake Mines Limited was being diamond-drilled from a heading driven into the property from New Dickenson. Cochenour Willans Gold Mines, Limited, mined a higher grade of ore and had a 4-per-cent increase in output. The adjoining Martin-McNeely Mines Limited and Consolidated Marcus Gold Mines Ltd. were explored during the year from workings driven into the properties from Cochenour Willans. Pickle Crow Gold Mines Limited had a 4-per-cent drop in production. Goldfields Uranium Mines Limited acquired control of this company in 1958; in February 1959, control passed, by purchase, to Lamaque Gold Mines Limited.

Kirkland Lake District

Gold output from the seven mines in the district was maintained at virtually the same level as in 1957. Tons milled increased by 5 per cent, but the grade of ore milled decreased to 0.311 ounce per ton from 0.328 in 1957.

Lake Shore Mines Limited regained its position as the leading gold producer in the district, increasing tons milled by 3 1/2 per cent and output by 12 per cent. Macassa Mines Limited increased its milled tonnage by 16 per cent, but there was a decrease in the grade of ore milled and the increase in output amounted only to 6 per cent. Milled tonnage was the highest in the mine's history, and output the highest since the peak year of 1940. Wright-Hargreaves Mines Limited, showed a big drop in production, but this was due primarily to the inclusion of mill clean-up gold in the 1957 output. Ore from the Wright-Hargreaves mine is now treated in the Lake Shore mill. This mine is the deepest in Canada, having sunk its No. 6 winze to 8,170 feet in 1957, and six new levels were under development in 1958.

Carrying out a major shaft-sinking program in 1958, Upper Canada Mines Limited sank 793 feet of shaft and cut seven new stations. Milled tonnage, however, increased only slightly, and the lower grade of the ore resulted in a 3 1/2-per-cent drop in output. Sylvanite Gold Mines Limited increased its milled tonnage by nearly 10 per cent, but a sharp drop in milling grade brought a 2-per-cent production decline. Teck-Hughes Gold Mines Limited, on a salvage basis for many years, took a new lease of life and carried out a considerable amount of development work, which included the sinking of No. 4 winze to a total of 81 feet. Tons milled increased by 8 1/2 per cent, but the ore was of lower grade and the increase in output amounted only to 2 per cent. Kirkland Minerals Corporation Limited milled a much higher grade of ore and had a 29-per-cent increase in output.

Thunder Bay District (Port Arthur Mining Division)

MacLeod-Cockshutt Gold Mines Limited increased its milled tonnage but milled a lower grade of ore with the result that output was virtually the same as in 1957. MacLeod is expected to begin milling ore from the adjoining property of Consolidated Mosher Mines Limited during 1959. Leitch Gold Mines Limited showed a 4-per-cent increase in milled tonnage, increased the milled grade to more than 1 ounce of gold per ton, and had a 15-per-cent increase in output.

Sudbury District

Renabie Mines Limited had a 6-per-cent increase in milled tonnage but a drop in milled grade, and the result was an 11-per-cent drop in gold output.

Base-metal Mines

From 1957 to 1958, production of gold as a by-product from base-metal mines increased from 1.7 to 2.1 per cent of Ontario's gold output. A cutback in production and a three-month labour strike against The International Nickel Company of Canada Limited at the nickel-copper mines of the Sudbury basin, which are the main source of by-product gold, resulted in a 22-per-cent drop in gold output. Large increases in output at the new copper-zinc-gold mines in the Port Arthur mining division - Geco Mines Limited, Willroy Mines Limited and Coldstream Copper Mines Limited - offset the drop in production from the nickel mines.

Manitoba and Saskatchewan

Gold production from the three auriferous-quartz mines in Manitoba dropped by 30 per cent, being 29,267 ounces less than in 1957. The Nor-Acme mine at Snow Lake, in The Pas mining district, under lease by the Howe Sound Company (Britannia Mining and Smelting Company Ltd.), closed in July 1958 with all known ore exhausted. San Antonio Gold Mines Limited and its subsidiary, Forty-Four Mines Limited, both at Rice Lake in the Winnipeg mining district, showed small increases in gold output.

By-product gold from the copper-zinc mines of Hudson Bay Mining and Smelting Co. Limited, at Flin Flon, on the Manitoba side of the border, and from the Sherritt Gordon Mines Limited nickel-copper mine at Lynn Lake, showed a decrease.

The output of by-product gold from the Saskatchewan portion of the copper-zinc mines of Hudson Bay Mining and Smelting Co. Limited increased.

The combined total from the base-metal ores of Manitoba and Saskatchewan increased 8 per cent, to 106,057 ounces in 1958 from 98,088 in 1957. Base-metal gold was 61 per cent of all the gold recovered in Manitoba and Saskatchewan in 1958.

Alberta

A small amount of placer gold was again recovered from the gravels of the North Saskatchewan River, near Edmonton.

British Columbia

Every year since 1948, except 1957, British Columbia's gold production has declined. In 1958, the province's gold output declined by 8 per cent. Gold output from the four auriferous-quartz mines in the province rose slightly, the major decline being a 67-per-cent drop in gold from base-metal ores.

Bralorne Mines Limited, the province's principal gold producer, in the Bridge River area, showed a 12-per-cent increase in production. Development at depth of its new veins - Nos. 77 and 79 - has improved mine ore grade. Pioneer Gold Mines of B.C. Limited, adjoining Bralorne, was not so fortunate in finding new ore, and its production dropped by 11 per cent. It was announced, early in 1959, that the two mines had combined into one company to be known as Bralorne Pioneer Mines Limited. The Cariboo Gold Quartz Mining Company Limited, at Wells, had a 28-per-cent drop in output. A long exploratory heading was driven through the Aurum section of the mine towards the Mosquito Creek fault. French Mines Limited, a Cariboo subsidiary in the Hedley area, continued to operate a small mill treating high-grade ore from an extension of the ore zone of the old Kelowna Mines Hedley Limited (French mine), which closed in 1955.

Many of the base-metal mines in British Columbia closed during 1958, and this caused a drop of some 27,000 ounces in production from this source.

Activity in placer operations in the Wells and Atlin areas increased, and more placer gold was recovered.

Northwest Territories

Revised preliminary estimates showed a 1-per-cent increase in gold production, from 340,018 to 343,838 ounces.

Giant Yellowknife Gold Mines Limited dropped 10 per cent in output. This company has considerable difficulty in recovering gold from its ores owing to the high arsenic content of the ore. A new roaster unit and bag plant was being installed in 1958 in an attempt to improve recovery. From flue gases the bag plant will extract arsenic, which will be kept in special underground store rooms. It is planned to deepen the central shaft and increase the mill rate in 1959. The combined production of the Con and Rycon mines of The Consolidated Mining and Smelting Company of Canada Limited, at Yellowknife, increased by 23 per cent in 1958. A heading was being driven into the N'Kana claims north of the Rycon mine. The winze in the Con mine is to be deepened 250 feet in 1959. Consolidated Discovery Yellowknife Mines

Limited, which operates Canada's highest-grade gold mine, some 65 air miles north of Yellowknife, increased recovery by 3 per cent. This mine was shaft-sinking and four new levels were to be developed.

Yukon

There was renewed interest in placer gold-mining in the Dawson area. A drop in production from the older established placer operations, however, caused an 8-per-cent decline in gold output.

The Yukon Consolidated Gold Corporation Limited continued to run seven dredges and one hydraulic operation in the Dawson area and started a new hydraulic operation on a bench above Dominion Creek. Weather conditions permitted a longer-than-usual operating season. Several new placer operations commenced in the Dawson area. Only a small amount of gold was recovered from the claims of Yukon Explorations Ltd. in the Sixty Mile River area. Most of the work carried out by the Yukon Placer Mining Company for this company consisted in stripping and preparatory work for a renewal of full-scale sluicing operations during the 1959 operating season. Another large producer, Waddco Placers Limited, in the Mayo Lake area, did not operate in 1958. A Yukon Placer Mining Company subsidiary, Ballarat Mines Limited, renewed full-scale activities on the Groetcher Concession close to Dawson City.

Developments at Other Properties in Canada

Quebec

Drilling operations continued into the gravel deposits along the Chaudière River valley near Beauceville in the Eastern Townships. Results of the drilling will determine if gold dredging will commence in the area in the summer of 1959.

Ontario

The H. G. Young Mines Limited, adjoining Campbell Red Lake Mines Limited in the Red Lake area, started shaft-sinking to 800 feet after surface diamond-drilling had indicated two possible ore zones.

Northwest Territories

Taurcanis Mines Limited, at Matthews Lake, 150 miles northeast of Yellowknife, is planning to deepen its shaft a further 300 feet to open two new levels. Work was carried out on an airstrip during the year. Salmita Consolidated Mines Limited, adjoining the Taurcanis mine, sank a shaft to 125 feet and did some drifting in 1958. North Goldcrest Mines Ltd. did diamond-drilling in the old Homer ground south of Taurcanis. Giant Yellowknife Gold Mines Limited carried out a mapping and diamond-drilling program on the ground of Akaitcho Yellowknife Gold Mines Ltd. to the north of Giant.

Manitoba

It was announced early in 1959 that Explorers Alliance Limited was reopening an old gold property in the Herb Lake area.

British Columbia

Tofino Mines Limited was developing a gold prospect on the west coast of Vancouver Island. Building of a 50-ton-a-day mill is under consideration. Privateer Mine Limited was also considering reopening a former gold producer on Vancouver Island.

Yukon Territory

A former lode gold mine in the Freegold Mountain area was being re-examined.

Consumption and Uses

In its Annual Bullion Review, 1957, Samuel Montagu & Co. Ltd., of London, England, recognized as an international authority on gold transactions, estimated that of a total of 36,100,000 ounces of new gold sold in 1958, 53 per cent went into central bank reserves, 11 per cent to hoarders and 14 per cent for industrial consumption. The remaining 22 per cent was bought in Switzerland, Great Britain and Canada for investment by individuals, institutions and even some foreign-government bodies.

Today, gold is used principally as a monetary reserve of governments and central banks to give stability to paper currencies and to settle international trade balances.

Sizable quantities are also used in domestic industry and the arts. According to data furnished by the Bureau of the Mint in the United States, the gold used in that country in 1957 for this purpose totalled 1.45 million ounces, which was equivalent to about 80 per cent of United States domestic mine production for that year.

Approximately half of the gold used in industry is for jewelry. Gold is easily worked. When thick, it is called gold plate; when rolled thin, it is sheet; when rolled very thin, it is called foil; and when hammered until it is transparent, it is called leaf. Although gold still goes into expensive tableware, it is used most extensively in the manufacture of jewelry, watch-cases and utensils and for gold leaf and decorative finishes.

Because gold resists corrosion and oxidation and is extremely ductile and highly conductive, its industrial application continues to expand. It is used considerably in dentistry and medicine, in chemical plants, and for laboratory ware and delicate instruments. The ceramic industry is increasing its use of gold for decoration and the preparation of ceramic colours.

World Gold Production*

(fine ounces)

Country	1958	1957
North America		
Canada	4,571,347	4,433,894
United States	1,801,005	1,817,197
Mexico	332,238	346,320
Central America and other countries	249,500	210,300
Total	6,954,090	6,807,711
South America		
Colombia	371,715	325,130
Peru	159,127	165,093
Brazil	116,190	120,755
Chile	70,858	103,587
Other countries	150,709	125,382
Total	868,599	839,947
Europe		
U. S. S. R.	10,000,000	10,000,000
Sweden	100,000	95,745
Other countries	300,000	304,255
Total	10,400,000	10,400,000
Asia		
Philippines	422,833	379,982
Japan	308,450	302,706
India	170,109	179,198
Other countries	115,912	97,216
Total	1,017,304	959,102
Africa		
Union of South Africa	17,656,442	17,031,690
Ghana	851,433	788,151
Southern Rhodesia	554,838	536,849
Belgian Congo	356,126	374,258
Other countries	128,234	130,297
Total	19,547,073	18,861,245
Oceania		
Australia	1,100,404	1,083,941
Other countries	150,571	178,032
Total	1,250,975	1,261,973
World total (estimate)	40,400,000	39,620,000

*American Bureau of Metal Statistics.

Gold is also finding additional use in the atomic age. Gold plating on the outer surface of the Vanguard earth satellite provided protection from the elements in outer space and facilitated official tracking. The 13-pound nose cone of the United States Army's Pioneer III moon rocket, which rose 66,654 miles above the earth on December 7, 1958, was coated with gold.

Late in 1958 the Gold Committee of the Canadian Metal Mining Association was authorized to launch a program of research into the expanded industrial uses of gold. The Committee made arrangements with the Department of Mines and Technical Surveys to carry out research in the Ottawa laboratories of the Mines Branch.

The Price of Gold

The official United States price of gold, established under authority of the Gold Reserve Act of 1934 at $35 (U.S.) per fine troy ounce, has remained unchanged. The Royal Canadian Mint in Ottawa buys gold from Canadian producers and pays for the gold at the fixed United States price but in Canadian funds. The average Mint value for a troy ounce of fine gold in Canadian dollars was estimated at $33.98 for 1958. In 1957 it was $33.55; in 1956, $34.45. In January 1958 the value averaged $34.46, but this declined to $33.59 by July and was $33.74 in the last week of 1958.

There was considerable interest during the year in the question of a possible increase in the United States price of gold, but at the 13th annual meeting of the International Monetary Fund, held at New Delhi, India, early in October 1958, R.H. Anderson, Secretary of the United States Treasury, restated the American position and said that the price of gold in United States dollars should remain unchanged. I.M.F. officials also gave little encouragement for an increase in the price of gold in the immediate future.

Notable in 1958 was the flow of gold out of the United States. The decrease of approximately $2,200 million in American gold reserves was the largest for any year on record. United States gold stocks at the end of 1958 stood at $20,500 million. By law, the United States requires a 25-per-cent cover of gold to support Federal Reserve notes and deposit liabilities. In spite of the outflow, the gold coverage was still 42 per cent at the end of the year. Canada's gold reserve is approximately $1,000 million and that of the United Kingdom is $3,200 million. The total of gold and United States dollar reserves in Canada stood at $1,927 million at the end of November 1958; at the same date in 1957 it was $1,895 million.

International Financial Statistics, published by the International Monetary Fund, gives the following prices for bar gold as quoted at free-exchange rates in United States dollars per fine ounce of gold.

Country	1957	1958 (July)
Belgium	35.06	35.22
France	36.29	36.33
Hong Kong	38.35	38.30
Italy	35.32	35.34
Lebanon	35.05	35.74

During the year the Canadian Metal Mining Association requested the Canadian Government to authorize the Royal Canadian Mint to produce gold bars of one kilogram (approximately 32 ounces) with the Mint stamp and attestation as to weight in fine ounces. The Minister of Finance told the Association that such authorization could not be given at this time.

Noranda Mines Limited, which has its own facilities for reducing gold bars to the required fineness and whose stamp is registered and accepted on the London Gold Exchange, announced that it was producing one-kilogram bars to be available for private purchase.

A brokerage firm in Toronto announced that it would sell gold bars, either of 400 ounces or of one kilogram, to private purchasers. On February 3, 1959, the Toronto Stock Exchange began to give daily quotations on the value of one-kilogram gold bars.

INDIUM

D.B. Fraser

Indium is one of the rarer metals that has become increasingly available in recent years. Considerable research has been carried out to find useful applications for it, and industrial requirements have increased substantially.

The metal was first discovered spectrographically in Germany in 1863, but not until about 1927 was it produced in quantities exceeding a few grams. Information on world production is vague, but indium is produced in the United States, Germany, Belgium, Italy, Peru, Japan and probably Russia, as well as in Canada.

In nature, indium is found only as traces in certain zinc, lead, tin, tungsten and iron ores, but it has a widespread association with sphalerite, the principal zinc-bearing mineral. Some zinc ores contain as much as 1 per cent indium, but normally indium is present in much smaller amounts. The metal is produced commercially as a by-product from the smelting and treatment of zinc and lead ores.

Production

In Canada, indium is produced only by The Consolidated Mining and Smelting Company of Canada Limited, at Trail, British Columbia. The principal source of the company's ore is the Sullivan lead-zinc-silver mine at Kimberley, British Columbia, from which concentrates are shipped to Trail, where the contained lead, zinc and other metals, including indium, are recovered. In addition to concentrates from the Sullivan mine, the company treats ores and concentrates from a number of other mines. The quantity of indium contained in the various ores treated is insignificant.

Certain of the metallurgical operations at Trail result in slag concentrations containing about 2.5 per cent indium. This slag is reduced electrothermally to produce a bullion containing lead, tin, indium and antimony, which is treated electrolytically to yield a high (20-25%) indium anode slime. The anode slime is then treated chemically to give a crude (99%) indium metal, which is refined electrolytically to produce a standard grade (99.97%) of indium or a high-purity grade approximating 99.999 per cent indium.

Although the presence of indium in zinc concentrate from the Sullivan mine had been known for many years, no serious attempt to recover it separately was made until 1940. The first commercial indium was made at Trail on a laboratory scale in 1942. This production and that of subsequent years are shown in the following table:

Year	Troy Ounces	$
1942	470	4,710
1949	689	1,550
1950	4,952	12,083
1951	582	1,368
1952	404	909
1953	6,752	9,588
1954	477	1,278
1955	104,774	232,598
1956	363,192	795,390
1957	384,360	693,770
1958	not available	

The potential annual production at Trail is approximately 1 million troy ounces, or 35 tons.

Properties and Uses

Indium is silvery-white, very 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 and low coefficient of sliding friction. It is easily scratched by 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 and is extremely resistant to atmospheric and alkaline corrosion. A rod of indium, like one of tin, 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 a number of the base metals, improving their performance in certain special applications. Its principal use is in high-speed bearing alloys, where the addition of indium to silver-lead and other alloys increases the strength, wettability and corrosion-resistance of the bearing surface. The standard-grade (99.97%) indium 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 where resistance to alkaline corrosion is required, and in gold dental alloys.

In electronics, high-purity indium is finding increasing application in transistors, where it is used to modify the properties of germanium. Indium oxide has possible uses as a resistor, and indium sulphide as a thermistor and a rectifier. The selenide, which is a photoconductor, is potentially applicable in electrophotographic plates.

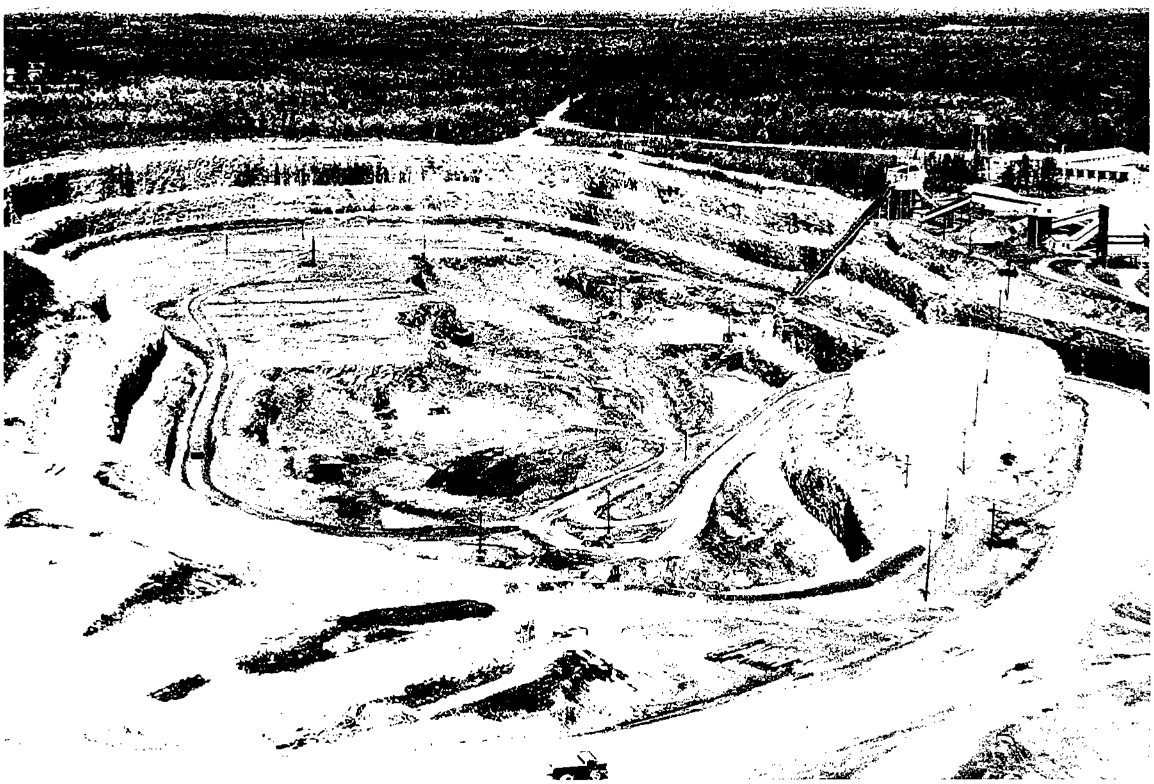
In the field of nuclear energy, low-energy neutrons easily induce radioactivity in indium; hence indium can be used as an indicator in an atomic pile. Indium sulphate solution is potentially useful as a source of gamma rays in irradiation reactors for the preservation of food.

Trade and Consumption

No figures are available on the export, import or domestic consumption of indium. Most of Canada's output is exported to the United States and the United Kingdom, smaller amounts going to a number of countries in Europe.

Prices

From 1946 to March 1958, the price of indium quoted in E & M J. Metal and Mineral Markets was $2.25 a troy ounce of 99.9+ purity. On March 20, 1958, the price was quoted as $2.25 a troy ounce in small lots and $1.25 to $2.25 a troy ounce in lots of more than 5,000 ounces. These price prevailed for the rest of the year.



Courtesy of Marmoraton Mining Company Limited
H. R. Oakman 690-H-7

The iron-ore open pit at Marmora, southeastern Ontario.

IRON ORE

R.B. Elver

Shipments of iron ore by Canadian producers decreased 29.4 per cent to 14,041,360 tons* in 1958, from 19,885,870 tons in 1957. The decrease in value was 24.6 per cent, down from the all-time high of $167,221,425 reached in 1957. Of the four producing provinces, British Columbia was the only one to increase shipments during the year. The United States maintained its position as the main market for Canadian iron ore despite a 32-per-cent cutback in imports. Exports to the United Kingdom and western Europe also decreased. An important feature of the 1958 international iron-ore market was that imports of Venezuelan iron ore by the United States, the United Kingdom and western Europe decreased only slightly, whereas imports from all other major producing countries decreased significantly. Canadian imports, derived almost wholly from the Lake Superior region of the United States, decreased 24.8 per cent from the 1957 figure. Indicated total consumption decreased 21 per cent during the year. The trend towards a proportional increase in the domestic use of Canadian iron ore continued, the proportion of domestic iron ore received by Canadian iron and steel plants rising from 32 per cent in 1957 to about 37 per cent in 1958.

During 1958, two mines went into production, bringing the total number of operating companies to nine. Direct-shipping ores accounted for 64 per cent of Canada's shipments, with concentrates and agglomerates contributing 20 and 16 per cent respectively. About 80 per cent of the ore shipped was of the hematite-goethite variety, while sintered siderite and magnetite accounted for 11.3 and 8.7 per cent respectively. More than 77 per cent of the ore produced came from open-pit mines.

In addition, three companies produced iron by-products. One produced iron-oxide pellets as a coproduct of the treatment of nickeliferous pyrrhotite concentrates; another produced iron-oxide sinter as a coproduct of sulphur dioxide from the roasting of pyrite. A third firm smelted ilmenite ore to produce titanium-dioxide slag and 'remelt iron', a type of pig iron.

Despite the sharp drop in the demand for iron ore, exploration and development of iron-bearing properties continued. Four companies had properties under development for production, one of which deferred its starting date from 1958 to 1959. With these development projects included, it is estimated that Canada's annual production capacity will approach 35

*Tons of 2,240 pounds (long or gross) are used throughout unless otherwise stated.

Iron Ore - Production, Trade and Consumption

	1958		1957	
	Long Tons	$	Long Tons	$
Production (shipments)				
Quebec	5,411,004	46,859,490	7,922,275	65,805,057
Newfoundland	4,813,192	38,226,828	7,298,910	57,898,102
Ontario	3,254,422	36,851,421	4,345,630	41,317,629
British Columbia ...	562,742	4,193,442	319,055	2,200,637
Total	14,041,360	126,131,181	19,885,870	167,221,425
Imports				
United States.......	2,984,663	28,021,942	3,778,140	32,593,452
Brazil.............	62,437	909,249	264,192	3,685,845
United Kingdom......	201	862	-	-
Chile..............	-	-	10,367	107,128
Sweden	-	-	5	363
Total..............	3,047,301	28,932,053	4,052,704	36,386,788
Exports				
United States.......	8,595,843	77,749,050	12,613,121	110,179,709
United Kingdom.....	2,000,526	16,212,753	3,047,029	24,283,931
West Germany	810,543	6,144,130	1,097,105	8,294,106
Netherlands	464,540	3,765,352	545,687	4,455,135
Japan..............	493,332	3,587,471	336,429	2,342,738
Belgium............	26,530	215,502	145,688	1,176,397
Italy...............	-	-	108,692	908,748
France.............	-	-	79,018	640,630
Total	12,391,314	107,674,258	17,972,770	152,281,394
Consumption (indicated)*	4,697,347		5,965,805	

*Shipments plus imports less exports, but no account taken of changes in stocks at consuming plants.

million tons by 1962. Billions of tons of concentrating-grade material have been indicated by diamond-drilling and geological mapping in Quebec, Labrador and Ontario. More than 100 companies conducted exploration programs on iron-bearing properties in Canada during the year.

The North American economy, in which a general recession first became evident in the latter half of 1957, did not show signs of recovery until April and May of 1958. By year-end, recovery seemed definite, and it was freely predicted that in the coming year there would be a general improvement in all sections. Estimates of 1959 United States steel production made by several United States steel firms suggest that output will rise to about 110 million net tons from the 85 million net tons produced in 1958. By year-end, the United States steel operating rate had climbed to 75 per cent of capacity from the 47-per-cent low reached in April. In the United Kingdom and western Europe, steel production and iron-ore consumption also tended to soften, although the outlook for a strong recovery in 1959 is still uncertain in these overseas markets. Despite a build-up of iron-ore stocks during 1958, consumption increased in Canada and the United States during the latter part of the year, and this was reflected in a strengthening of Canadian iron-ore shipments towards the close of the 1958 shipping season.

World Production

During 1958, Canada dropped to ninth place from the position of fourth-ranking producer, which it held in the preceding year. This spectacular fall resulted from the decrease of more than 29 per cent in Canadian production rather than from an increase in the output of other countries. China, the only

Iron Ore Production, by Countries*

(thousands of long tons)

Country	1958	1957	1956
U.S.S.R.	87,397	82,909	76,767
United States	67,947	106,148	97,877
France	58,516	56,855	51,850
China	19,685	18,210	19,680
Sweden	18,304	19,664	18,761
West Germany	17,701	18,481	16,655
Venezuela	15,239	15,135	10,841
United Kingdom	14,612	16,902	16,245
Canada	14,041	19,886	19,954
Subtotal	313,442	354,190	328,630
Other countries	67,720	71,461	65,618
World total	381,162	425,651	394,248

*American Iron and Steel Institute, 1959.

country apart from the Union of Soviet Socialist Republics and France to have a significant increase in production, ranked fourth, but its output was less than the quantity produced by Canada in 1957. Present plans and forecasts indicate that Canada's production will expand rapidly in the next few years, so that its position will probably be unchallenged by Free World countries despite the 1958 decrease in its production.

Canadian Production and Trade

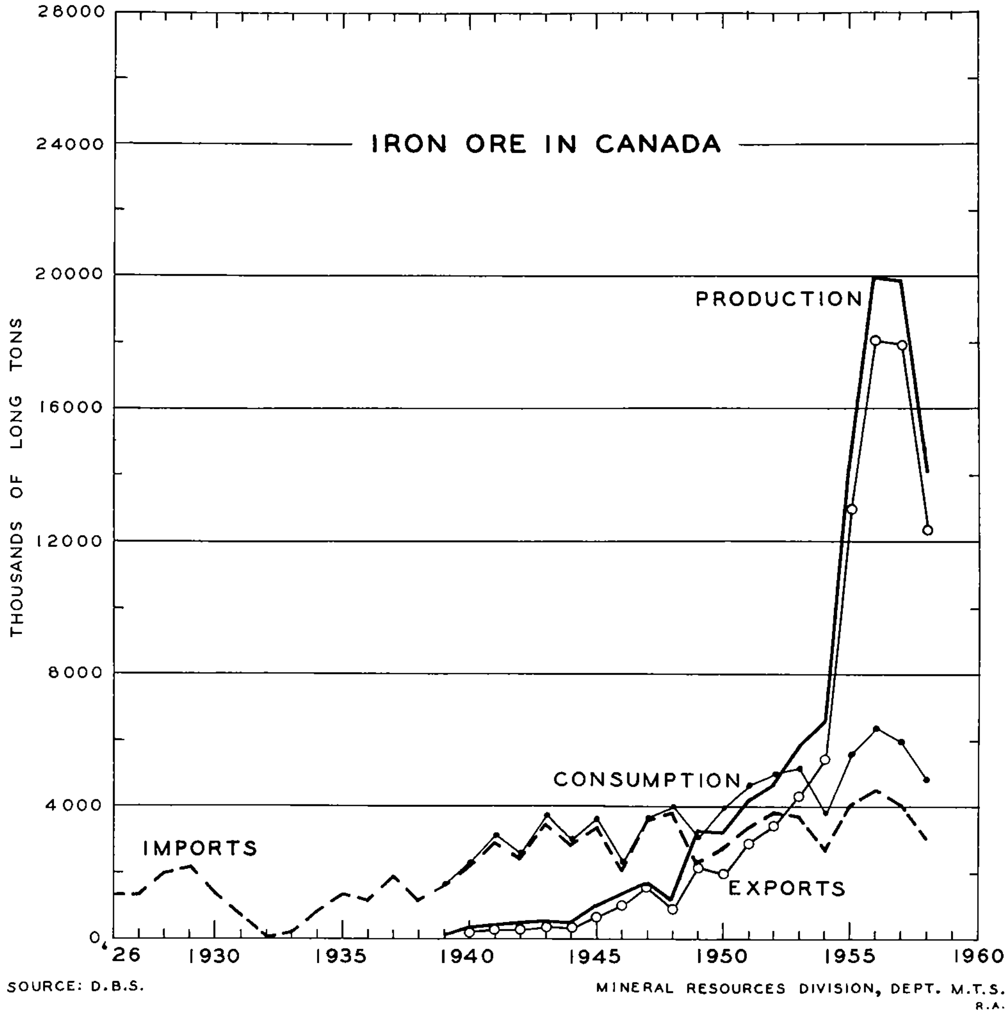
Canada's modern iron-ore industry began in 1939 when Algoma Ore Properties Limited brought its Helen mine, in the Michipicoten area of Ontario, back into production after the mine had been closed for about 20 years. No iron ore was produced in Canada during the period from 1925 to 1938, although production of 5,878,178 long tons was recorded during the period from 1886 to 1924. Since production resumed in 1939, growth in iron-ore output has been rapid, especially since the mid-1940's. Annual production is expected to be 40 million to 50 million tons by the mid-1960's, and perhaps 96 million tons by 1980.

Iron Ore - Production, Trade and Consumption, 1948-58
(long tons)

	Production (shipments)	Imports	Exports	Consumption (indicated)*
1948	1,193,968	3,839,431	955,604	4,077,795
1949	3,281,336	2,247,531	2,277,053	3,251,814
1950	3,218,983	2,741,568	1,988,817	3,971,734
1951	4,179,027	3,420,909	2,880,149	4,719,787
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

*Shipments plus imports less exports but no account taken of changes in stocks at consuming plants.

Most of Canada's iron-ore production is exported, by far the major portion going to the United States. Canada's proximity to the major steel-producing areas of the United States, its incentive taxation policies, its political stability, its immense reserves of iron ore, and Canadian-American company affiliations make it apparent that Canada will contribute an increasing proportion of the iron ore needed by the ever-expanding American iron-and-steel industry. The export of iron ore to the United Kingdom and western European countries by Dominion Wabana Ore Division of Dominion Steel and Coal Corporation Limited, Iron Ore Company of Canada and associated


IRON ORE IN CANADA
THOUSANDS OF LONG TONS
28000
24000
20000
16000
12000
8000
4000
0
PRODUCTION
CONSUMPTION
IMPORTS
EXPORTS
26
1930
1935
1940
1945
1950
1955
1960
SOURCE: D.B.S.
MINERAL RESOURCES DIVISION, DEPT. M.T.S.
R.A.

companies has grown considerably in recent years. This upward trend is expected to continue and to grow even more rapidly as Europe's iron-ore reserves diminish and its steel output increases.

Iron-ore imports for blast-furnace feed in Ontario come entirely from the United States. This is due principally to part-ownership by The Steel Company of Canada, Limited, of several iron-ore mining companies in the United States. The steel-makers' need of blending ores from different sources for blast-furnace feed also contributes to the need for imports. Ore from Brazil and Liberia is used mainly as open-hearth, lump-ore feed.

Domestic Consumption

Iron ore is used primarily as a raw material in the making of iron and steel. Small tonnages, not normally referred to as iron ore, are used annually in the manufacture of paint, as heavy-weight aggregate in concrete, as heavy media in some beneficiation plants, and for similar purposes. Most of the iron ore consumed is fed into blast furnaces to be made into pig iron, some of which is used by iron foundries. Most pig iron, however, along with iron and steel scrap, goes into furnaces in the process of manufacturing crude steel. Some iron ore is put directly into open-hearth steel-making furnaces. The following is a summary of statistics on the consumption of iron ore in Canadian iron and steel plants.

Consumption of Iron Ore
in Canadian Iron and Steel Plants

	Long Tons	
	1958	1957
In blast furnaces, direct	3,819,718	4,531,461
In steel furnaces, direct	312,264	315,647
In sintering plants before ore is placed in blast or steel furnaces	905,901	1,112,130
Miscellaneous	165	645
	5,038,048	5,959,883

Source: American Iron Ore Association, Cleveland, Ohio.

Consumption of Iron Ore and
Production of Pig Iron and Crude Steel
in Canada, 1957-58(1)

	1958 (long tons)	1957 (long tons)
Total receipts at iron and steel plants(2) ...	4,960,304	6,095,732
Receipts imported(2)	3,168,118	4,017,544
Receipts from domestic sources(2)	1,792,186	2,078,188
Stocks at iron and steel plants, Dec. 31 of previous year(2)	3,082,646	2,951,000
Stocks at iron and steel plants, Dec. 31 of year at top of column(2)	2,992,084	3,082,646
Net change in stocks	-90,562	+131,646
Consumption of iron ore(2) (3)	5,038,048	5,959,883
	(net tons)	(net tons)
Pig-iron production(4)	3,061,055	3,718,155
Capacity as of Jan. 1	4,148,375	4,149,000
Steel-ingot production(4)	4,251,507	4,924,133
Capacity as of Jan. 1	5,913,000	5,470,100

(1) Figures in this table do not correspond with those listed in the table entitled "Iron Ore - Production, Trade and Consumption", on page
(2) American Iron Ore Association, Cleveland, Ohio.
(3) Consumption figures are compiled from company submissions and cannot be calculated from statistics shown in this table.
(4) Dominion Bureau of Statistics, Ottawa.

Canadian Developments

This section outlines some of the more important developments concerning present, future and potential iron-ore producers.

Canadian Producers of Iron Ore during 1958

Company and Property Location	Product Mined	Product Shipped	Shipments[1] (Long tons)	
			1957	1958[2]
Algoma Ore Properties Ltd.; mines and sinter plant near Jamestown, Ont.	Siderite from underground and open-pit mines (35% Fe)	Some ore beneficiated by sink-float; nearly all sintered to iron oxide (50.1% Fe)	1,513,849	1,577,220
Canadian Charleson Ltd.; south of Steep Rock Lake near Atikokan, Ont.	Hematite-bearing gravels (15% Fe)	Jig and spiral concentrates (58% Fe)	-	39,702
Dominion Wabana Ore Division; Bell Island, Conception Bay, Nfld.	Hematite-chamosite from underground mine (50% Fe)	Heavy-media concentrates (50.7% Fe, 0.9% P)	2,781,840	2,119,000
Empire Development Co. Ltd.; Elk River, 8 miles east of Port Alice, Vancouver Island, B.C.	Magnetite from open-pit mine (42.5% Fe)	Magnetite concentrates (57.5% Fe)	71,313	232,432
Hilton Mines, The; near Bristol, Que., 40 miles northwest of Ottawa	Low-grade magnetite from open-pit mine	Iron-oxide pellets (66.5% Fe)	-	260,288

Iron Ore Co. of Canada; Labrador-New Quebec, near Schefferville, Que.	Hematite-goethite from open-pit mines (52% Fe)	Direct-shipping ore (52% Fe)	12,435,659	7,967,208
Marmoraton Mining Co. Ltd.; near Marmora in southeastern Ontario	Low-grade magnetite from open-pit mine (37% Fe)	Iron-oxide pellets (66.5% Fe)	456,237	471,045
Steep Rock Iron Mines Ltd.; Steep Rock Lake north of Atikokan, Ont.	Hematite-goethite from open-pit and underground mines (53% Fe)	Mainly direct-shipping ore, but some gravity concentrates (53% Fe)	2,348,538	1,156,358
Texada Mines Ltd.; Texada Island, B.C.	Magnetite from open-pit mine (41.1% Fe)	Magnetite concentrate (56.2% Fe)	186,849	319,443
By-product Producers				
International Nickel Co. of Canada, Ltd., The; mines in Sudbury area; plant at Copper Cliff, Ont.	Pyrrhotite flotation concentrates treated	Iron-oxide pellets (68% Fe)	115,000	121,082
Noranda Mines Ltd.; mines near Noranda, Que.; plants at Pt. Robinson and Cutler, Ont.	Pyrrhotite-pyrite flotation concentrates treated	Iron-oxide sinter (67-68% Fe)	39,000 (production)	115,000 (production)
Quebec Iron & Titanium Corp.; mine in Allard Lake area, Que.; smelter at Sorel, Que.	Ilmenite-hematite from open-pit mine (40% Fe and 35% TiO_2)	Desulphurized iron or 'remelt iron', and titanium-rich slag	169,397 (iron)	100,964 (iron)

(1) Statistics supplied by the companies to the Mineral Resources Division.
(2) Statistics for some companies are preliminary estimates.

Companies under Development with Announced Plans for Production

Company and Expected Production Date	Property Location	Participating Companies	Type of Ore	Product to Be Shipped
Caland Ore Co. Ltd. (1959-60)	Steep Rock Lake, Ont.	Inland Steel Co.	Hematite-goethite	Direct-shipping ore
Lowphos Ore Ltd. (1959)	Sudbury area, 20 miles north of Capreol, Ont.	National Steel Corp. (M.A. Hanna Co. operator)	Magnetite-bearing iron formation	High-grade magnetite concentrates
Nimpkish Iron Mines Ltd. (1959-60)	26 miles W. of Beaver Cove, Vancouver Island, B.C.	International Iron Mines Ltd., Standard Slag Co.	Magnetite	Magnetite concentrates
Quebec Cartier Mining Co. (1960-61)	Lac Jeannine, Mt. Reed and Mt. Wright areas of Quebec (Lac Jeannine deposit to be mined first)	United States Steel Corp.	Specularite-bearing iron formation with varying amounts of magnetite	High-grade iron-oxide concentrates

Labrador-Quebec

Iron Ore Company of Canada continued to explore and develop iron-bearing deposits on its Labrador-Quebec leases obtained from Hollinger North Shore Exploration Company Limited and Labrador Mining and Exploration Company Limited. Particular attention was given to the magnetite-specularite iron formations in the Wabush Lake area of Labrador. Here, several hundred million tons of material grading 37 per cent iron have been indicated. Although no definite plans have been announced, these deposits will probably be exploited within the next few years to produce perhaps 5 million tons of high-grade concentrates annually.

Quebec Iron and Titanium Corporation suspended smelting operations at Sorel in October despite a strong market for its remelt iron. A sharp reduction in demand for titanium-rich slag, a coproduct in the production of remelt iron, forced the closure. Shipments of ilmenite ore from Havre St. Pierre to Sorel were down owing to a build-up of stocks at Sorel. Three new electric furnaces were completed by the end of 1958. With their completion the annual capacity of eight furnaces was increased to 312,000 net tons of remelt iron.

The Hilton Mines made its first shipment of high-grade pellets in February. Since then, the rate of production has steadily increased, so that in the last few months the beneficiation plant has been operating at close to the installed capacity of 600,000 tons of pellets a year.

Quebec Cartier Mining Company announced definite plans for production from its Lac Jeannine deposit. Here, several hundred million tons of specularite-bearing iron formation grading about 32 per cent iron will be mined at an annual rate of 20 million tons to produce 8 million tons of high-grade concentrate. Contracts for a beneficiation plant, a 193-mile railway from Shelter Bay, a hydroelectric power dam and other surface facilities were let in 1958. Exploration and development work continued on other claim groups held in the Mount Reed and Mount Wright areas, a few miles to the north and northeast, respectively, of Lac Jeannine.

Oglebay Norton Company of Cleveland optioned the Montgolfier-township property of Atlin-Ruffner Mines (B.C.) Limited. The property is 60 miles north of Taschereau on the Canadian National Railways in northwestern Quebec. Large tonnages of beneficiating-type iron formation have been indicated.

Albanel Minerals Limited, a subsidiary of The Cleveland-Cliffs Iron Company and M.J. O'Brien, Limited, continued exploration work on its low-grade iron formations at Albanel Lake, 100 miles northeast of Chibougamau.

Great Whale Iron Mines Limited carried out extensive geological mapping, diamond-drilling, and ore testing of its iron prospect 35 miles inland from Hudson Bay. Large tonnages of low-grade iron formation have been indicated.

In the Ungava Bay area, Ungava Iron Ores Company Limited and Oceanic Iron Ore of Canada Limited carried out marketing and financial studies with a view to bringing their concentrating-grade iron formations into production.

Wabush Iron Company Limited, backed by Pickands Mather and Company, Interlake Iron Corporation, Youngstown Sheet and Tube Company, and The Steel Company of Canada, Limited, carried out preliminary surveys on the concentrating-grade iron formations of the Wabush Lake area, Labrador, held under option from Canadian Javelin Limited. Late in the year, contracts for the construction of a 42-mile railway were let.

In the Mount Wright area of Quebec, several companies explored and tested low-grade iron formations. Normanville Mining Company, formed by Jones & Laughlin Steel Corporation and The Cleveland-Cliffs Iron Company to develop the property optioned from Quebec Cobalt and Exploration Limited, is one of the more active companies in the area. Bellechasse Mining Corporation Limited, Consolidated Fenimore Iron Mines, Pickands Mather and Company, and Warren S. Moore Company also hold properties in the area, in which substantial reserves of concentrating-grade iron deposits have been indicated.

Ontario

Algoma Ore Properties Limited commenced production of siderite ore from the Sir James open-pit mine early in the year. Shipments were made to a new sink-float plant at the sintering plant, some 9 miles west of the mine site, near Jamestown. Underground development of the lower levels of the Helen and Victoria mines continued. The company's sinter plant now has an annual capacity of 1.9 million tons of sinter.

In the Steep Rock Lake area, some 140 miles west of Port Arthur, Steep Rock Iron Mines Limited built one concentration plant and had another under construction. Although much of the ore mined is direct-shipping, these new plants will enable the company to market a more salable product in the face of increasing demand for tailored ores. In addition, lower-grade material can now be economically mined and concentrated. Development of the new Hogarth underground mine and the 'G' open-pit continued.

Caland Ore Company Limited maintained steady progress in the dredging of the east arm of Steep Rock Lake. The Falls Bay Point mine shaft and a conveyor system for the open-pit mine were completed. Production of direct-shipping hematite ore from both open-pit and underground mines is planned at an annual rate of 3 million tons.

Two miles south of the property of Steep Rock Iron Mines Limited, Canadian Charleson Limited made its first shipment of hematite concentrate in October upon completion of a 1 1/4-mile railway spur to connect with the Steep Rock Lake line. Annual capacity is rated at about 180,000 tons of iron ore concentrate.

The International Nickel Company of Canada, Limited, experienced a strike in the last quarter, after operating near capacity during the summer. The company resumed production of iron-oxide pellets early in 1959.

Noranda Mines Limited, early in 1959, suspended operations indefinitely at its Port Robinson plant. The plant was built in 1954 to treat pyrite concentrates from the company's operations in the Noranda area of Quebec. Process difficulties, rising costs and an oversupply of sulphur on world markets contributed to the company's decision. The company will continue to operate a similar, but larger, plant at Cutler.

Lowphos Ore Limited completed its new beneficiation plant but deferred initial production until 1959 owing to economic conditions. The annual rated capacity is 550,000 tons.

Exploration for iron ore was intensive and widespread throughout the province. In southeastern Ontario, Frobisher Limited and Warren S. Moore Company were among the more active companies. In northern and northwestern Ontario, concentrating-grade iron formations were examined by many companies including Anaconda Iron Ore (Ontario) Limited, Cliffs of Canada Limited, El Sol Gold Mines Limited, Iron Bay Mines Limited, Panther International Mining Company Limited and The Steel Company of Canada, Limited.

British Columbia

In March 1957, the British Columbia government passed and assented to the Mineral Property Taxation Act. Under the provisions of the Act, Order in Council No. 2591 was passed, on October 30, 1957, to tax iron ore in the ground. In effect, the tax was based on annual production rather than ore reserves. Partial refunds could be obtained if the ore was smelted within the province, as provided for in the Iron Bounty Act of 1957, or if a certain amount of exploration work was done. On July 17, 1958, the assessments made under the Act concerning present producers were ruled invalid by the Supreme Court of British Columbia. On July 25, the Act was declared ultra vires by the same court. In October the British Columbia government appealed the decision to the British Columbia Court of Appeals.

Empire Development Company Limited resumed production in May, and the first shipments left for Japan in July.

Nimpkish Iron Mines Limited was incorporated as a private company to operate an iron property on Vancouver Island. A contract with Japanese interests is pending.

Texada Mines Limited continued shipping magnetite concentrate to Japan from its operations on Texada Island.

Other Areas

Kelsey Lake Development Company Limited optioned, and plans to drill, the deep magnetite deposit of Irex Iron Mines Limited near Prince Albert, Saskatchewan.

Belcher Mining Corporation Limited and Ultra-Shawkey Mines Limited continued explorations of low-grade, iron-bearing deposits on the Belcher Islands and Baffin Island respectively.

Prices and Tariffs

Traditionally, prices received by most Canadian iron-ore producers are based on the Lake Erie price - the price paid per long ton of iron ore delivered at rail of vessel at Lower Lake ports. The Lake Erie price is based on an iron content of 51.5 per cent and is further classified as to source and phosphorous content The structure of the ore and the nature of the impurities present also affect the price. The following base prices were in effect during the 1958 season, those for the Lake Superior ores being unchanged from 1957 (E & M J Metal and Mineral Markets, January 1, 1959).

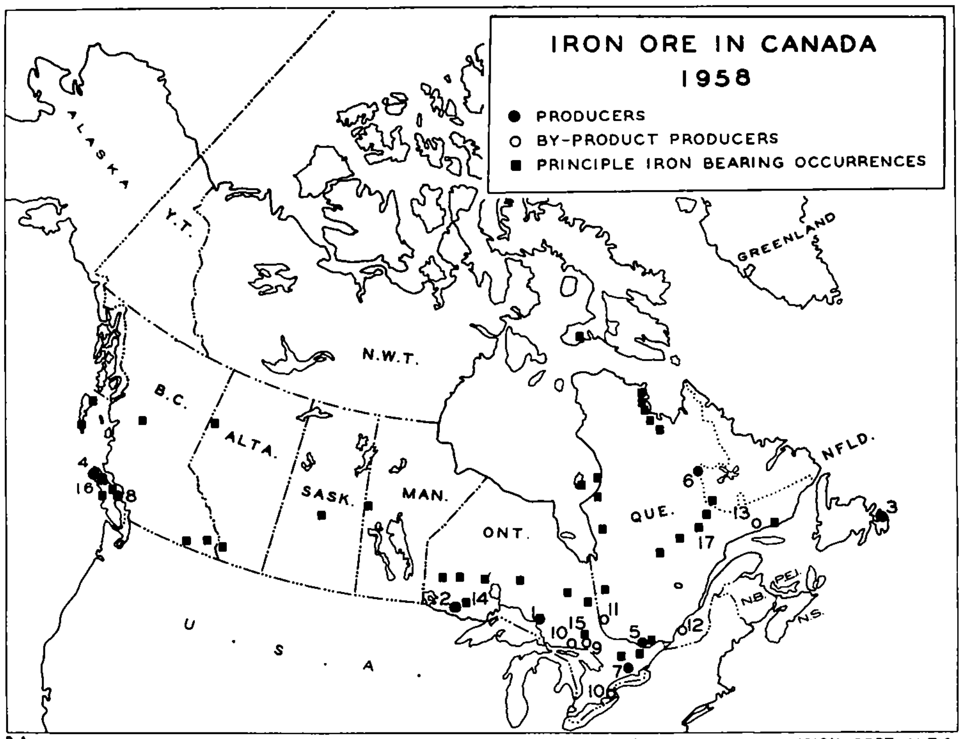
Lake Superior Ores	Per Ton
Mesabi non-Bessemer	$11.45
Mesabi Bessemer	$11.60
Old Range non-Bessemer	$11.70
Old Range Bessemer	$11.85
Open-hearth lump	$12.70

Swedish Iron Ore, c.i.f. Atlantic ports, 60 to 68 per cent minimum, per unit of 20 pounds - 25 cents plus, depending on grade.

Brazilian Iron Ore, f.o.b. Brazilian ports, 68 to 69 per cent, per long ton - $14.60, premium for low phosphorus.

Neither Canada nor the United States maintained tariffs on iron ore. Neither are there import duties on iron ore entering any of the countries to which Canadian producers shipped ore during 1957. These include the United Kingdom, West Germany, Italy, France, the Benelux countries and Japan.

In September 1958, the United States Tariff Commission ordered public hearings, to begin January 6, 1959, on the effects of iron-ore imports on the United States domestic industry. The hearings stemmed from demands originating in the mid-western iron ore producing states (Minnesota and Michigan) and were supported by the United States steel-scrap industry. At the hearings no representations opposed iron-ore imports into the United States, and the major United States steel firms and iron-ore merchant companies strongly protested any restrictive measures that might be considered by the Tariff Commission.



R.A. MINERAL RESOURCES DIVISION, DEPT. M.T.S.

Producers in 1958

1. Algoma Ore Properties Limited
2. Canadian Charleson Limited
   Steep Rock Iron Mines Limited
3. Dominion Wabana Ore Division
4. Empire Development Company Limited
5. Hilton Mines, The
6. Iron Ore Company of Canada
7. Marmoraton Mining Company Limited
8. Texada Mines Limited

By-product Producers

9. International Nickel Company of Canada Limited, The (mine and plant)
10. Noranda Mines Limited (plants)
11. Noranda Mines Limited (mine)
12. Quebec Iron and Titanium Corporation (plant)
13. Quebec Iron and Titanium Corporation (mine)

Prospective Producers by 1961

14. Caland Ore Company Limited (in 1959-60)
15. Lowphos Ore Limited (in 1959)
16. Nimpkish Iron Mines Limited (in 1959-60)
17. Quebec Cartier Mining Company Limited (in 1960-61)

LEAD

D.B. Fraser

Canada's production of lead in 1958 was 186,680 tons, or 5,196 tons more than in 1957. Output from mines in British Columbia, which regularly produce about 80 per cent of the Canadian total, increased by 7,322 tons; there were also small increases in Quebec and Ontario. Production in Yukon Territory declined by 1,710 tons, and in New Brunswick by 1,076 tons.

The refined lead produced by The Consolidated Mining and Smelting Company of Canada Limited (Cominco), operator of Canada's only lead smelter, at Trail, British Columbia, decreased to 132,987 tons in 1958 from the 142,935 tons produced in 1957. A curtailment of lead output was made at Trail in mid-year owing to reduced market demand.

Most of the lead concentrates produced in British Columbia, as well as those produced in Yukon Territory, were treated at Cominco's custom refinery at Trail, British Columbia. The remainder was exported to lead smelters in the United States for treatment. Lead concentrates produced in the eastern provinces were exported to smelters in Europe and the United States. The exports of primary lead increased from 128,708 tons in 1957 to 146,432 tons in 1958. The United States received 44 per cent of these exports, the United Kingdom 34 per cent, Belgium 11 per cent, West Germany 9 per cent, while the remaining 2 per cent went in small shipments to 12 other countries.

Lead output, exports and consumption are shown graphically on page 137. The main production has come from relatively few sources, the most important being Cominco's Sullivan mine at Kimberley, British Columbia. National output rose to a record 256,000 tons in 1942; after World War II it declined to 165,000 tons a year. There was a moderate increase after 1950 owing to the addition of Newfoundland's output when that province entered Confederation and the reopening of silver-lead-zinc mines in Yukon Territory.

Besides the Sullivan mine, the main sources of current supply are the Buchans deposit in Newfoundland, Cominco's Bluebell mine at Riondel, British Columbia, and the Yukon mines of United Keno Hill Mines Limited. Large deposits of lead-bearing ore have been outlined at Pine Point on the south shore of Great Slave Lake, and smaller deposits have been explored in the Pelly River and Hyland River areas of Yukon Territory, but no production has come from these deposits yet. Intermittent small production has come from the base-metals deposits of northern New Brunswick since 1954.

(text continued on page 137)

Lead - Production, Trade and Consumption

	1958		1957	
	Short Tons	$	Short Tons	$
Production				
All forms(1)				
British Columbia	147,416	33,493,047	140,094	39,114,378
Newfoundland	23,980	5,448,339	24,512	6,843,665
Yukon Territory	10,783	2,449,920	12,493	3,488,023
Quebec	3,150	715,620	2,709	756,324
Ontario	1,257	285,502	506	141,354
New Brunswick	94	21,377	1,170	326,663
Total	186,680	42,413,805	181,484	50,670,407
Refined(2)	132,987		142,935	
Exports				
In ore and concentrates				
United States	23,460	5,473,829	23,421	5,889,327
Belgium	16,223	2,763,332	11,108	2,486,192
West Germany	13,781	2,332,101	8,383	1,888,308
Other countries	617	108,011	1,255	229,175
Total	54,081	10,677,273	44,167	10,493,002
Refined				
United Kingdom	49,841	7,401,313	45,676	9,359,656
United States	40,503	7,666,272	28,623	6,926,035
Taiwan	553	85,023	-	-
Japan	538	87,523	9,232	2,308,601
Other countries	916	136,386	1,010	268,031
Total	92,351	15,376,517	84,541	18,862,323
Scrap				
United States	367	37,728	143	20,989
Denmark	42	5,510	-	-
Belgium	22	1,759	-	-
Other countries	-	-	198	20,036
Total	431	44,997	341	41,025
Lead pipe and tubing and lead manufactures				
United States		22,457		11,570
United Kingdom		787		-
Mexico		618		637
Other countries		2,843		23,311
Total		26,705		35,518

Lead - Production, Trade and Consumption (cont'd)

	1958	1957
	$	$
Imports		
Lead and lead products		
Compounds of tetraethyl lead	2,307,328	2,373,402
Lead in pigs and blocks ...	301,129	378,854
Lead in bars and sheets ...	12,608	13,338
Litharge................	331,475	383,620
Lead manufactures	243,540	259,412
Miscellaneous lead products	257,273	272,180
Total..................	3,453,353	3,680,806

	1958			1957		
	Virgin Pig (s.t.)	Secondary (s.t.)	Total (s.t.)	Virgin Pig (s.t.)	Secondary (s.t.)	Total (s.t.)
Consumption						
Refined						
Ammunition .	4,434	-	4,434	4,106	-	4,106
Foil and collapsible tubes	132	438	570	166	445	611
Heat-treating ...	278	536	814	282	241	523
Oxides, paints, pigments ..	5,755	660	6,415	6,296	251	6,547
Solders	1,109	1,055	2,164	1,389	1,087	2,476
Babbitt	69	572	641	238	164	402
Type metal .	10	48	58	19	100	119
For anti-monial lead	888	5,208	6,096	1,794	682	2,476
Cable covering ..	4,960	455	5,415	8,476	737	9,213
Pipes, sheets, traps and bends	4,242	264	4,506	3,645	88	3,733
Block for caulking ...	1,958	491	2,449	2,854	448	3,302
Brass and bronze	475	78	553	557	127	684
Batteries ...	18,926	8,421	27,347	20,722	9,733	30,455
Other uses ..	9,560	1,147	10,707	9,539	397	9,936
Total	52,796	19,373	72,169	60,083	14,500	74,583

(continued on next page)

Lead - Production, Trade and Consumption (cont'd)

	1958 Short Tons	1957 Short Tons
Consumption (summary)		
Primary virgin lead....	52,796	60,083
Refined lead from secondary material ...	19,373	14,500
Total refined	72,169	74,583
Scrap lead	12,477	6,600
Total lead consumption	84,646	81,183

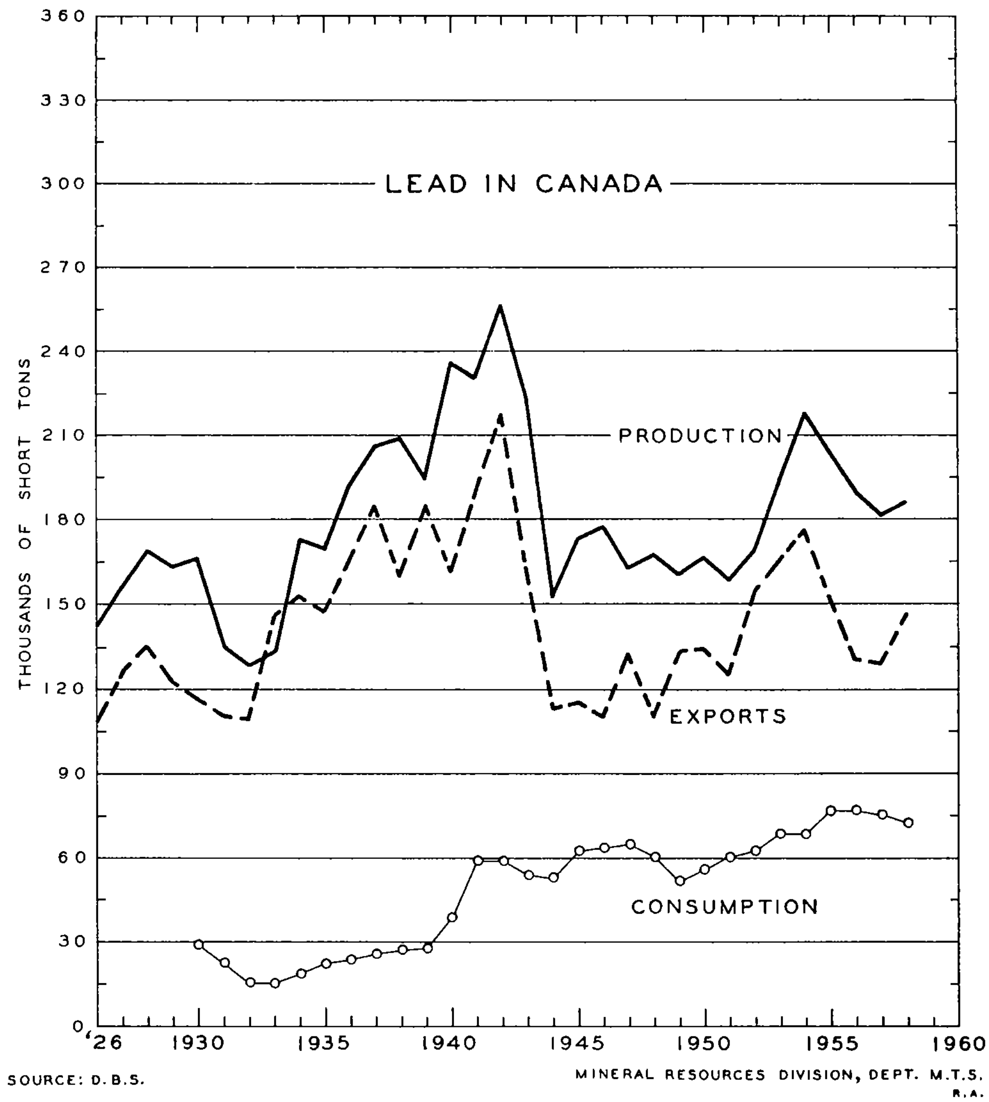
(1)See (1) below.
(2)See (2) below.

Lead - Production, Trade and Consumption, 1948-58

(short tons)

	Production		Exports			Imports	Consumption(4)
	All Forms(1)	Refined(2)	In Ore and Concentrates	Refined	Total	Refined(3)	Refined
1948	167,251	160,025	5,607	103,762	109,369	58	59,542
1949	159,775	146,149	19,891	113,534	133,425	2,154	51,281
1950	165,697	170,023	19,276	115,168	134,444	1,237	54,723
1951	158,231	162,000	19,648	105,736	125,384	727	60,348
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

(1)Primary lead in base bullion produced from domestic ores, plus recoverable lead in domestic ores and concentrates exported.
(2)Primary refined lead from all sources.
(3)Lead in pigs and blocks.
(4)Refined lead, both primary and secondary in origin, 1955 to 58, inclusive, excluding estimated quantities of primary refined to battery producers.



The consumption of primary refined lead in 1958 was 52,796 tons; in 1957 it was 60,083 tons. The amounts of refined lead used in cable-sheathing and storage-battery manufacture declined by 3,798 tons and 3,108 tons, respectively.

Lead consumption in the United States, Canada's main market, declined from 1,138,115 tons in 1957 to 986,387 tons in 1958 principally because of decreased use of lead in battery manufacture, cable sheathing, tetraethyl lead, and paints.

Import quotas on unmanufactured lead and zinc were imposed by the United States government on October 1, 1958. Commercial imports were limited by an annual quota equivalent in amount to 80 per cent of the average annual commercial imports during the five-year period, 1953 to 1957. The quota was allocated among exporting countries and subdivided by calendar quarters and tariff-schedule classifications. The lead classifications specified were the following: 1) under paragraph 391, the dutiable lead content of lead-bearing ores, flue dust, and mattes of all kinds, excepting those containing less than 2 per cent of lead (the dutiable lead content is the full metal content after deduction of 1 1/2 units); and 2) under the first item of paragraph 392, the lead content of all the articles specified excepting babbitt metal and solder, namely, lead bullion or base bullion, lead in pigs and bars, lead dross, reclaimed lead, scrap lead, antimonial lead, antimonial scrap lead, type metal and all alloys or combinations of lead not specially provided for. The Canadian quota for lead-bearing ores, flue dust and mattes was set at 6,720 short tons per quarter, and for the lead-metal articles in 2), at 7,960 short tons per quarter.

Developments at Producing Mines*

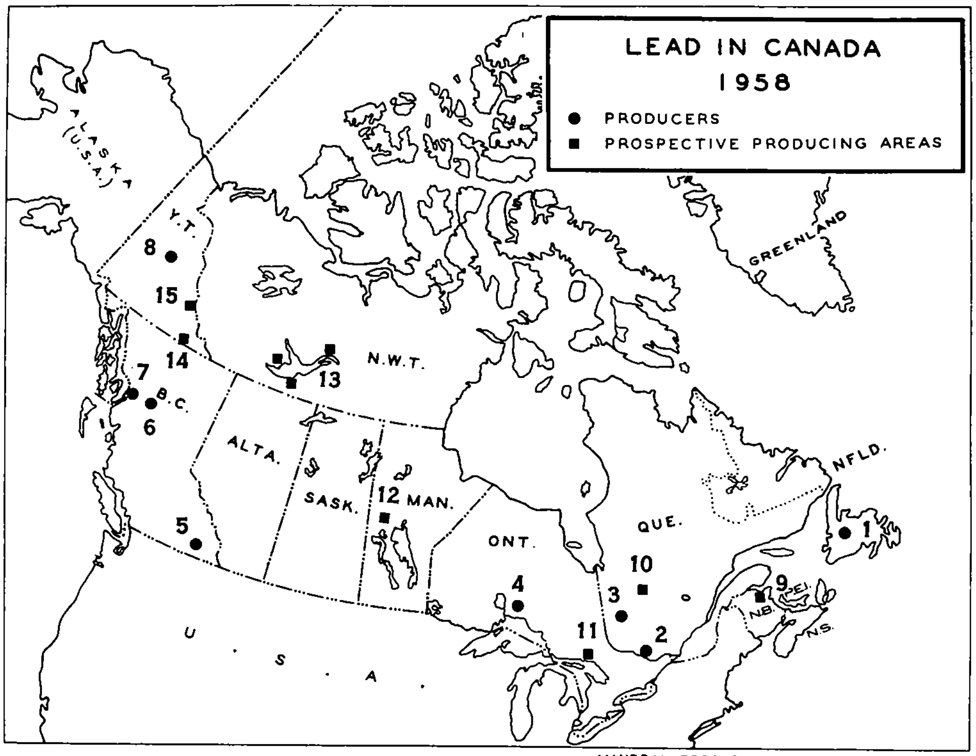
British Columbia

The Consolidated Mining and Smelting Company of Canada Limited mined 2,443,884 tons of ore from its Sullivan mine at Kimberley. The open-pit section of the mine remained closed. From the Bluebell mine on the east shore of Kootenay Lake 255,859 tons were mined, and from the H.B. mine, 22 miles east of Trail, 458,213 tons. The ore extracted in 1958 from British Columbia mines totalled 3,157,956 tons; in 1957 the total was 3,273,613 tons.

Lead concentrates produced at Cominco's three mines were treated at the Trail smelter together with custom concentrates from other mines in British Columbia and Yukon Territory and from foreign shippers. Output from all sources in 1958, including some metal sold in unrefined products, was 134,827 tons; in 1957 it was 144,017 tons. Of the combined lead and zinc production of 328,341 tons, approximately 64 per cent was derived from Sullivan concentrates, 17 per cent from the concentrates of other company-owned mines, 9 per cent from purchased ores and concentrates and 10 per cent from the retreatment of stockpiles of zinc-plant residues and lead-blast-furnace slag. Lead production was lower than in recent years because of a reduction in market demand.

Canadian Exploration Limited produced 383,458 tons of zinc-lead ore from the Jersey mine near Salmo, and recovered 10,420 tons of lead concentrate containing 7,972 tons of lead. Most of the tonnage was mined by underground trackless methods.

Reeves MacDonald Mines Limited, 12 miles south of Salmo, treated 417,076 tons of zinc-lead ore, from which 3,987 tons of lead were recovered in concentrates.



MINERAL RESOURCES DIVISION, DEPT. M.T.S.

Producers

1. Buchans Mining Company Limited
2. New Calumet Mines Limited
3. Manitou-Barvue Mines Limited
4. Willroy Mines Limited
5. Reeves MacDonald Mines Limited
   Canadian Exploration Limited
   Consolidated Mining and Smelting
   Company of Canada Limited, The
   (lead smelter and lead refinery)
   Sullivan mine
   Bluebell mine
   H. B. mine
   Sheep Creek Mines Limited
   Sunshine Lardeau Mines Limited
   Yale Lead and Zinc Mines Limited
   ViolaMac Mines Limited
   Slocan Van Roi Mines Limited
   Western Exploration Co. Ltd.
   Highland-Bell Limited
6. New Cronin Babine Mines Limited
7. Torbrit Silver Mines Limited
8. United Keno Hill Mines Limited

Prospective Producing Areas

9. Bathurst
10. Bachelor Lake
11. Sudbury Basin
12. Chisel Lake
13. Great Slave Lake
14. Watson Lake
15. Pelly River

Sheep Creek Mines Limited, in the Lake Windermere district, milled 192,426 tons of zinc-lead ore and produced zinc and lead concentrates, the lead concentrates totalling 5,225 tons grading 61.7 per cent lead. Production began from the lower 'A' zone during the year at a rate great enough to supply as much as 20 per cent of the ore milled.

Yale Lead and Zinc Mines Limited, at Ainsworth, milled 51,480 tons of lead-zinc-silver ore from which 3,004 tons of lead were recovered in concentrates. Mining was suspended in December, but the mill continued to operate, treating custom ores.

ViolaMac Mines Limited, near Sandon, recovered 1,132 tons of contained lead in concentrates produced from silver-lead-zinc ore from the Victor mine. The ore was treated at Sandon in the 250-ton mill of Carnegie Mining Corporation Limited, a ViolaMac subsidiary. In previous years ViolaMac ore was custom-milled by Western Exploration Co. Ltd. at Silverton.

Highland-Bell Limited, at Beaverdell, milled 18,729 tons of silver-lead-zinc ore and produced 1,697 tons of lead concentrate. Its principal metal production was 900,669 ounces of silver.

Torbrit Silver Mines Limited, near Alice Arm, milled 135,892 tons of silver-lead ore and recovered 753 tons of lead in lead concentrate and 1,331,088 ounces of silver in lead concentrate and bullion. The company reported that reserves on hand at the end of 1958 would be exhausted by the late spring or early summer of 1959.

In May, Sunshine Lardeau Mines Limited, near Camborne, completed the mining of available lead-zinc-silver ore and shut down its 75-ton mill. In the fiscal year ended on October 31, 1958, the mill treated 16,443 tons grading 8.15 per cent lead, 9.24 per cent zinc and 11.48 ounces of silver per ton. In addition, 671 tons of crude ore were shipped for direct smelting. Leasing operations continued until September, when all production stopped.

Western Exploration Co. Ltd. closed its 250-ton mill at Silverton in December, but development work continued at the company's mining properties near Silverton.

Silver Standard Mines Limited, near Hazelton, carried out salvage operations until May, and then shut down its 80-ton mill. In the fiscal year ended on March 31, 1958, the mill treated 20,169 tons of silver-lead-zinc ore, from which 1,010 tons of lead in concentrates were recovered.

Other producers of lead concentrate included Slocan Van Roi Mines Limited, at Silverton; Lajo Mines Limited, near Kaslo; and New Cronin Babine Mines Limited, near Smithers.

Ontario

Willroy Mines Limited, at Manitouwadge, milled 330,982 tons of ore in its first full year of operation and produced zinc, copper and lead concentrates. Shaft-deepening was started 800 feet below the collar, with the 1,450-foot horizon as the objective.

Quebec

New Calumet Mines Limited, in Pontiac county, treated 104,844 tons of zinc-lead-silver ore in the fiscal year ended on September 30, 1958, and recovered 2,133 tons of lead in concentrate. Mining was on a reduced scale owing to low zinc and lead prices.

Manitou-Barvue Mines Limited (formerly Golden Manitou Mines Limited), Abitibi East county, treated 183,690 tons of zinc-lead ore and 295,790 tons of copper ore in a split-circuit mill, and produced 1,054 tons of lead in lead concentrate.

New Brunswick

Heath Steele Mines Limited suspended its breaking-in operations in March at the lead-zinc-copper mine 32 miles northwest of Newcastle because of low metal prices. The mine and 1,500-ton mill were placed on a stand-by basis, pending an improvement in prices.

Newfoundland

The Buchans unit of American Smelting and Refining Company milled 389,000 tons of zinc-lead-copper ore, 18,000 tons more than in the previous year, and produced concentrates of zinc, copper and lead, the lead concentrates totalling 41,791 tons. The estimated recoverable lead content of all concentrates produced was 25,744 tons. Sinking of the MacLean shaft, designed to open up the deeper-seated orebody in the extension of the Rothermere ore zone, continued during the year, and a depth of 2,146 feet was reached at year-end.

Yukon Territory

United Keno Hill Mines Limited, Mayo district, milled 175,058 tons of silver-lead-zinc ore in the fiscal year ended on September 30, 1958, and produced 11,128 tons of lead in lead and zinc concentrates. The Calumet mine supplied 51 per cent of the mill feed, and the Hector mine 35 per cent. The rest was development ore from the Elsa and Keno mines, some ore from dumps and a small amount derived from clean-up operations at the Galkeno mine. The last-mentioned mine was purchased from Northwest Mines and Oils Limited (formerly Galkeno Mines Limited) along with a 220-ton mill and other equipment and mineral claims.

Other Developments

British Columbia

The Jordan River lead-zinc prospect in the Revelstoke district, held by American Standard Mines Limited, was examined under an option by The Bunker Hill Company, which carried out sampling and mapping operations.

Manitoba

Two of the four zinc-copper orebodies held by Hudson Bay Mining and Smelting Co. Limited in the Snow Lake area contain a small amount of lead. Mine development continued at one of the two, the Chisel Lake mine, which contains 3,832,400 tons averaging 11 per cent zinc, 0.91 per cent lead, 0.42 per cent copper, and 1.96 ounces of silver and 0.066 ounce of gold per ton. The shaft was deepened 676 feet to a point 1,163 feet below the surface, and lateral development was started on four levels. Drainage of Chisel Lake was partially completed. No work was done at the Ghost Lake deposit, which contains 260,700 tons grading 11.6 per cent zinc, 1.42 per cent copper and 0.7 per cent lead, with silver and gold.

Research was carried out at Flin Flon by Hudson Bay Mining and Smelting on the recovery of lead from Chisel Lake ores and from zinc-oxide-leaching-plant residues. At December 31, 1958, these residues totalled 84,385 tons grading 11.8 per cent lead, 17.7 per cent zinc, 1.01 per cent copper and 2.81 ounces of silver and 0.075 ounce gold per ton.

Quebec

Early in 1958, The Coniagas Mines Limited discontinued exploration and development of the Bachelor Lake deposit, about 100 miles northeast of Barraute, owing to low metal prices. Reserves to the 625-foot horizon totalled 407,310 tons averaging 1 per cent lead, 15.7 per cent zinc and 8.8 ounces of silver per ton.

New Brunswick

Brunswick Mining and Smelting Corporation Limited suspended mine development and pilot-mill testing in March at its two large zinc-lead-copper deposits 12 miles and 17 miles southwest of Bathurst, owing to the unfavourable market outlook for zinc and lead. The sinking of No. 2 shaft, at No. 12 mine, was completed to a depth of 973 feet. Pilot-plant research was directed toward a comparison of bulk-flotation procedures carried out on No. 12 mine ore and selective flotation procedures previously tested. Flotation tests were run also on samples of No. 6 mine ore. Pilot-plant testing on the refining of Brunswick ores was carried out at Josephtown, Pennsylvania, and economic studies were continued on the relative merits of leaching techniques and improved blast-furnace methods.

Nigadoo Mines Limited, 14 miles northwest of Bathurst, continued exploration and underground development until mid-year and then suspended operations owing to the low metal prices prevailing. Mineral-dressing tests were carried out in the Keymet mill, 15 miles north of Nigadoo, purchased in 1957 for ore-testing purposes and eventual production.

Northwest Territories

No work was done at Pine Point, on the south shore of Great Slave Lake, on the large zinc-lead deposits of Pine Point Mines Limited, a subsidiary of The Consolidated Mining and Smelting Company of Canada Limited, previous exploration having outlined adequate reserves.

Uses and Consumption

The main consuming industries and the tonnages used by each are shown on page 135.

Lead is used principally in storage-battery manufacture and cable covering, and in tetraethyl-lead compounds for improving the quality of gasoline. It is also used for acid-tank lining, paint manufacture, ammunition, bearing metal, solder and pipe.

Lead is used in containers for storing and shipping radioactive substances and as shielding against nuclear radiation in reactor installations.

About 40 per cent of Canada's production of primary refined lead is consumed in the domestic market. In addition to new lead, considerable quantities of refined lead and lead alloy, such as antimonial lead, are recovered from scrap materials and re-used as battery plates, bearing metal, solder and type metal. In 1958, about 32,000 tons of refined and alloy lead from scrap were consumed.

Among the principal consumers of lead in Canada are: Electric Storage Battery Company (Canada) Limited; Prest-O-Lite Battery Company Limited; Hart Battery, Division of Dominion Linseed Oil Company Limited; The Canada Metal Company Limited; Federated Metals Canada Limited; Ethyl Corporation of Canada Limited; Northern Electric Company Limited; Canada Wire and Cable Company Limited; Carter White Lead Company of Canada Limited; and McArthur, Irwin, Division of Dominion Linseed Oil Company Limited.

World Production of Lead

World production on a mine basis for 1958, 1957 and 1956, as given by the American Bureau of Metal Statistics, was as follows:

	Short Tons		
	1958	1957	1956
Australia	347,880	350,880	315,067
United States	267,377	338,216	352,826
Russia**	340,000	310,000	290,000
Mexico	222,580	236,858	220,030
Canada	186,680	181,484	188,854
Peru	147,887	151,183	142,279
Morocco	102,409	101,287	93,875
Yugoslavia	99,034	99,304	96,258
South West Africa	83,858	93,063	87,480
West Germany	67,146	78,394	72,181
Spain	74,134	69,024	64,735
Italy	61,470	56,185	51,237
Sweden	46,594	40,199	36,097
Japan	40,448	39,762	32,451
Poland*	39,400	39,400	38,800
Other countries	252,589	255,451	231,146
Total	2,379,486	2,440,690	2,313,316

*Conjectural.

Prices and Tariffs

The Canadian price of lead was 12.25 cents a pound during the first three months of 1958. In April the price declined to 11.25 cents, in May to 11 cents, and in June to 10.5 cents. During the last quarter of the year the price increased to 11.75 cents.

Lead ores and concentrates entered Canada duty-free; pig lead was subject to a British preferential duty of 0.75 cents a pound and to a most favoured nation and general duty of 1 cent a pound. Varying schedules were applied to imports of lead in semifabricated forms.

The United States tariff on the lead content of ores and concentrates was 0.75 cents a pound. On pig lead, lead bullion, scrap lead and various lead alloys, it was 1.0625 cents a pound on the lead content. Varying tariffs were applied to imports of lead in other forms.

MAGNESIUM

W.H. Jackson

Canada is the world's fourth largest producer of magnesium ingot, being surpassed by the United States, the Soviet Union and Norway. The United Kingdom is also a substantial producer. The installed primary ingot capacity of the Canadian industry is now 13,000 short tons* a year. A decline in demand coupled with increased competition for major markets resulted during 1957 and 1958 in smaller sales of the Canadian metal. Production in 1958 therefore eased to 6,796 tons, or 29 per cent less than the postwar high of 9,606 tons, reached in 1956. Norway displaced Canada as the third largest producer of magnesium in 1957. In 1958 its production, which has been steadily rising for several years, was 10,132 tons. World production in 1958, as estimated by the United States Bureau of Mines, was 103,900 tons, or 51,100 tons less than in 1957.

Nearly 71 per cent of the $4,064,825 value of Canada's 1958 magnesium-metal production was realized from exports, the main consumers being the United Kingdom, West Germany, France and Mexico. The variability of export demand has a direct influence on Canadian magnesium output. As shown in the accompanying statistical tables, demand has fallen in all major markets with the exception of India, France and West Germany. The spectacular rise in shipments to German fabricators does not, however, offset the absence of Japanese markets. In 1956, Japan was the largest consumer of Canadian magnesium, and even in 1957 its purchases, valued at $1,654,891, were second only to those of the United Kingdom. The metal was used as a reducing agent in the production of titanium. With the slump in titanium markets, the demand for Canadian magnesium in Japan ceased.

Sources of Magnesium

Many minerals contain the element magnesium, but only a few are suited to economic recovery of the metal. Among these are dolomite, $MgCa(CO_3)_2$; magnesite, $MgCO_3$; brucite, $Mg(OH)_2$; and carnallite, $MgCl_2.KCl.6H_2O$. Salt lakes and other naturally occurring sources of brine may contain high concentrations of magnesium chloride. Sea water containing about 0.5 per cent has, however, become an important source of world production. Dolomite and brucite are the ores upon which the Canadian industry is based.

*Short tons (2,000 pounds) are used in this review.

Magnesium - Production, Trade and Consumption

	1958*		1957	
	Short Tons	$	Short Tons	$
Production (metal)				
Ontario	4,544	2,747,755	7,592	4,767,043
Quebec	2,252	1,317,070	793	487,853
Total	6,796	4,064,825	8,385	5,254,896
Imports (alloys)				
United States		244,994		275,618
United Kingdom		7,524		1,124
West Germany		3,250		-
Other countries		-		-
Total		255,768		276,742
Exports (metal)				
United Kingdom		1,297,697		1,795,875
West Germany		565,126		131,375
France		478,131		362,581
Mexico		149,861		246,673
United States		58,730		87,603
India		51,846		18,794
Belgium		38,986		42,474
Switzerland		36,117		51,966
Other countries		195,497		1,798,229
Total		2,871,991		4,535,570
	1957		1956	
Consumption (metal - available data)				
In white-metal-alloys industry*	341		421	
In brass-and-copper-products industry*	42		64	
In aluminum-products industry*	457		518	
Total	840		1,003	

*Dominion Bureau of Statistics classification.

Magnesium - Production, Trade and Consumption, 1948-58

	Production(1) (short tons)	Imports(2) ($)	Exports(3) ($)	Consumption (short tons)
1948		73,198		449
1949		63,755		487
1950		61,033		537
1951		113,391		1,332
1952		136,742		1,119
1953		144,253		1,414
1954		99,944		1,308
1955		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	

(1) Statistics for 1948 to 1955 inclusive not available for publication.
(2) Magnesium alloys.
(3) Statistics for 1948 to 1954 inclusive not separately available.

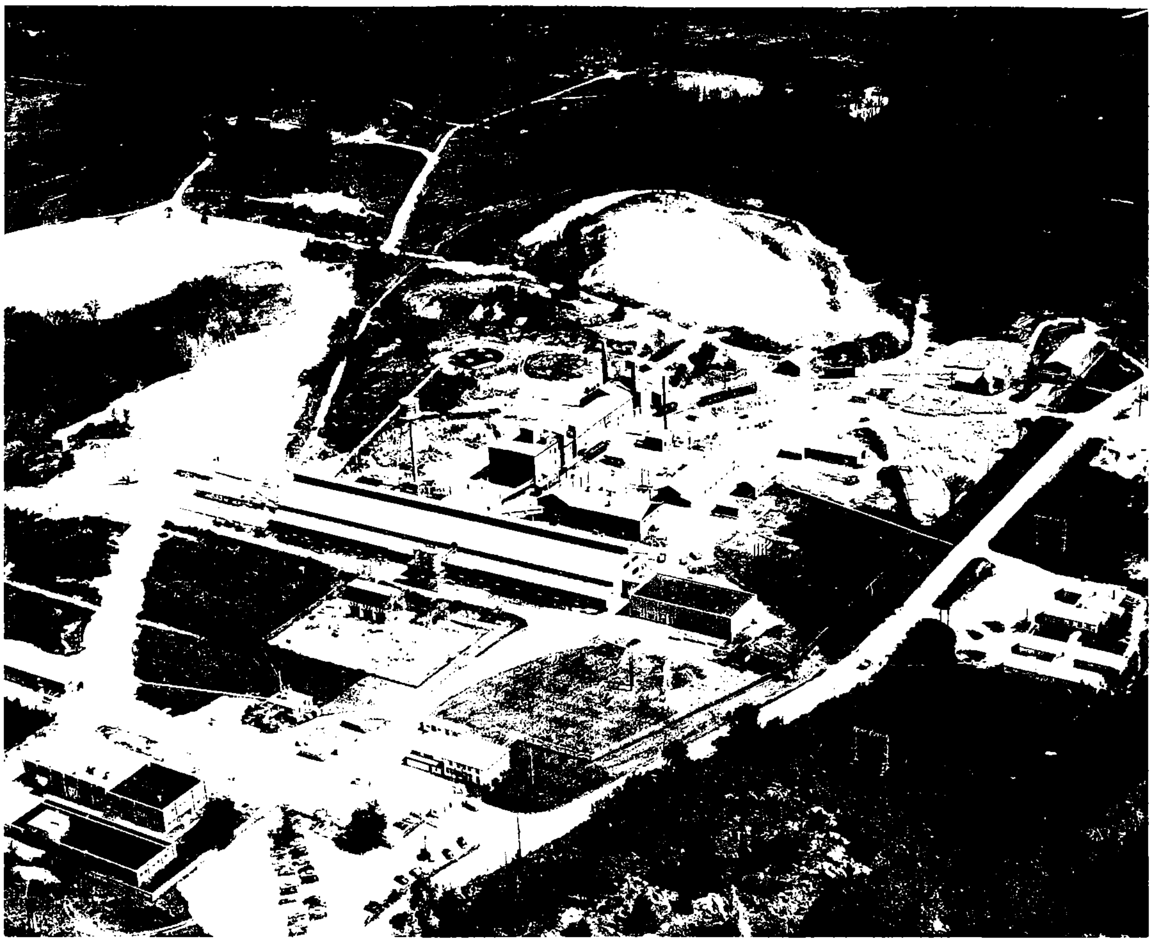
Two basic procedures are used to recover metallic magnesium. In the electrolytic process the cell feed is molten, anhydrous magnesium chloride, which may be derived from sea water directly or from magnesium oxide by the addition of chlorine. In thermal processes magnesium oxide is used as a source. The most useful is the silicothermic method, wherein calcined magnesite or dolomite may be reduced by ferrosilicon.

Canadian Reduction Plants and Processes

Dominion Magnesium Limited

Ingot, typically 99.97 per cent pure, is produced by this company at its reduction plant some 70 miles northwest of Ottawa near Haley Station, Ontario. The plant has a capacity of 8,000 tons a year and produces ingot by melting the crystalline magnesium distillate derived from the Pidgeon ferrosilicon process. In this thermal process, finely ground, calcined dolomite and ferrosilicon are mixed in the proper proportions, pressed into briquettes and charged into cylindrical retorts. External electric furnaces heat the charge to 1,170°C under vacuum. Magnesium is reduced and simultaneously distilled as a gas, which cools and forms crystalline rings in the water-cooled head sections of horizontal retorts.

The dolomite used by the company is quarried from a pit adjacent to the plant. Ferrosilicon is obtained from a subsidiary, Electro-Reagents (Quebec) Limited, at Beauharnois, Quebec.



Courtesy of Dominion Magnesium Limited
Walter R. Allen 5176-12

The thermal reduction plant at Haley Station, Ontario, for the production of primary magnesium from dolomite.

Standard stock products are ingots of magnesium and magnesium alloys as well as extrusion billets, forging stock and rolling slab. Certain special-purpose magnesium alloys are also produced by utilizing the rare earths, thorium and zirconium.

Magnesium Company of Canada Limited

A wholly owned subsidiary of Aluminium Limited, the company sells magnesium produced in an electrolytic reduction plant located at Arvida, Quebec. Plant capacity is 5,000 tons a year.

The raw material used is the mineral brucite found as granules in limestone near Wakefield, Quebec. The recovery process consists in selective quarrying, crushing and calcining of the brucite limestone, followed by a series of operations involving screening, hydration and sizing to separate magnesia from lime. Concentrate from the mine containing about 92 per cent magnesia is shipped to Arvida for conversion to magnesium chloride prior to electrolytic reduction. Electrolysis of the molten magnesium chloride releases metallic magnesium, which is periodically tapped from the cells.

Commercially pure ingot having a chemical analysis of 99.80 per cent magnesium is produced for alloying, and higher-purity magnesium for reduction requirements. The company also produces a wide range of alloys in standard compositions and special alloys to specification.

Magnesium Fabricators

Extrusions and castings are manufactured by Light Alloys Limited, Haley Station, Ontario. Other companies which produce castings in Canada are: Western Magnesium Limited, Vancouver; Barber Die Casting Co., Limited, Hamilton; Grenville Castings Limited, Merrickville, Ontario; Canadian Magnesium Products Limited, Preston, Ontario; and Robert Mitchell Company, Limited, Montreal.

Uses

Pure magnesium, like aluminum, is soft and has little strength. The metal may be used as a deoxidizer for such copper-base alloys as brass and bronze and is an important alloying element with zinc and aluminum. High-strength aluminum alloys contain from 0.2 to 10 per cent magnesium. As a reducing agent, magnesium is of particular value in the production of zirconium and titanium by the Kroll process. At the Port Hope refinery of Eldorado Mining and Refining Limited, magnesium is used to reduce uranium tetrafluoride to the metal. Other uses include the cathodic protection of steel structures by magnesium anodes, pyrotechnics and the production of nodular cast iron.

The extreme lightness of magnesium-base alloys and the excellent machinability resulting from inherent properties make magnesium desirable where a high strength-to-weight ratio may be used to advantage. An exceptionally high damping capacity is also in its favour. Because magnesium alloys in some forms are not as easily cold-worked as aluminum, their acceptance by industry has been retarded despite the adaptability of the metal to all modern fabricating processes. If heated, however, the metal can be deep-drawn in one operation to a much greater depth than any other light alloy. The production of castings, extrusions and forgings has been facilitated by the development of suitable structural alloys containing up to 10 per cent aluminum and smaller quantities of zinc and manganese. Newer magnesium alloys have been developed for high-temperature or high-strength applications involving the use of zirconium, thorium, silver and the rare earths.

Many of the end uses of magnesium and its alloys depend on defence needs, which will vary from time to time and cause fluctuations in demand. Examples are the production of titanium and manufactured components of aircraft or missiles. Future demand arising from other uses dependent on advanced technology cannot yet be predicted. One interesting application is the use of magnesium alloy as a cladding material for the fuel elements in certain nuclear reactors. In Europe its use in automobile manufacture is growing, and this trend may lead to an increase in its application in North America, where tooling plate, truck flooring, bodies and frames containing magnesium are winning some acceptance. Magnesium is also used in appliances, photo-engraving, battery cases and luggage and will gradually find increased acceptance as its distinctive properties are appreciated.

Prices

The Canadian price of magnesium metal was quoted throughout 1958 till October as 33.5 cents a pound. Since then, prices have been subject to inquiry.

Prices in the United States, according to E & M J Metal and Mineral Markets of December 25, 1958, were as follows:

10,000-lb lots, pig, ingot, 99.8%, f.o.b. shipping point, per lb	35.25¢ to 36.65¢
Notched ingot, per lb	36.00¢ " 37.45¢

Tariffs

Canada

	British Preferential	Most Favoured Nation	General
Sheet or plate of magnesium or alloys of magnesium, plain, corrugated, pebbled, or with a raised surface pattern for use in Canadian manufactures (expires October 31, 1959)	free	free	25%
Alloys of magnesium, viz ingots, pigs, sheets, plates, strip, bars, rods and tubes	5%	10%	25%
Magnesium scrap	free	free	free
Magnesium carbonate for use in the manufacture of rubber products	"	20%	30%
Magnesium carbonate, basic or other, except crude rock, not otherwise provided	20%	20%	30%

United States

	On Canadian Magnesium
Metallic magnesium and metallic magnesium scrap (scrap exempt until June 30, 1959)	50%
Magnesium alloys, powder, ribbon, sheet, tubing, wire and all other articles of magnesium not specially provided for, per lb magnesium content	20¢ plus 10%
Other, per lb magnesium content	17¢ plus 8 1/2%
Magnesium carbonate, precipitated, per lb	0.5¢
Magnesium chloride, anhydrous, per lb	1¢
Magnesium oxide, or calcined, per lb	0.53¢
Magnesia, per lb	2.5¢

Although the United States magnesium-fabricating industry is well developed, the extremely high tariffs now in effect keep all but a little of the Canadian metal from entering that market. Exports to the United States in 1958 were valued at only $58,730 while imports, primarily of sheet and forgings, were valued at $244,994.

As only about 10 per cent of production is consumed in Canada, further development of the primary industry will depend on whether a stable demand can be developed for ingot and alloys. The future development of rolling and press-forging facilities depends on expansion of the domestic market.

MANGANESE

V. B. Schneider

A decline in Canadian consumption of manganese ore and alloys, which began in the fourth quarter of 1957, continued through 1958. Because of a decrease of 13.5 per cent in Canadian steel production in 1958, plus a reduction of ferromanganese exports from 46,733 tons* in 1957 to 225 tons in 1958, manganese ore imports dropped to 42,060 tons, the lowest quantity since 1938.

There is little prospect of an appreciable increase in exports of ferromanganese to the United States in 1959. The United States Bureau of Mines reported that consumer stocks of manganese ore in the United States exceeded 2 million tons by the end of 1958. This was half a million tons more than in the previous year, when the stocks were considered excessive. United States consumption of manganese ore, for all purposes, as reported by the Bureau of Mines, was 1,497,574 tons in 1958, down 863,886 tons from the consumption of 1957.

On November 24, 1958, India repealed the export duty on manganese ore of 44-per-cent or higher grade. This, the last of the duties imposed in August 1956, amounted at the time of repeal to 30 rupees a long-ton unit, or approximately $5.94 a long ton.

A much discussed barter deal between the United States and India failed to materialize by the year's end, but negotiations have continued into 1959. If the deal is concluded, the gross value of the barter could be in the order of $40 million. It would include manganese ore and standard ferro-manganese from India.

No manganese ore is produced in Canada, although in past years small amounts have been mined from bog deposits in New Brunswick and British Columbia.

*Short tons (2,000 pounds) unless otherwise specified.

Manganese - Trade and Consumption

	1958		1957	
	Short Tons	$	Short Tons	$
Imports				
Manganese ore				
United States.........	11,044	767,675	3,763	526,499
China	10,312	197,592	-	-
India................	6,702	119,545	19,634	721,436
Cuba................	4,782	137,910	118	6,311
Union of South Africa .	3,020	127,110	4,838	227,699
Belgian Congo........	2,379	143,952	30,081	1,874,650
Ghana...............	2,362	130,664	62,966	3,460,112
Mexico..............	1,344	68,161	-	-
United Kingdom	112	30,056	118	29,544
France..............	2	232	2	213
Greece..............	1	68	-	-
Brazil	-	-	9,798	673,282
Total...............	42,060	1,722,965	131,318	7,519,746
Ferromanganese under 1% silicon				
India	1,117	155,176	-	-
United States	635	146,537	518	170,179
Chile	312	66,337	112	28,118
France.............	223	43,596	-	-
Japan	196	45,166	111	37,931
Other countries	-	-	2	876
Total	2,483	456,812	743	237,104
Silicomanganese over 1% silicon				
United States	1,095	244,688	1,039	455,520
Japan	1,054	293,722	1,163	378,715
Norway	31	4,956	-	-
United Kingdom	5	1,869	-	-
Other countries	-	-	55	20,074
Total...............	2,185	545,235	2,257	854,309
Exports				
Ferromanganese				
United States	198	44,014	46,689	7,726,202
El Salvador..........	18	4,040	-	-
Colombia............	9	2,354	44	12,035
Total...............	225	50,408	46,733	7,738,237

Manganese - Trade and Consumption (cont'd)

	1958		1957	
	Short Tons	$	Short Tons	$
Consumption				
Ore				
Metallurgical-grade......	43,745		192,473	
Battery-grade...........	2,398		2,615	
Total..................	46,143		195,088	

Manganese - Trade and Consumption 1948-58

(short tons)

	Imports			Exports	Consumption
	Manganese Ore	Manganese Alloys		Ferro-manganese	Ore
		Under 1% Silicon	Over 1% Silicon		
1948	230,298	542	60	74,499	230,301
1949	137,854	1,486	22	35,288	152,692
1950	135,698	1,017	82	26,571	123,096
1951	222,082	292	338	67,508	223,328
1952	194,405	1,629	153	31,290	169,560
1953	66,682	1,044	18	683	69,533
1954	48,962	8,527	19	3,639	66,052
1955	175,282	3,945	272	29,404	113,075
1956	207,977	2,191	1,130	59,445	219,141
1957	131,318	743	2,257	46,733	195,088
1958	42,060	2,483	2,185	225	46,143

Electro Metallurgical Company, Division of Union Carbide Canada Limited, uses metallurgical-grade ore to manufacture high- and low-carbon ferromanganese and silicomanganese at its Welland, Ontario, plant. Chromium Mining and Smelting Corporation Limited produces manganese alloys at its Beauharnois, Quebec, plant. Canadian Furnace Company, Limited, at Port Colborne, Ontario, produces silvery pig iron from low-grade manganiferous ores.

Canadian Occurrences and Development

Strategic Materials Corporation, through its subsidiary, Stratmat Limited, owns a large low-grade manganese deposit a few miles northeast of Woodstock, New Brunswick. Strategic-Udy Metallurgical and Chemical Processes Limited, controlled by Stratmat Limited, did research work on the Woodstock manganese ore in 1958. As a result of the test work, ferromanganese and pig iron were produced on a pilot-plant scale.

There are large reserves of manganiferous iron ore in the Schefferville area of Labrador-New Quebec. In Labrador, in 11 deposits, reserves have been estimated at 13,321,000 long tons averaging 49.23 per cent iron and 7.45 per cent manganese. In Quebec, in 19 deposits, reserves have been estimated at 40,045,000 long tons averaging 50.25 per cent iron and 7.70 per cent manganese. There are sections in the Labrador-New Quebec orebodies where the manganese content averages nearly 20 per cent. The Labrador-New Quebec orebodies are owned by Labrador Mining and Exploration Company Limited, Iron Ore Company of Canada and Hollinger North Shore Exploration Company Limited.

Marpic Explorations Limited did some exploration and development work on a manganese occurrence in the New Ross area of Nova Scotia, during 1958.

World Mine Production

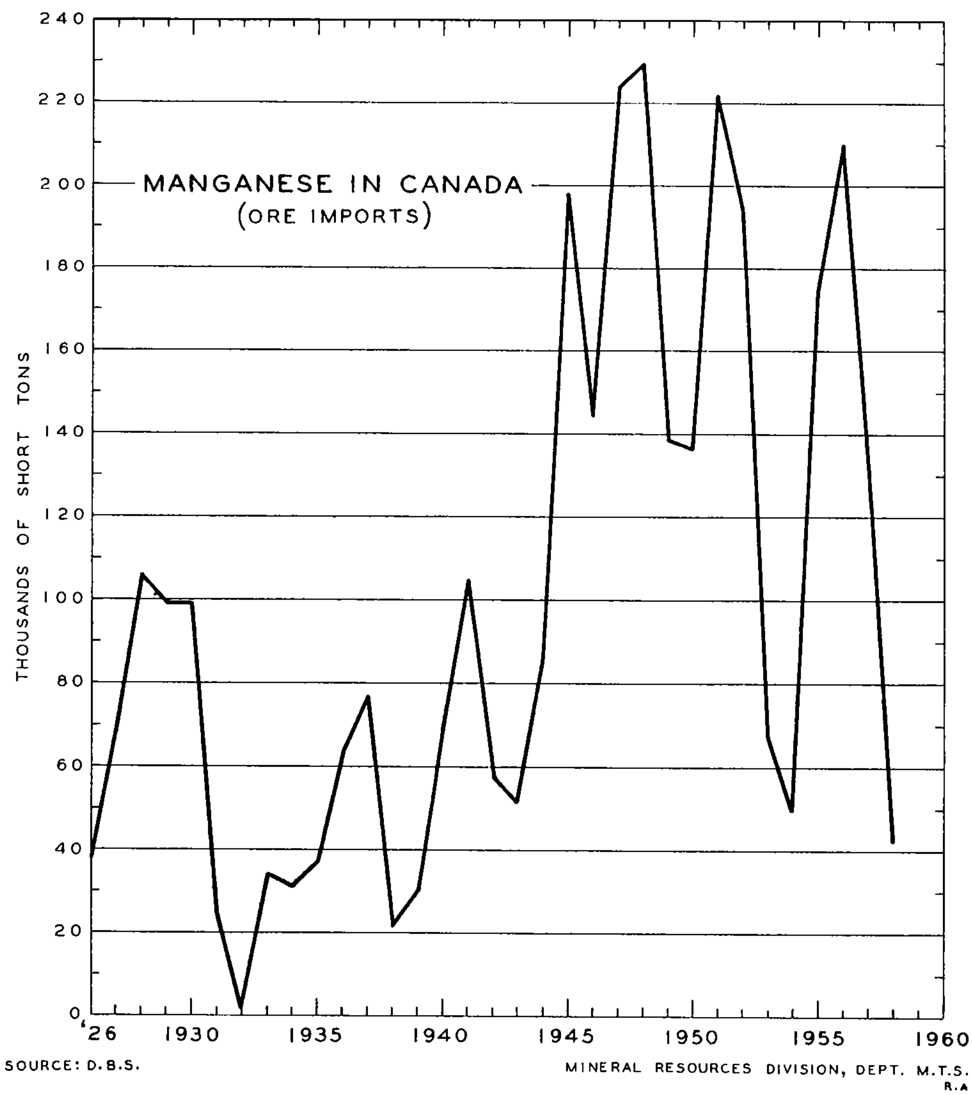
World production of manganese ore in 1958 amounted to some 13 million tons. Of this, it is estimated that Russia produced 5,915,000 tons, India 1,377,602 tons, the Union of South Africa 934,097 tons, Brazil 766,153 tons, China 600,000 tons and Ghana 574,124 tons.

The Amapá mine in Brazil, approached peak capacity during 1958. This mine, with its potential output of 1 million tons a year and its relative nearness to the United States, has made Brazil a serious threat to India as the Free World's leading producer.

India's first ferromanganese plant began operations in the Joda Valley of Orissa in mid-1958; by the year's end several other plants were also in production or about to commence production. This marks the beginning of a new era in India's metal and ore business and is indicative of India's efforts to compete with the manganese operations of Brazil, Mexico and South Africa.

Consumption, Uses and Specifications

Approximately 95 per cent of the world output of manganese ore is used to make manganese alloys for the steel industry. An average of 13 pounds of manganese is needed to produce a ton of steel ingot, this amount being necessary to deoxidize, clean and combine with sulphur to produce steel that may be readily rolled and fabricated. As an alloying element, manganese improves the strength and toughness of structural steels and cast irons. The



dry-battery industry accounts for 3 per cent, and the chemical industry for the remainder of manganese consumption.

Metallurgical-grade Manganese

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, silicomanganese, spiegeleisen, manganese metal and ore, in the order given.

Electrolytic manganese metal is used in place of low-carbon ferro-manganese to reduce the carbon content in stainless steels, thus eliminating the need of a carbon stabilizer.

General specifications for metallurgical-grade manganese ore are as follows: a minimum of 48 per cent manganese; maxima of 7 per cent iron, 8 per cent silica, 0.15 per cent phosphorus, 6 per cent alumina and 1 per cent zinc. The ore should be in hard lumps of less than 4 inches, and not more than 12 per cent should pass a 20-mesh screen.

Battery-grade Manganese

Manganese ore for dry-cell use must be manganese-dioxide (pyrolusite) ore of not less than 75 per cent MnO_2 and not more than 1.5 per cent iron, and should be very low in such metals as arsenic, copper, zinc, nickel and cobalt.

Chemical-grade Manganese

Chemical-grade manganese ore should contain at least 35 per cent manganese. It is used to make manganese-sulphate fertilizer and in the production of other salts for use in the glass, dye, paint, varnish and photographic industries.

Canadian Consumers

Consumers of metallurgical-grade ore are: Electro Metallurgical Company at Welland, Ontario; Chromium Mining and Smelting Corporation, Limited, at Beauharnois, Quebec; and Canadian Furnace Company, Limited, at Port Colborne, Ontario.

Consumers of battery-grade ore are National Carbon Limited and General Dry Batteries of Canada Limited, both of Toronto; Burgess Battery Company, Limited, Niagara Falls; and Ray-O-Vac (Canada) Limited, Winnipeg.

Electrolytic manganese metal imported from United States is used at Atlas Steels, Limited, Welland, Ontario, in making low-carbon stainless steel. It is also used by the aluminum- and magnesium-alloy industries.

Prices

Prices of manganese in the United States, according to E & M J Metal and Mineral Markets of December 25, 1958, were as follows:

Manganese ore

Indian	Per long-ton unit, 46-48% Mn, c.i.f. U.S. ports, import duty extra, export duty excluded	\$ 0.915 to \$ 0.965 (nominal)

Manganese dioxide	Per long ton, 84% MnO_2, bulk, crude, c.i.f. U.S. ports	\$110 to \$120
Manganese metal	Per lb, 95 1/2%, delivered, carload	
	Bulk	45 ¢
	Packed	45 3/4¢
	Per lb, 99%, electrolytic, f.o.b. shipping point, freight allowed east of Mississippi	34 ¢
	Per lb, 99%, electrolytic, f.o.b. shipping point, freight allowed east of Mississippi, ton lots	36 ¢
	Premium for hydrogen removed	3/4¢ lb
Ferromanganese	Per lb contained Mn, carload lots, lump	
	Standard (74-76% Mn), f.o.b. shipping point	12.25¢
	Medium-carbon (80-85% Mn, 1 1/4-1 1/2%C), f.o.b. U.S.	25.50¢
	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. 18-20% Si	12.80¢
	2% C max. 15-17 1/2% Si	12.60¢
	3% C max. 12-14 1/2% Si	12.40¢
Spiegeleisen	Per gross ton, carload lots, lumps, f.o.b. Palmerton, Pa.	
	3% max. Si, 16-19% Mn	\$100.50
	3% max. Si, 19-21% Mn	\$102.50
	3% max. Si, 21-23% Mn	\$105.00

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Tariffs

Canada

	British Preferential	Most Favoured 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	0.8¢ per lb on Mn content and 6% ad valorem
Over 1% but under 4% C	15/16¢ per lb on Mn content
4% or more C	5/8¢ per lb on Mn content

*These classes must contain 30% or more Mn.

MOLYBDENUM

V.B. Schneider

Molybdenite Corporation of Canada Limited was the sole producer of molybdenite (MoS_2) and molybdic oxide (MoO_3) in 1958. Shipments of contained molybdenum amounted to 888,264 pounds valued at $1,152,838. The value of exports (molybdic oxide and molybdenum concentrates) dropped from $5,024,485 in 1957 to $1,620,225. In 1957, however, the value of exports was unusually high because of a labour strike that closed a conversion plant at Langeloth, Pennsylvania, for the latter half of the year. During the strike concentrates of MoS_2 were shipped to Canada, converted to MoO_3 and returned to the United States.

In December 1956, at the mine site, Molybdenite Corporation began to operate its roasting plant - the only plant of its kind in Canada - to convert molybdenite to technical-grade MoO_3 (the raw material from which all types of molybdenum salts and compounds are produced and which is added to iron and steel - either to the charge or to the molten bath). Before that time, molybdenum had been shipped from Canada as MoS_2. It was hoped that this expansion of facilities would lead to greater participation in the domestic market on the part of Molybdenite Corporation. Late in 1958, however, the roasting plant was shut down because of cost factors and the company reverted to its previous policy of exporting its molybdenum in the form of MoS_2.

The company started to produce lubricant-grade molybdenum disulphide during the year at a new mine-site plant.

The United States, the largest consumer of molybdenum, produces about 90 per cent and consumes about 54 per cent of the world output. The largest producer in the world is American Metal Climax Inc., at Climax, Colorado.

The bulk of the molybdenum sold in Free World markets in competition with Climax products is a by-product of copper mining. Production of by-product molybdenum declined in 1958 when copper production was curtailed.

Production

Canada

Molybdenite Corporation's property is located at the junction of LaMotte, Lacorne, Vassan and Malartic townships, 23 miles north of Val d'Or, Quebec. Bismuth is produced as a by-product.

Molybdenum - Production, Trade and Consumption

	1958		1957	
	Pounds	$	Pounds	$
Production (shipments)(1)				
Mo content	888,264	1,152,838	783,739	1,166,557
Imports				
Molybdic oxide (2)				
United States	304,822	217,960	477,304	401,928
Calcium molybdate (grouped with vanadium oxide and tungsten oxide for manufacture of steel)				
United States	135,333	109,247	249,608	410,762
West Germany	-	-	35,968	57,353
Total	135,333	109,247	285,576	468,115
Ferromolybdenum(3)				
United States	196,000	210,038	237,233	266,812
Exports(2)				
Molybdic oxide and molybdic concentrates				
Austria	504,800	479,314	-	-
United Kingdom	469,300	336,000	2,400	400
West Germany	403,800	337,675	-	-
United States	182,000	160,985	4,892,600	3,870,185
Netherlands	163,800	135,656	-	-
Italy	113,800	97,214	367,400	221,900
Sweden	49,600	69,036	41,300	35,000
Australia	5,100	4,345	-	-
Japan	-	-	706,100	897,000
Total	1,892,200	1,620,225	6,009,800	5,024,485
Consumption				
Mo content				
Molybdic oxide	298,078		326,420	
Ferromolybdenum	183,161		322,366	
Calcium molybdate	7,888		13,248	
Sodium molybdate	24,983		24,109	
Molybdenum metal	3,213		9,660	
Molybdenum wire	1,801		2,617	
Total	519,124		698,420	

(1) Producers' shipments of molybdic oxide and molybdenum contentrates (Mo content).
(2) Gross weight.
(3) United States exports of ferromolybdenum (gross weight) to Canada as reported by United States Exports of Domestic and Foreign Produce. Imports of ferromolybdenum are not available separate from official Canadian trade statistics.

Molybdenum - Production, Trade and Consumption, 1948-58
(pounds)

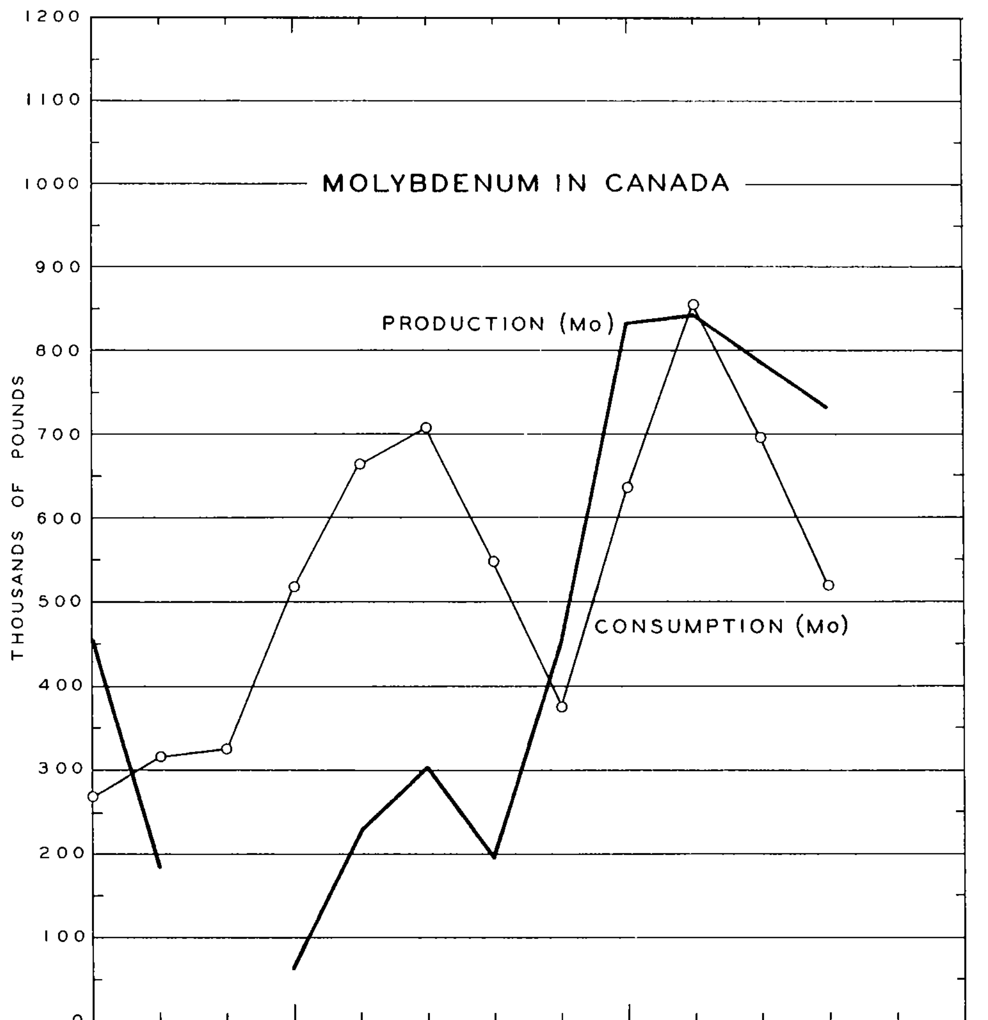
	Production	Exports	Imports			Consumption
			Calcium Molybdate	Molybdic Oxide	Ferro-molybdenum	
	(1)	(2)	(4)	(5)	(6)	(7)
1948	182,857	-	54,497	330,727	207,193	
1949	-	-	78,532	319,029	143,200	
1950	62,130	-	141,544	444,185	250,550	486,140
1951	228,958	-	62,364	566,334	315,394	662,000
1952	303,578	-	169,392	520,104	439,476	709,271
1953	194,344	-	197,758	358,124	201,626	548,455
1954	451,450	-	121,339	423,344	79,856	374,118
1955	833,506	1,478,900	129,130	658,060	174,504	634,061
1956	842,263	1,318,200	322,295	955,308	495,748	855,468
1957	783,739	6,009,800(3)	285,576	477,304	237,233	698,420
1958	888,264	1,892,200	135,333	304,822	196,000	519,124

(1) Producers' shipments of molybdenum concentrates (Mo content) 1948 to 1956 inclusive; 1957 and 1958, molybdic oxide and molybdenum concentrates (Mo content).
(2) Exports of molybdenum concentrates (gross weight) 1955 and 1956; 1957 and 1958,exports of molybdic oxide and molybdenum concentrates (gross weight).
(3) 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.
(4) Including vanadium oxide and tungsten oxide.
(5) Gross weight.
(6) United States exports to Canada reported by United States Exports of Domestic and Foreign Produce. Gross weight.
(7) Molybdenum addition agents (Mo content) reported by consumers.

Proven ore reserves in January 1958 were 180,983 tons averaging 0.43 per cent MoS_2. During the year, the mill feed rate was increased and the grade decreased to about 0.38 per cent MoS_2. Preissac Molybdenite Mines Limited, a subsidiary of Molybdenite Corporation of Canada Limited, has indicated ore reserves of 1,250,000 tons. This property is 20 miles northwest of the Lacorne mine in Preissac township.

In June, International Ranwick Limited started production of concentrates containing molybdenum and copper at the Min-Ore property. In August, however, milling operations were suspended, pending solution of technical difficulties caused in the milling process by talc in the ore.

Late in the year, Jonsmith Mines Limited announced a new molybdenite discovery in DesRosiers township, about 30 miles northwest of Gogama, Ontario.



SOURCE: D.B.S. MINERAL RESOURCES DIVISION, DEPT. M.T.S. R.A.

United States

Production and consumption of molybdenum concentrate were down in 1958, according to the United States Bureau of Mines.* Production, at 41,069,000 pounds of contained molybdenum, was the lowest since 1951; consumption, at 31,298,000 pounds of contained molybdenum, was the least since 1954. The stocks of molybdenum concentrate held by industry decreased 20 per cent, but stocks of molybdenum products (ferromolybdenum, molybdic oxide, and molybdenum salts and metal) at producers' and consumers' plants increased 40 and 39 per cent respectively during the year.

*U.S. Bureau of Mines, Minerals Yearbook, 1958.

Climax Molybdenum Company and The American Metal Company, Limited, were merged on January 1, 1958. The name of the new firm is American Metal Climax Inc. The large deposit at Climax, Colorado, which was first explored in 1917 and is the site of the world's largest producer, is the only United States mine operated chiefly for molybdenum. During the five-year period from 1953 to 1957 world production was approximately 327 million pounds of contained molybdenum. Of this, the Climax mine produced 203 million pounds.

Production of molybdenum as a by-product of copper- and tungsten-mining was carried on in Utah, Arizona, California, New Mexico and Nevada. The United States Bureau of Mines reported that production from by-product operations was 12 per cent below the 1957 output. Among the larger producers of by-product molybdenum in 1957 were Kennecott Copper Corporation (second only to American Metal Climax Inc.), Phelps Dodge Corporation, Union Carbide Nuclear Company, Miami Copper Company, American Smelting and Refining Company and San Manuel Copper Corporation.

Other Countries

Chile is second in the production of molybdenum, all of which it obtains as a by-product from its large porphyry deposits. In 1939, molybdenite was first recovered at Sewell, from the copper ores of El Teniente mine of Braden Copper Company, a Kennecott Copper subsidiary.

In 1958, The Anaconda Company installed a molybdenite-recovery unit on its Chuquicamata copper property.

Japan, Norway and Yugoslavia are producers of some importance, but their production is small and they rank behind Canada. China, North Korea and the Union of Soviet Socialist Republics also produce molybdenum, but data on their production are not available.

Consumption and Uses

The iron-and-steel industry uses about 90 per cent of the molybdenum consumed. Molybdenite is added to steel in the ladle when sulphur is also desired as an addition. Because of cost, molybdic oxide is generally the favoured additive, and it is widely used in the manufacture of constructional low-alloy steels. Ferromolybdenum is generally used where a higher molybdenum content is required, as in cast iron and malleable steel castings. Ninety-three per cent of the molybdenum consumed in Canada in 1957 and 1958 was in molybdic oxide and ferromolybdenum. Lesser amounts of molybdenum are consumed in sodium molybdate, calcium molybdate, molybdenum metal and molybdenum wire.

Crude molybdenite was used as a lubricant more than a hundred years ago, but the use of purified MoS_2 is a development of the last 15 years.

Purified-molybdenite lubricants are manufactured as greases, oil dispersions, resin-bonded films and dry powder. Their consumption in the United States grew from almost nothing a few years ago to 225,000 pounds of contained molybdenum in 1958.

In December 1958, Climax Molybdenum Company announced the development of a new product called ' Moly-Gro', which is said to be able to increase the harvest of peas, alfalfa, peanuts, soy beans, clover and other crops.

Molybdenum compounds are used in the ceramic industry for manufacturing white pigment, and in conjunction with other elements to make vitreous enamels adhere to iron and steel.

Molybdenum is of great strategic value to the United States, not only for its own particular alloying properties, but because it can be used as a partial substitute for tungsten, nickel, chromium and vanadium in low-alloy and certain high-speed steels.

Among the more important Canadian consumers of molybdenum primary products are: Atlas Steels Limited, Welland; 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; Dominion Colour Corporation Limited, New Toronto - all in Ontario; L'Air Liquide, Montreal; Canadian Steel Foundries (1956) Limited, Montreal; Dominion Brake Shoe Company, Limited, Joliette - all in Quebec; and Dominion Steel and Coal Corporation, Limited, Sydney, Nova Scotia.

Prices

E & M J Metal and Mineral Markets of December 25, 1958, quotes molybdenum prices in the United States as follows:

Molybdenum powder	Per lb, carbon-red, f.o.b. shipping point	$3.35
Molybdenum ore	Per lb contained Mo 95% MoS_2, f.o.b. shipping point Climax (effective Nov. 1, 1958, cost of container extra)	$1.25
Molybdic trioxide	Per lb Mo, f.o.b. shipping point:	
	Bags	$1.46
	Cans	$1.47
Ferromolybdenum	Per lb contained Mo, lots 5,000 lb or more, f.o.b. shipping point:	
	58-64% Mo powdered, packed	$1.82
	Other sizes, packed	$1.76

Calcium molybdate	Per lb Mo, lumps, packed	$1.50

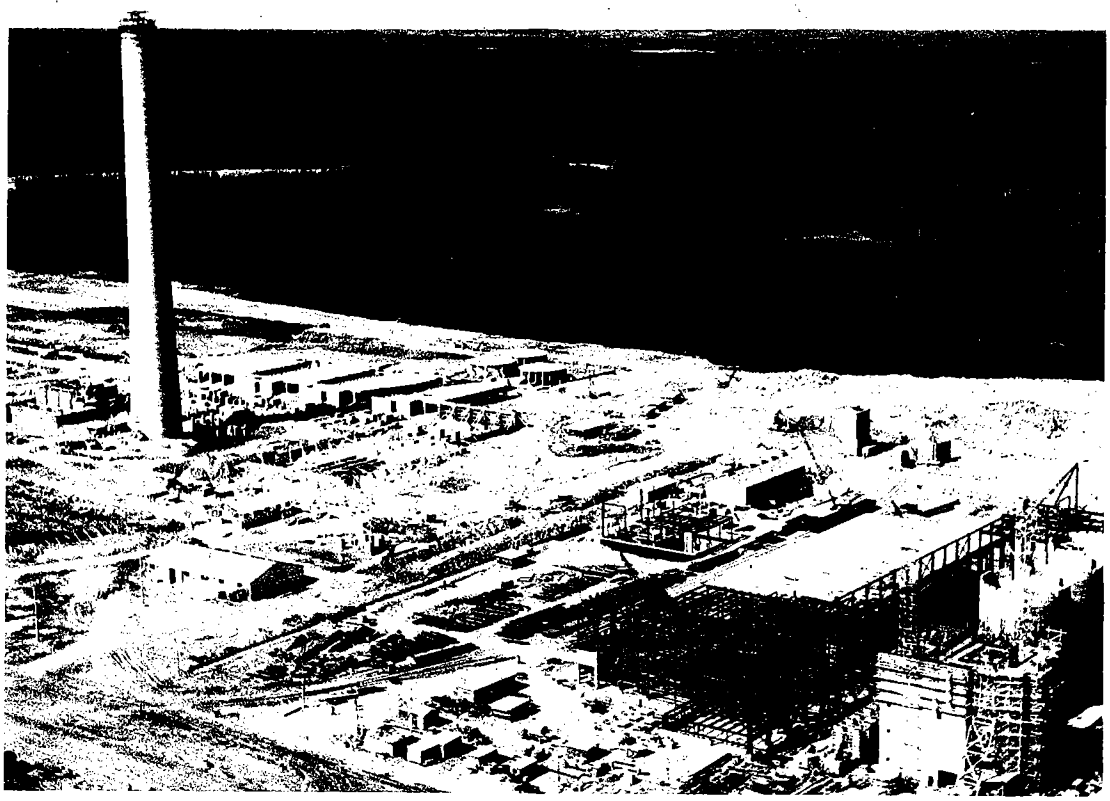
Tariffs

Canada

	British Preferential	Most Favoured Nation	General
Calcium molybdate and molybdic oxide	free	free	5% ad valorem
Molybdenum rod and tubing (expires June 30, 1959)	"	"	30% " "
Molybdenum strip	"	"	30% " "
Molybdenum wire and molybdenum imported by manufacturers of radio tubes and parts	"	"	30% " "
Ferromolybdenum	"	5% ad valorem	5% " "
Molybdenum ores and concentrates	"	free	free

United States

Molybdenum ores and concentrates per lb contained Mo	31 1/2¢
Calcium molybdate, ferromolybdenum, metallic molybdenum, molybdenum powder and all other alloys and compounds of molybdenum, per lb contained Mo	25¢ plus 7 1/2% ad valorem
Molybdenum bars, ingots, sheets, shot, wire and other forms not specially provided for, and scrap containing more than 50% molybdenum, molybdenum carbide or combinations thereof:	
Bars, ingots, scrap, shot	21% ad valorem
Other forms	25 1/2% " "



Courtesy of The International Nickel Company
of Canada, Limited
INCO 3351#A

Section of the Thompson-mine plant site in north-central Manitoba as construction proceeded late in 1958. From left to right: smelter foundations and 500-foot stack, concentrator steelwork, headframe and three fine-ore bins.

NICKEL

C.C. Allen

For the first time since 1950, nickel production did not increase over that of the preceding year. It declined in 1958 to 139,559 short tons from the 187,958-ton output of 1957. Ninety per cent of this production came from the Sudbury area; the remainder from Manitoba, the Northwest Territories and British Columbia.

The shortage of nickel, which commenced during the Korean war, ended in 1957, and 1958 was characterized by a large excess of supply over demand. This surplus also caused the disappearance of the premium market except for nickel under firm contract. The large nickel surplus necessitated production cutbacks. In March and again in April, The International Nickel Company of Canada, Limited, announced successive 10-per-cent reductions. These were followed by a further 20-per-cent reduction in July, when International Nickel went from a five- to a four-day work week. The three reductions resulted in a production decrease of about 35 per cent, which was equivalent to 50,000 tons of nickel. A strike of the employees of International Nickel that lasted from September 24 to December 22 caused a production loss of 28,000 tons. At the end of the strike, the five-day work week was resumed at a production capacity of 132,500 tons of nickel. The current annual production capacity of International Nickel is 155,000 tons.

Falconbridge Nickel Mines Limited, Sherritt Gordon Mines Limited and North Rankin Nickel Mines Limited operated at close to optimum capacity. Nickel Rim Mines Limited and Western Nickel Limited both ceased production because of the oversupply and the disappearance of the premium market.

Domestic Mine Production and Development

Ontario

The International Nickel Company of Canada, Limited, continued to operate its five mines - the Creighton, Frood-Stobie, Garson, Levack and Murray. The Murray was temporarily closed in connection with the reduced production program but has been reopened. Development work at the Crean Hill mine and construction work on the Levack concentrator were suspended. The 1958 deliveries of International Nickel were 102,900 tons of nickel. The ore mined totalled 9,457,000 tons. Ore reserves in the Sudbury-area mines at December 31, 1958, amounted to 264,628,000 tons containing 7,960,300 tons of nickel and copper.

(text continued on page 172)

Nickel - Production, Trade and Consumption

	1958		1957	
	Short Tons	$	Short Tons	$
Production (all forms)[1]				
Ontario	127,144	177,168,918	177,396	243,518,138
Manitoba	9,778	13,328,056	10,034	14,725,014
Northwest Territories	1,933	2,648,538	528	734,157
British Columbia	704	996,507	-	-
Total	139,559	194,142,019	187,958	258,977,309
Exports				
Nickel in matte or speiss				
United Kingdom	30,942	42,361,998	28,710	38,502,055
Norway (2)	26,062	35,571,977	24,480	32,831,889
United States	9,160	12,511,363	18,391	24,649,619
West Germany	630	864,542	820	1,097,805
Other countries	865	1,185,924	1,293	1,735,152
Total	67,659	92,495,804	73,694	98,816,520
Nickel in oxide				
United Kingdom	850	563,636	841	517,894
United States	488	650,829	801	955,845
Other countries	55	83,267	64	102,943
Total	1,393	1,297,732	1,706	1,576,682
Refined metal				
United States	66,491	90,604,067	90,581	127,265,463
United Kingdom	7,479	9,875,782	4,748	6,353,619
West Germany	4,936	7,395,965	3,013	5,101,754
Italy	1,785	3,826,323	1,572	2,920,928
Sweden	1,205	1,998,035	964	1,739,585
Other countries	3,272	5,085,859	2,380	4,478,491
Total	85,168	118,786,031	103,258	147,859,840
Imports				
Semifabricated nickel[3]				
United States	2,143	3,853,706	1,955	3,560,185
United Kingdom	12	40,051	57	169,455
Other countries	-	-	79	112,333
Total	2,155	3,893,757	2,091	3,841,973

Nickel - Production, Trade and Consumption (cont'd)

	1958 Short Tons	1958 $	1957 Short Tons	1957 $
Nickel manufactures				
United States		1,332,083		1,332,994
West Germany		207,641		245,472
United Kingdom		168,799		189,755
Other countries		125,830		101,379
Total		1,834,353		1,869,600
Total imports		5,728,110		5,711,573
Consumption (refined metal)(4)	4,098		4,532	

(1) Includes nickel in matte exported, refined metal produced in Canada and nickel in oxides and salts sold or produced.

(2) For refining and re-export.

(3) Nickel in bars, rods, strips, sheets and wire, nickel and nickel-silver in ingots and nickel chrome in bars.

(4) Producers' domestic shipments of refined metal.

Nickel - Production, Trade and Consumption, 1948-58
(short tons)

	Production(a)	Exports				Imports(b)	Consumption(c)
	All Forms	In Matte	In Oxide	Refined Metal	Total		
1948	131,740	50,801	9,792	71,247	131,840	1,368	1,887
1949	128,690	56,902	1,151	69,088	127,141	1,444	1,749
1950	123,659	53,090	1,668	66,894	121,652	1,337	2,226
1951	137,903	57,882	944	72,357	131,183	1,306	2,744
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	4,098

(a) Refined metal, plus content of oxide and matte exported.

(b) Nickel in semifabricated forms, including nickel in bars, rods, strips, sheets and wire; nickel and nickel-silver in ingots and nickel-chromium in bars.

(c) Producers' domestic shipments of refined metal.

Northwest Territories

North Rankin Nickel Mines Limited shipped concentrates containing 4,393,739 pounds of nickel and, at the end of the 1958 season, had concentrates on hand containing 1,767,000 pounds of nickel. The 1958 production was treated at the Fort Saskatchewan refinery of Sherritt Gordon Mines Limited. North Rankin recently signed a further four-year sales contract with Sherritt Gordon providing for a maximum delivery of 28 million pounds of nickel, with a maximum of 7 million pounds in any individual year.

British Columbia

Western Nickel Limited, near Hope, completed a 1,000-ton mill and began production in January 1958. Production ceased in August because of the curtailment of premium prices for nickel. Western Nickel shipped concentrates to the Fort Saskatchewan, Alberta, refinery.

Quebec

Canadian Copper Refiners Limited recovered nickel sulphate from the impure electrolyte produced during the refining of copper anodes.

Exploration in Canada

Ontario

Fatima Mining Company Limited continued diamond-drilling on its property in Bartlett and Geikie townships and intersected values in nickel from 1 to 2 per cent. Negotiations are continuing for financing with European capital, and tenders have been requested for a 790-foot-shaft contract.

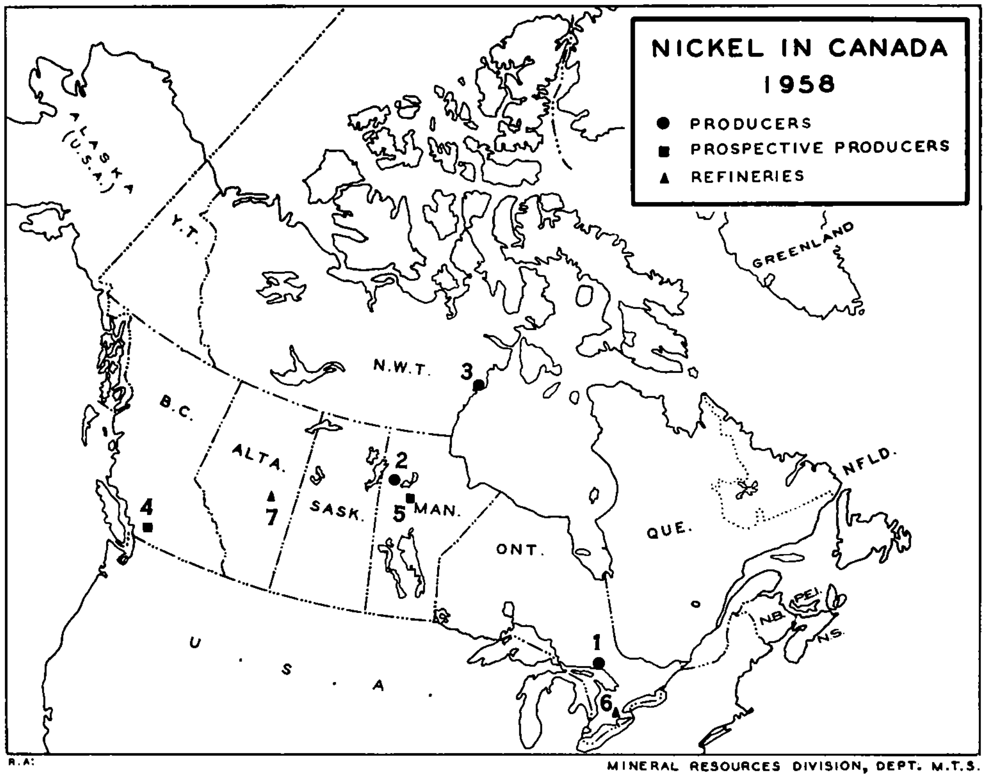
Eastern Mining and Smelting Corporation Ltd. reorganized, becoming Nickel Mining and Smelting Corporation Limited. Plans for a nickel-copper smelter at Chicoutimi, Quebec, were deferred and the Gordon Lake property, in northwestern Ontario, was closed down.

Manitoba

Canorama Explorations Limited continued geophysical exploration on claims in the Thompson-Moak Lake area.

Genrico Nickel Mines Limited encountered nickel-copper mineralization in diamond-drilling on the Tow Lake property, some 30 miles east of Lynn Lake.

Maralgo Mines Limited, by diamond-drilling near Hambone Lake, southwest of Ospwagan Lake, outlined several million tons grading just under 1 per cent nickel. This property was recently purchased by International Nickel.



Producers

1. Sudbury area
   International Nickel Company of Canada, Limited, The (5 mines, 2 smelters)
   Falconbridge Nickel Mines Limited (6 mines, 1 smelter)
   Nickel Rim Mines Limited
2. Sherritt Gordon Mines Limited, Lynn Lake, Manitoba
3. North Rankin Nickel Mines Limited
4. Western Nickel Limited, near Hope, British Columbia

Prospective Producers

5. International Nickel Company of Canada, Limited, The – Thompson project

Refineries

6. International Nickel Company of Canada, Limited, The, Port Colborne, Ontario
7. Sherritt Gordon Mines Limited, Fort Saskatchewan, Alberta

New Manitoba Mining and Smelting Company Limited, with property southwest of Cat Lake, postponed production plans.

Panther International Mining Company Limited announced plans for an initial 10,000 feet of exploratory diamond-drilling on anomalies in the Mystery-Moak Lake area.

International Nickel continued exploration work along the Burntwood River and completed a large amount of diamond-drilling around Ospwagan Lake, with encouraging results.

Falconbridge Nickel Mines Limited carried out air, ground and diamond-drilling surveys on a group of claims southwest of Thompson.

Rio Canadian Exploration Ltd. plans ground surveys and diamond-drilling, to follow aeromagnetic surveys on a number of claims in the Thompson area.

Northwest Territories

International Nickel and Sherritt Gordon diamond-drilled their respective claims in the Coppermine River area. Mineralized widths were reported to be narrow and grades low.

Quebec

Quebec Ascot Copper Corporation Limited intersected interesting values in nickel and copper while diamond-drilling a series of vertical holes in Beauchastel township in the Noranda district.

World Production and Development

Cuba

Cuban Nickel Company, which operates at Nicaro in Oriente province, cut production in August 1958 by about 30 per cent - from 25,000 to 17,500 short tons of nickel a year. This rate was subsequently reduced to 12,500 tons.

Cuban American Nickel Company changed its name to Freeport Nickel Company. Initial nickel production at the Moa Bay property is scheduled for 1959, and the capacity rate of 25,000 tons of nickel is to be attained in 1960.

Dominican Republic

Minera y Beneficiadora Falconbridge Dominicana C por A, a subsidiary of Falconbridge Nickel Mines Limited, is developing what are reported to be sizable deposits of nickel-bearing ore.

New Caledonia

Société Anonyme Le Nickel is running its smelter at about 50 per cent of capacity but at the same time is continuing expansion plans in both France and New Caledonia. The company proposes to have a nickel-production capacity of 11,000 to 16,500 short tons for 1959 and to increase it to 20,000 short tons for 1960 and 27,500 for 1961.

New Guinea

Rich deposits of nickel-cobalt ore, with estimated reserves ranging from 100 million to 200 million tons, are reported on the island of Waigeo, northeast of Netherlands New Guinea. United States Steel Corporation and three Dutch firms are interested in the exploration and exploitation rights, though parliamentary approval to the concession must be obtained.

Philippines

The Philippine government has amended its nickel law to make the terms more attractive to foreign investors and to stimulate development of the nickel deposits in Surigao province, northeastern Mindanao island. The reserves of laterite ore are estimated to consist of 59 million dry metric tons averaging 1.38 per cent nickel and a larger tonnage of lower-grade nickel.

Free World nickel-production capacity, which is increasing rapidly, is expected to be as follows:

	Short Tons		
	1959	1960	1961
International Nickel	155,000	165,000	192,500
Falconbridge	30,000	30,000	30,000
Sherritt Gordon	13,750	13,750	13,750
Nicaro Nickel	27,000	27,000	27,000
Freeport Nickel	5,000	25,000	25,000
New Caledonia (French and Japanese)	34,000	39,000	42,500
M.A. Hanna	10,000	10,000	10,000
Total	274,750	309,750	340,750

Consumption and Uses

Domestic shipments of refined metal from producers in Canada amounted to 4,098 tons. The comparable total for 1957 was 4,532 tons.

It is estimated that, of the nickel consumed during 1958 in the Free World, 27 per cent was used in stainless steels, 16 per cent in constructional steels, 16 per cent in high-nickel alloys, 13 per cent in nickel plating, 12 per cent in iron and steel castings, 6 per cent in copper and brass products and 10 per cent in miscellaneous categories.

Nickel is now in abundant supply and will likely be so for several years. Consequently, industries that previously had to skimp on nickel consumption and those that turned to substitutes can now use the desired amounts with assurance of present and future supplies. Nickel steels have been reintroduced into the automobile industry, and nickel plate of greater thickness is being used on car trims and zinc alloys. The nickel content of constructional steels has been increased. Efforts are being made to increase the consumption and use of stainless steel in a great number of kitchen and household articles.

Greater use is being made of super high-strength nickel-containing steel for jet-aircraft landing gears and missiles, in which light weight and high strength are essential. A second field of potential growth is in the nickel and nickel-chrome plating of aluminum where the inherent light weight of aluminum is of advantage and where the protective coating of nickel resists corrosion and tarnishing.

Prices

The Canadian price of electrolytic nickel, f.o.b. Port Colborne, Ontario, was 71.5 cents a pound throughout the first half of the year. In July it decreased to 70.5 cents and in August to 70 cents, and this price prevailed for the rest of the year. The United States price, including the 1 1/4-cent United States import duty, remained unchanged at 74 cents (U.S.) f.o.b. Port Colborne.

The price of nickel oxide was reduced from 70.25 cents per pound of contained nickel unpackaged at Copper Cliff, Ontario, to 69.6 cents per pound packaged at Buffalo, New York, or other established points of entry. The adjustment was made to compete more effectively with Cuban nickel oxide.

Tariffs

Canada

	British Preferential	Most Favoured Nation	General
Nickel and alloys with nickel content of 60% or more by weight, not otherwise provided, viz., ingots, block and shot; shapes and sections, billets, bars and rods rolled, extruded or drawn (not including nickel processed for use as anodes); strip, sheet and plate; seamless tubes	free	free	free
Anodes of nickel	5%	7 1/2%	10%
Rods with nickel content of 90% or more for manufacture of nickel electrode wire for spark plugs	free	free	10%
Articles of iron, steel or nickel of which chief component is iron, steel or nickel for use in manufacture of storage batteries	10%	10%	20%

United States

Nickel ore, matte, oxide........................	free
Nickel and alloys (nickel chief value) in pigs, ingots, shot, cubes, grains, cathodes or similar forms..	1 1/4¢ lb
Nickel in bars, rods, plates, sheets, castings, strips, wire or electrodes	12 1/2% ad valorem
Nickel scrap..................................	free
Nickel tubes, tubing (if cold-rolled, cold-drawn or cold-worked, 2 1/2% extra)......................	6 1/4% ad valorem

PLATINUM METALS

C.C. Allen

The platinum metals include the two groups of platinum-iridium-osmium and palladium-rhodium-ruthenium. All occur in the nickel-copper ores of the Sudbury district of Ontario, though osmium is not recovered in commercial quantities. The amount present in the Sudbury ores averages about 0.025 ounce of platinum metals per ton of ore, but this becomes appreciable when the large tonnages of ore treated are considered. In 1958 Canada's production was 146,092 troy ounces of platinum valued at $9,481,371 and 154,366 ounces of palladium-rhodium-ruthenium-iridium valued at $4,840,072. In 1957 it was 199,565 ounces of platinum valued at $17,835,124 and 216,582 ounces of palladium-rhodium-iridium-ruthenium valued at $7,896,209. The 1958 decrease in production value was due to both lower quantity and lower prices.

South Africa and Canada continued to be the leading Free World producers of platinum metals. Both countries produce platinum metals associated with nickel-copper sulphides. In Canada, however, platinum metals are by-products of nickel and copper output whereas in the Rustenburg district of South Africa nickel and copper are by-products of the output of platinum metals. In Canada, consequently, the production of platinum metals depends on the demand for nickel and copper, while in South Africa it depends on the world demand for platinum metals.

The output of platinum metals in the major producing countries during 1958 was as follows:

	Troy Ounces
Union of South Africa	305,000 (estimated)
Canada	300,458
U.S.S.R.	250,000 (estimated)
Colombia	16,036
United States	14,322

Domestic Mine Production

The International Nickel Company of Canada,Limited, which is the principal Canadian producer of platinum metals, delivered 145,400 troy ounces in 1958. The nickel-copper ore it treated during the year amounted to 9,457,000 tons. International Nickel currently operates five mines at Sudbury,

Platinum Metals – Production and Trade

	1958		1957	
	Troy Ounces	$	Troy Ounces	$
Production				
Platinum	146,092	9,481,371	199,565	17,835,124
Palladium, rhodium, ruthenium, iridium	154,366	4,840,072	216,582	7,896,209
Total	300,458	14,321,443	416,147	25,731,333
Exports				
Platinum metals in concentrates(1)		14,795,041		17,261,343
Platinum metals, refined and semiprocessed				
United States		4,832,731		10,081,412
Other countries		195,957		376,750
Total		5,028,688		10,458,162
Platinum, old and scrap				
United Kingdom		10,250		89,659
United States		3,140		11,420
Total		13,390		101,079
Imports				
Platinum metals, semiprocessed and manufactured				
United Kingdom(2)		8,204,343		15,194,988
United States		437,017		209,403
Other countries		–		26,540
Total		8,641,360		15,430,931
Platinum-crucible category (extrusion nozzles)				
United States		1,535,132		1,361,181
Catalysts(3) for refining petroleum				
United States		2,603,792		6,136,076
United Kingdom		175,391		104,063
West Germany		–		225,046
Total		2,779,183		6,465,185

(1) To United Kingdom and Norway for refining and/or processing.

(2) Derived from domestic concentrates refined and processed in the United Kingdom.

(3) Materials for use as catalysts in refining petroleum. These materials consist chiefly of platinum.

Platinum Metals - Production and Trade, 1948-58

	Production(1)			Exports(2)	Imports(3)
	Platinum	Other Platinum Metals	Total		
	(troy oz)	(troy oz)	(troy oz)	($)	($)
1948	121,404	148,343	269,747	16,776,733	10,738,062
1949	153,784	182,233	336,017	18,016,023	10,736,534
1950	124,571	148,741	273,312	21,200,788	21,339,915
1951	153,483	164,905	318,388	30,340,210	17,077,931
1952	122,317	157,407	279,724	30,529,112	17,373,023
1953	137,545	166,018	303,563	26,278,956	16,517,392
1954	154,356	189,350	343,706	27,629,755	17,784,372
1955	170,494	214,252	384,746	26,303,400	15,723,099
1956	151,357	163,451	314,808	35,386,111	19,579,826
1957	199,565	216,582	416,147	27,719,505	15,430,931
1958	146,092	154,366	300,458	19,823,729	8,641,360

(1) Platinum metals, content of residues, concentrates and matte shipped to the United Kingdom and Norway for treatment.
(2) Value of platinum metals contained in concentrates and residues shipped to the United Kingdom for treatment. Also included in these figures are the exports of refined and semiprocessed platinum metals to the United States and other countries.
(3) Imports from the United Kingdom of refined and semiprocessed platinum metals derived from Canadian residues and concentrates shipped to the United Kingdom for treatment.

Ontario, namely the Creighton, Frood-Stobie, Garson, Levack and Murray. On December 31, ore reserves at these mines totalled 264,628,000 tons containing 7,960,300 tons of nickel and copper. The ore at the Frood mine is, on the average, considerably richer in platinum metals than the ore in the rest of the Sudbury district.

The large world nickel surplus necessitated cutbacks and, in March and again in April, International Nickel announced successive 10-per-cent reductions in production. On July 7 the company also went from a five- to a four-day week and made a further reduction of 20 per cent, which, along with the two previous reductions, amounted to a 35-per-cent decrease in output. A strike of International Nickel's employees that lasted from September 24 to December 22 resulted in a complete closing of the company's Canadian production facilities and, consequently, a further decrease in its output of platinum metals.

Falconbridge Nickel Mines Limited treated 2,087,180 tons of nickel-copper ore. Ore reserves at December 31, 1958, were 43,892,750 tons of developed and indicated ore. Falconbridge currently operates six mines, namely, Falconbridge, East, McKim, Longvac, Hardy and Fecunis.

The platinum-metal values in the nickel-copper ores of the Sudbury district occur as sulphides. The platinum sulphides are reduced in pyro-metallurgical treatment and are eventually recovered as sludges or residues from the electrolytic refining of both nickel and copper. Precious-metals residues from International Nickel's Copper Cliff and Port Colborne refineries are refined to platinum metals in England at the Acton refinery of Mond Nickel Co. Ltd. Falconbridge ships nickel-copper matte containing platinum metals to Kristiansand, Norway, for refining, and the resulting platinum-metal residues are refined by the Baker Platinum Division of Engelhard Industries Inc., Newark, New Jersey.

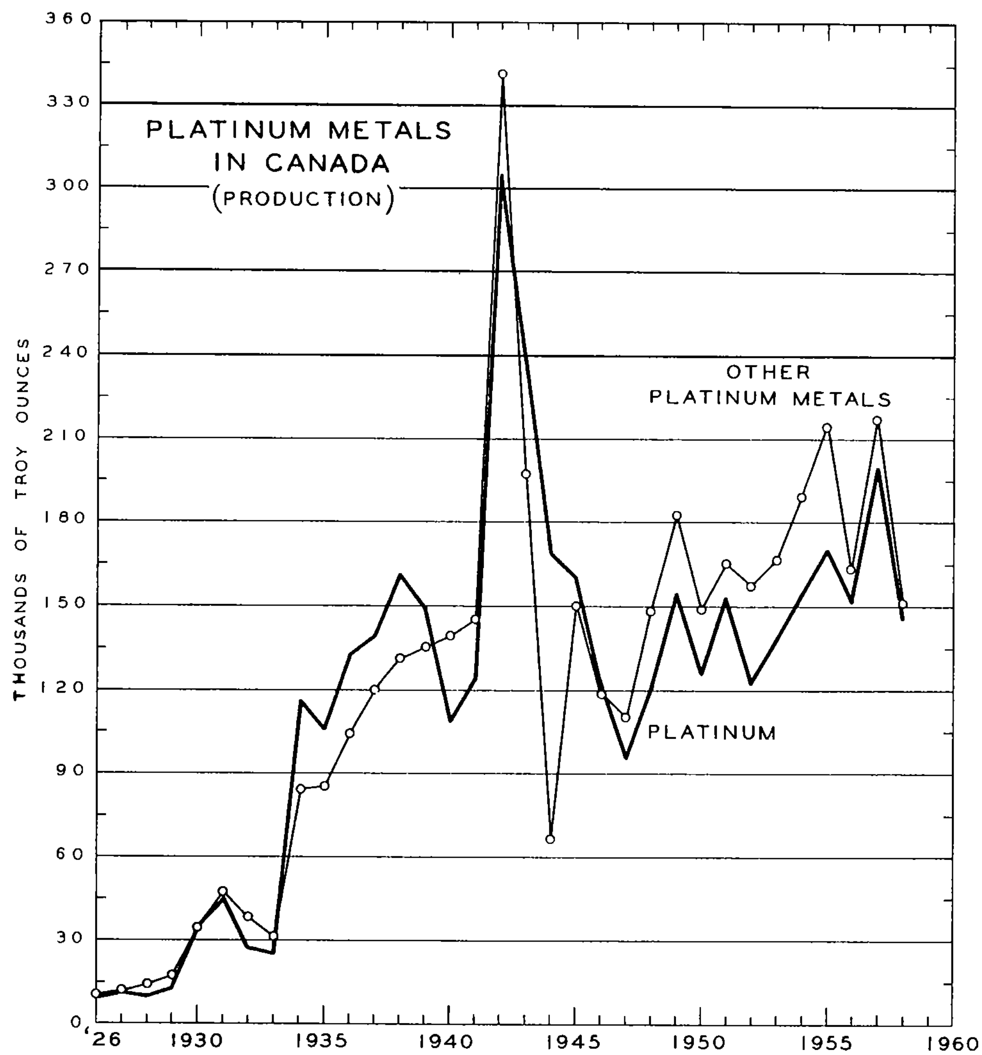
Low values in platinum metals occur in practically all nickel-copper sulphide deposits, as in the Sherritt Gordon deposit at Lynn Lake, Manitoba, and at the properties of North Rankin Nickel Mines Limited, at Rankin Inlet, Northwest Territories, and Pacific Nickel Mines Limited, near Hope, British Columbia. The last-mentioned was closed in July 1958. Nickel concentrates from Lynn Lake and Rankin Inlet are treated at the Fort Saskatchewan, Alberta, refinery of Sherritt Gordon Mines Limited, where an ammonia leach process is used for the recovery of nickel, copper and cobalt. Values in platinum metals are not recovered by this process.

Small amounts of platinum metals are recovered from the sludges of Canadian Copper Refiners Limited at Montreal East, such sludges resulting from the electrolysis of copper anodes.

International Nickel is continuing construction and development of the Thompson mine and related facilities in northern Manitoba. The annual production capacity of the mine is to be 75 million pounds of nickel, and production is to begin in July 1960. Values in precious metals, including the platinum metals, are reported to be about half those of the Sudbury area.

World Production

Rustenburg Platinum Mines Limited operates two mines known as the Rustenburg Section and the Union Section, adjacent to Rustenburg, Transvaal, South Africa. Both sections mine in the Merensky Reef horizon of the Bushveld Complex. Average mine grade is about 0.25 ounce of platinum metals per ton of ore over a 30-inch mining width. In 1956, Rustenburg Platinum commenced a program to increase its production rates 80 per cent over those of 1955. The program was to include not only an increase in mining and milling, but also an expansion of local smelting and refining facilities. The current mining and milling capacity of Rustenburg Platinum is 2,500,000 tons, or about 625,000 ounces, of platinum metals a year. All platinum-metals concentrates are refined by Johnson, Matthey and Company, Limited, Hatton



SOURCE: D.B.S. MINERAL RESOURCES DIVISION, DEPT. M.T.S. R.A.

Garden, London, England. During 1958, Rustenburg Platinum cut production of platinum metals 50 per cent because of adverse world market conditions.

Osmiridium, a natural alloy of osmium and iridium, is recovered in milling ore from the Rand gold mines of South Africa. Annual production amounts to about 6,500 ounces.

Platinum was discovered in placer deposits in the Russian Urals in 1823, and since that time Russia has been a major producer of platinum metals. Production statistics have not been published since 1926 though the current production of the Union of Soviet Socialist Republics is estimated by the United States Bureau of Mines to be about 125,000 ounces annually.

Platinum was first discovered in Colombia, South America, in the sixteenth century - by Spaniards searching for gold in river gravels. Since then, Colombia has always been a producer of platinum metals; in 1957 it produced 19,830 ounces. The South American Gold and Platinum Company obtains platinum by operating dredges, and there is casual production of minor amounts by primitive methods. The main producing area is the Chocó division between the headwaters of the San Juan and Atrato rivers.

In the United States, placer platinum is recovered from Goodnews Bay, Alaska, and from gold placers in California. Platinum metals are also recovered in the smelting and refining of gold and copper ores.

Consumption and Uses

The United States consumes about 75 per cent of the world production of platinum metals.

How the platinum metals are consumed depends on their physical and chemical properties, the most important of which are high melting temperatures, catalytic capacity, and resistance to heat and chemical reagents and to oxidation at ordinary temperatures. About 75 per cent of the platinum produced is put to chemical use. Other major uses are provided by the electrical, jewelry, and medical- and dental-supply industries.

Platinum is used most extensively in the chemical industry - as a catalyst in the upgrading of low-octane to high-octane gas. The efficiency of this process, discovered in 1949, has resulted in rapid growth in the utilization of platinum as a petroleum catalyst. In 1956, the operating catalytic-reforming capacity of the United States was 1,300,000 barrels a day, or 14 per cent of the crude run. This refining capacity is expected to double within the next decade. Platinum catalysts are also used in the manufacture of sulphuric and nitric acid, in the hydrogenation of organic chemicals, pharmaceuticals, vitamins and antibiotics, in the purification of such gases as industrial air, mine air and automobile exhausts, and as reigniters to prevent flameout in jet engines. More familiar uses are found in platinum ware - for example, in the crucibles and electrodes employed in laboratories.

Platinum-gold and platinum-rhodium alloys are widely used in spinnerets for the manufacture of synthetic fibres and as extrusion nozzles in the fiberglas industry. Platinum metals are used in jewelry, particularly as rings and rhodium-plating in the manufacture of costume jewelry. Rhodium is also extensively employed in all forms of electroplating, in which a high-reflecting, nontarnishable surface is desired.

Palladium finds its most extensive use in the electrical industries, providing electrical contacts at low amperages where a high degree of reliability is desired. The absence of surface film ensures low contact resistance and reliable operation even after long periods of idleness. Palladium is commonly used in telephone relays, automobile voltage regulators, electric clocks, and sliding contacts in instruments.

Platinum has been employed more recently in the form of electrodes to prevent hull corrosion on sea-water craft. Alloys of platinum and 23.5 per cent cobalt form the most powerful magnets known. One special application of these magnets is in electric wrist watches. Iridium-192 is now extensively used as a source of gamma rays in the examination of castings and welds for flaws. Borescopes are also being used in increasing quantity. They are similar to portable periscopes, some being only 1/10 inch in diameter, and are used for the internal inspection of engine cylinders.

Canadian Consumers

The platinum-metals industry of Canada is dominated by Engelhard Industries of Canada Limited (formerly Baker Platinum of Canada Limited) and Johnson Matthey and Mallory Limited. Both organizations have offices and plants in Toronto, are members of their respective world-wide organizations and act as importers, manufacturers and sales agents for platinum metals, alloys, manufactured articles and platinum-metals salts. Imperial Smelting & Refining Company Limited, Toronto, manufactures jewelry, and both Handy & Harman of Canada Limited and Williams Gold Refining Company of Canada Limited utilize platinum metals in dental alloys.

Prices

Prices of platinum metals in the United States according to E & M J Metal and Mineral Markets of December 25, 1958, were as follows:

	Per Troy Ounce
Platinum	\$ 51 to \$ 55 (average \$52)
Palladium	\$ 15 to \$ 17
Osmium	\$ 70 to \$ 90
Iridium	\$ 70 to \$ 80
Rhodium	\$118 to \$125
Ruthenium	\$ 45 to \$ 55

The price of platinum, which was \$52 an ounce at the end of 1958, was \$76 to \$80 an ounce the previous year. The year 1958 was characterized by successive price reductions due to increasing supply and decreasing demand. Rustenburg Platinum decreased its production capacity 50 per cent,and International Nickel's 35-per-cent cutback in production was augmented by a further cutback resulting from the three months' strike. The use of platinum catalysts in the oil industry was less because of reduced use of platinum in catalysts and a lower expansion rate. The sales of platinum metals from the U.S.S.R. on free markets are not known, but, according to one estimate, that country marketed at least 250,000 troy ounces during 1958.

The platinum-metals production of International Nickel and Falconbridge are marketed by the Baker Platinum Division of Engelhard Industries, which has its headquarters in Newark, New Jersey. All South African production is refined and marketed by Johnson Matthey and Company, Limited, Hatton Garden, London.

Tariffs

Canada

	British Preferential	Most Favoured Nation	General
Platinum wire, platinum bars, strips, sheets, plates; platinum, palladium, iridium, osmium, ruthenium and rhodium, in lumps, ingots, powder, sponge or scrap	free	free	free
Platinum crucibles	"	"	"
Materials for use only as catalysts in refining of petroleum	"	"	25%

United States

Platinum ores and concentrates	free
Platinum, unmanufactured or in bars, ingots, plates or sheets not less than 1/8" thick, or in the form of scrap or sponge	"
Iridium, osmium, palladium, rhodium and ruthenium, and native combinations thereof with one an other or with platinum	"
Chemical compounds, mixtures and salts of which gold, platinum, rhodium or silver is the element of chief value	12 1/2%

SELENIUM AND TELLURIUM

A. F. Killin

SELENIUM

Selenium, a by-product of the electrolytic refining of blister copper, is one of the semiconductor metals widely used in the electronics industry. Production in 1958 decreased but exports and consumption rose above the 1957 figures. Producers' stocks continued to increase, and the consumption and export figures remained low compared with those of the peak years, 1955 and 1956. The continued depression in consumption and exports is a reflection of the 1958 business recession combined with increasing competition from ultra-pure silicon and germanium in the electronics field.

The only companies producing primary selenium in Canada are Canadian Copper Refiners Limited at Montreal East, Quebec, and The International Nickel Company of Canada Limited at Copper Cliff, Ontario, and Port Colborne, Ontario. Some selenium is also recovered from scrap left over in the manufacture of rectifiers and from old rectifiers. Production decreased in 1958 to 306,990 pounds from the 321,392 pounds produced in 1957. At 342,141 pounds, production of refined selenium in 1958 was 10,130 pounds over the 1957 figure.

The largest selenium metal-and-salts plant in Canada is operated by Canadian Copper Refiners Limited at Montreal East, Quebec. This plant, with an annual rated capacity of 450,000 pounds of selenium, is equipped to produce commercial-grade selenium metal (99.5% Se), high-purity (H. P.) selenium metal (99.99% Se) and a wide range of metallic and organic selenium compounds. The selenium originates in the copper anodes produced at the Noranda and Murdochville smelters in Quebec, and in blister copper from the Flin Flon, Manitoba, smelter. In addition to the selenium metal, the most important compounds produced are selenium dioxide (71% Se), sodium selenate (41% Se), sodium selenite (45% Se) and ferroselenium (55-75% Se).

Copper anodes produced from the nickel-copper ores of the Sudbury district of Ontario are the source of the selenium obtained at the Copper Cliff and Port Colborne refineries of The International Nickel Company of Canada Limited. This company's selenium refinery has an annual rated capacity of 240,000 pounds of minus 200 mesh, 99.7-per-cent selenium powder.

Selenium - Production, Exports and Consumption

	1958		1957	
	Pounds	$	Pounds	$
Production[1]				
Quebec	179,397	1,345,478	168,290	1,851,190
Ontario.................	90,295	677,213	86,459	951,049
Saskatchewan	30,234	226,755	40,152	441,672
Manitoba................	7,064	52,980	26,491	291,401
Total...................	306,990	2,302,426	321,392	3,535,312
Production (refined)[2].....	342,141		332,011	
Exports (metals and salts)				
United States............	138,253	871,118	134,561	1,421,117
United Kingdom	106,776	780,739	90,525	1,262,860
Australia	5,080	47,372	500	7,500
Belgium	220	1,540	-	-
France	22	137	661	13,194
Other countries	-	-	1,804	34,349
Total...................	250,351	1,700,906	228,051	2,739,020
Consumption, approximate, by industries (selenium content)[3]				
Electronic	6,241		3,433	
Glass...................	4,145		7,885	
Rubber	4,055		2,835	
Alloy steel..............	2,154		1,403	
Agriculture	5		16	
Total...................	16,600		15,572	

(1) Recoverable selenium content of blister copper produced from domestic ores, plus some refined selenium.
(2) Includes production from scrap.
(3) Based on producers' domestic sales.

Selenium - Production, Exports and Consumption, 1948-58

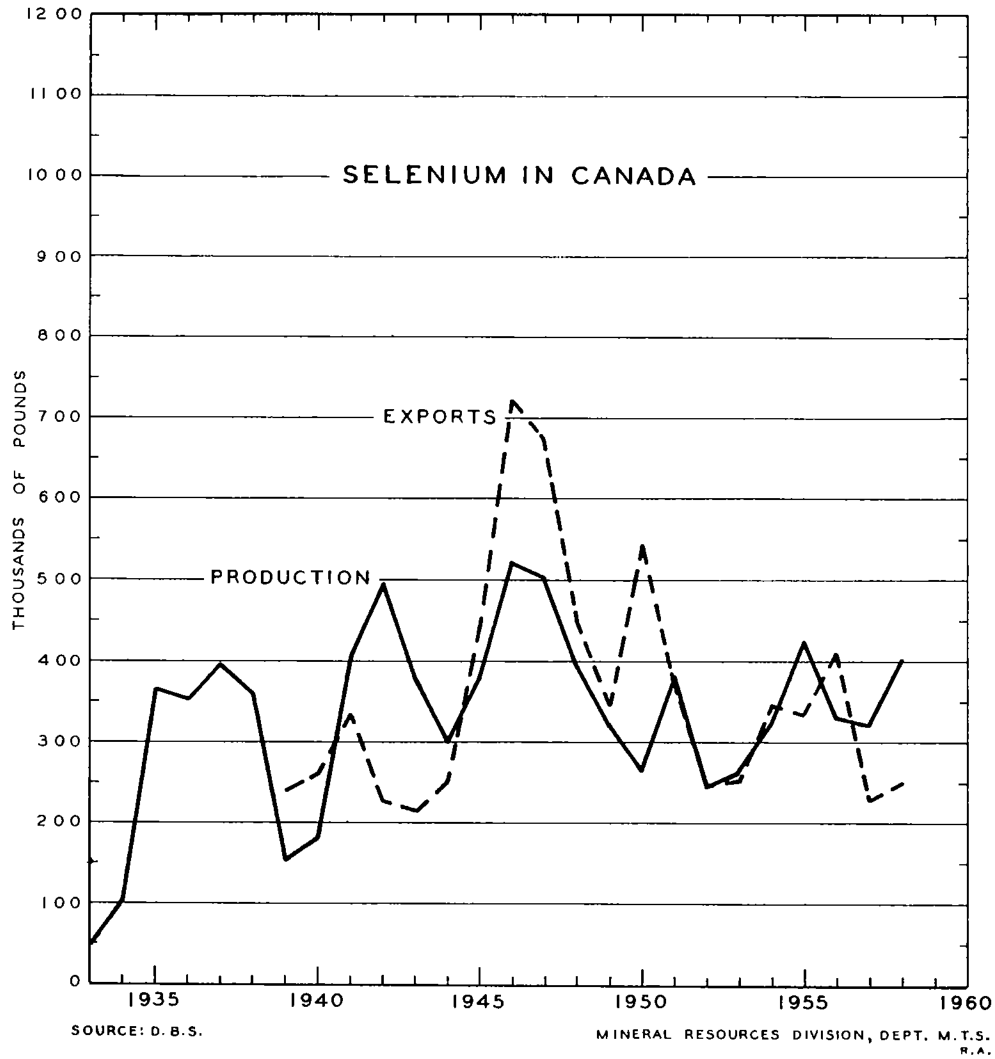
	Production		Exports	Consumption (3)
	All Forms (1)	Refined (2)	Metals and Salts	
1948	390,894	378,316	447,885	3,120
1949	318,225	288,166	343,784	3,625
1950	261,973	289,714	542,401	9,312
1951	382,603	371,060	370,473	13,647
1952	242,030	254,478	244,121	11,767
1953	262,346	307,903	253,620	14,465
1954	323,529	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

(1) Recoverable selenium content of blister copper produced from domestic ores, plus some refined selenium.
(2) Includes production from scrap.
(3) Producers' domestic shipments of selenium products (selenium content).

Consumption and Uses

Selenium and/or selenium compounds are used in the electronics, glass, rubber and alloy-steel industries and as pesticides in agriculture. The electronics industry accounts for the major use of selenium for the production of dry-plate rectifiers and photoelectric cells. High-purity selenium is used for electronic applications. Selenium dry-plate rectifiers have the advantages of high electrical efficiency, compactness, long life, light weight and ruggedness. They are used in many industrial applications in radio, television, battery chargers, electroplating equipment, magnetic brakes, shakers, agitators and circuit breakers. In the rectifier field, selenium is encountering increasing competition from ultra-pure silicon and germanium. In the manufacture of photoelectric cells, selenium is being replaced by other materials which are able to develop a larger amount of current. High-purity selenium is also used to coat the plates used in xerography, a dry-print process which utilizes the photoelectric properties of selenium.

In the manufacture of glass food containers, commercial-grade selenium powder is used in conjunction with arsenic compounds to produce white or 'flint' glass by the neutralization of the green tints imparted to the glass by iron impurities. Selenium is also used in the bright-red ruby glass used in stop lights and signal lights, in marine applications and in decorative tableware. The power of selenium to impart orange-to-dark-maroon colours to ceramic material is also utilized by the pigments industry for the colouring of glaze for chinaware, pottery, plastics and vitreous-enamel cover coats and the colouring of printing inks for glass containers. In the rubber industry,



commercial-grade selenium is used to increase heat, oxidation and abrasion resistance and to speed up the rate of vulcanization. The pharmaceutical industry employs selenium in the preparation of selenium sulphides which are claimed to control dermatitis of the scalp in humans and of the skins of animals.

Sodium selenate has been used as a systemic insecticide in greenhouses, but this use is declining owing to the discovery of compounds which are easier to apply.

Ferroselenium is used as an additive in the production of certain grades of stainless-steel alloys to improve the machinability and porosity of the castings without affecting the corrosion resistance and working properties of the material.

Among the more important consumers of selenium products in Canada are: Syntron (Canada) Limited, Stoney Creek, Ontario; Canadian Line Materials Limited, Toronto, Ontario; Bogue Electric of Canada Limited, Ottawa, Ontario; Dominion Glass Company Limited, Montreal, Quebec; Consumers Glass Company Limited, Ville St. Pierre, Quebec; Atlas Steels Limited, Welland, Ontario; Shawinigan Chemicals Limited, Shawinigan, Quebec; Fahralloy Canada Limited, Orillia, Ontario; and Ferro Enamels (Canada) Limited, Oakville, Ontario.

Prices

The price of commercial-grade selenium was quoted by E & M J Metal and Mineral Markets on January 1, 1958, at $7.50 a pound, and high purity grade selenium at $10.50 a pound. On February 19, 1959, a reduction of these prices to $7 and $9.50 a pound respectively went into effect.

TELLURIUM

Canadian tellurium production is also obtained as a by-product of the electrolytic refining of blister copper by The International Nickel Company of Canada, Limited at Copper Cliff, Ontario, and Canadian Copper Refiners Limited at Montreal East, Quebec. Although tellurium also occurs in gold, silver and lead ores, none is recovered from these sources in Canada.

International Nickel's source of tellurium is the copper-nickel ore of its deposits in the Sudbury area of Ontario. The major source of the tellurium produced at Canadian Copper Refiners' Montreal East refinery is the blister copper obtained from the smelter of Hudson Bay Mining and Smelting Co. Limited, at Flin Flon, Manitoba. Hudson Bay mines copper-zinc ore from its property on the Manitoba-Saskatchewan boundary. Some tellurium is also recovered from anodes produced at the Noranda copper smelter from the treatment of Quebec ores, and it is probable that some is recovered from anodes produced at the smelter of Gaspe Copper Mines Limited at Murdochville, Quebec.

Production of tellurium in Canada during 1958 increased to 38,250 pounds from the 31,524 pounds produced in 1957. As shown in the tables on page 194 and the graph on page 195 marked fluctuations have occurred in Canadian production since it commenced in 1934. The metal could be produced in much greater quantities if a market could be found for it.

Other world producers of tellurium are the United States, Australia, West Germany and Sweden.

Consumption and Uses

Tellurium compounds absorbed into the body by contact with the skin or inhalation of dust and fumes give the breath a strong garlic odour which persists up to three months after exposure. For this reason, industry has not exploited the full potential of this metal. Tellurium production almost always exceeds demand, but recent developments in the electronics industry have stimulated interest in the metal. If labour problems connected with its handling are solved, expanded uses and markets can be expected.

The rubber industry probably provides the largest single outlet for tellurium. When added to natural or synthetic rubber, tellurium increases the rate of vulcanization, improves the aging and mechanical properties and increases resistance to heat and abrasion. One of the principal uses of this improved rubber is in the insulation of portable cables for mining, dredging and welding. Another is in the manufacture of special conveyor belting.

Tellurium in the form of controlled-size pellets is used to improve the properties of copper and iron. A 99.5-per-cent copper, 0.5-per-cent tellurium alloy is found to have excellent thermal and electrical conductivity and good machinability. It is used in the manufacture of welding tips and the mass production of electrical connections. Small amounts of tellurium added to iron castings are used to control the depth of chill in order to produce a hard, abrasion-resistant surface.

Tellurium added to lead increases its corrosion resistance and hardness and makes it suitable for use as tank-lining and piping for handling sulphuric acid. An alloy of tellurium and lead is sometimes used in the manufacture of submarine sheathing for electrical cables.

The ceramic and glass industries use tellurium to impart blue to brown colours.

Tellurium chloride or tellurium dioxide in hydrochloric-acid solutions imparts a permanent black antique finish to silverware.

Recent advances in electronic science have increased the interest in ultra-pure tellurium for semiconductor and other electronic uses. Research into methods of producing high-purity tellurium is being conducted by producers of the metal. In the field of thermoelectronics, bismuth-tellurium thermocouples have been used for the direct conversion of heat into electricity and for cooling applications by passing an electric current through the thermocouple. These applications are still in the experimental stages.

Prices

The price of tellurium metal in the United States was quoted by E & M J Metal and Mineral Markets at $1.65 to $1.75 a pound throughout 1958.

Tellurium - Production and Consumption

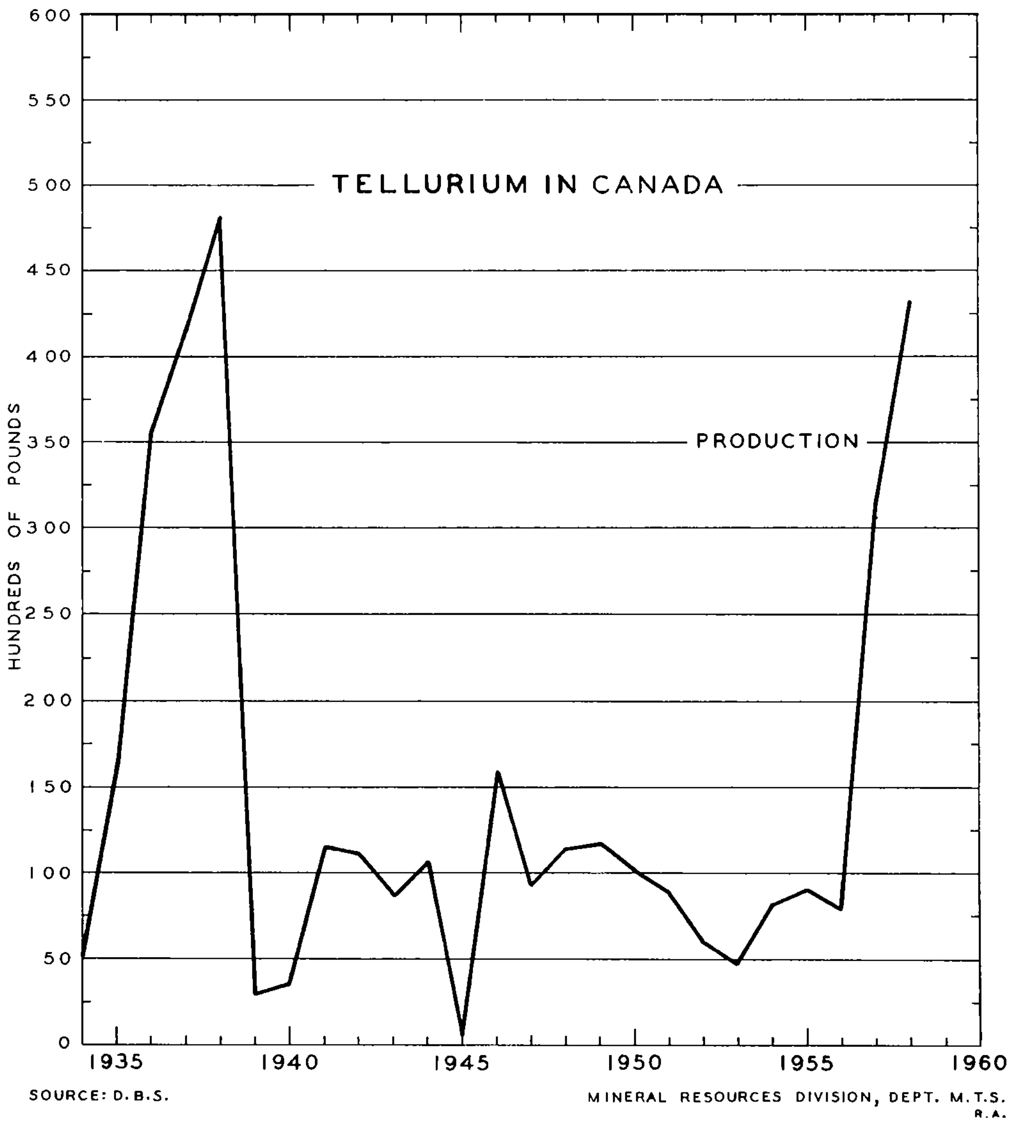
	1958		1957	
	Pounds	$	Pounds	$
Production (all forms)(1)				
Manitoba and Saskatchewan..	2,101	3,572	1,681	2,942
Ontario	6,692	11,376	6,915	12,101
Quebec	29,457	50,077	22,928	40,124
Total	38,250	65,025	31,524	55,167
Production (refined)(2)	42,337		34,895	
Consumption (refined)(3)	4,450		6,770	

(1) Includes recoverable tellurium content of blister and anode copper treated, but not necessarily recovered, in year designated, and also some refinery output.
(2) Refinery output from all sources.
(3) Producers' domestic shipments of refined tellurium.

Tellurium Production, 1948-58
(pounds)

	All Forms(a)	Refined(b)
1948	11,425	8,739
1949	11,692	8,726
1950	10,075	6,010
1951	8,913	6,301
1952	6,035	5,710
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

(a) Includes recoverable tellurium content of blister copper, which was not necessarily recovered in year designated. Also includes some refinery output.
(b) Refinery production from all sources.


TELLURIUM IN CANADA
PRODUCTION
HUNDREDS OF POUNDS
600
550
500
450
400
350
300
250
200
150
100
50
0
1935
1940
1945
1950
1955
1960
SOURCE: D.B.S.
MINERAL RESOURCES DIVISION, DEPT. M.T.S.
R.A.

SILVER

D. B. Fraser

Silver production in 1958 rose to 31,163,470 troy ounces from the 1957 total of 28,823,298 troy ounces. Output from Ontario mines increased by nearly 3 million ounces owing to expanded production of copper-zinc ores containing by-product silver and increased recovery of silver from silver-cobalt ores. Significant increases in silver recovery were made in Quebec, Newfoundland and Manitoba-Saskatchewan. Output in New Brunswick declined substantially owing to mine closures late in 1957 and 1958.

Fifty-six per cent of the total output was derived from lead-zinc and silver-lead-zinc ores, most of which were mined in British Columbia and Yukon Territory. Twenty-three per cent came from copper, copper-zinc and nickel-copper ores, 19 per cent from the silver-cobalt ores of northern Ontario and the remaining 2 per cent from lode- and placer-gold operations.

Fine silver was produced by The Consolidated Mining and Smelting Company of Canada Limited (Cominco), at Trail, British Columbia, from the refining of lead and zinc ores; Canadian Copper Refiners Limited, Montreal East, Quebec, in refining blister copper; Deloro Smelting and Refining Co. Ltd., Deloro, Ontario, from the refining of silver-cobalt ores; The International Nickel Company of Canada, Limited, Copper Cliff, Ontario, from the refining of nickel-copper ores; and Hollinger Consolidated Gold Mines, Limited, Timmins, Ontario, and The Royal Canadian Mint, Ottawa, Ontario, in refining gold bullion.

World production of silver in 1958 was an estimated 236,800,000 ounces. Mexico, with 47.6 million ounces, was again the leading producer, followed by the United States, with 35.7 million ounces, and Canada, with its 31.2 million ounces.

Developments at Producing Mines*

Yukon Territory

Production at the silver-lead-zinc mines of United Keno Hill Mines Limited in the Mayo district, Canada's largest single source of silver, was 5,984,373 ounces in the fiscal year ended on September 30, 1958. The previous year's output was 5,694,850 ounces. Of this 1958 total, 5,697,168 ounces were

*See map on page 202.

(text continued on page 201)

Silver - Production and Trade

	1958		1957	
	Troy Ounces	$	Troy Ounces	$
Production				
By provinces				
British Columbia and Alberta	8,013,456	6,956,481	8,585,030	7,500,741
Ontario	9,815,257	8,520,624	6,910,130	6,037,381
Yukon Territory	6,415,560	5,569,348	6,484,185	5,665,232
Quebec	3,908,361	3,392,848	3,645,856	3,185,384
Manitoba and Saskatchewan	1,619,836	1,406,180	1,553,405	1,357,210
Newfoundland	1,267,078	1,099,950	1,196,414	1,045,307
Northwest Territories	72,779	63,179	69,104	60,376
Nova Scotia and New Brunswick	51,143	44,397	379,174	331,284
Total	31,163,470	27,053,007	28,823,298	25,182,915
Refined silver	24,620,142		20,004,360	
By sources				
Base-metal ores	24,396,482		23,842,036	
Gold ores	707,433		648,862	
Silver-cobalt and silver ores	6,043,502		4,316,480	
Placer-gold ores	16,053		15,920	
Total	31,163,470		28,823,298	
Exports				
In ore and concentrates				
United States	4,075,781	3,418,431	5,374,362	4,440,106
West Germany	506,689	420,270	223,342	188,460
Belgium	472,046	399,259	296,431	249,933
Mexico	-	-	85,324	64,655
Other countries	44,272	36,528	-	-
Total	5,098,788	4,274,488	5,979,459	4,943,154

Silver - Production and Trade (cont'd)

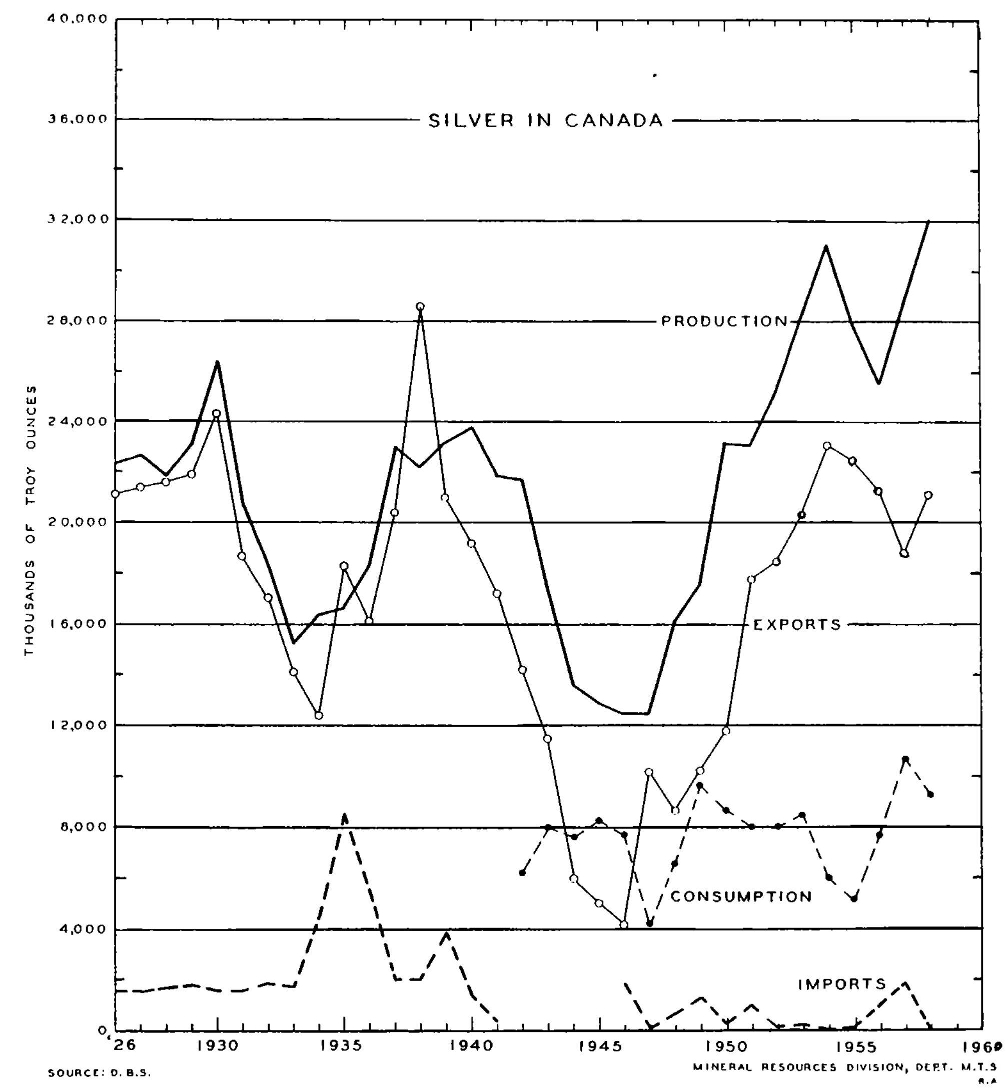
	1958		1957	
	Troy Ounces	$	Troy Ounces	$
Silver bullion				
United States	15,428,386	13,749,848	12,078,820	11,038,340
West Germany......	598,039	529,259	721,170	653,123
Other countries.....	125	489	-	-
Total	16,026,550	14,279,596	12,799,990	11,691,463
Manufactures				
United States		25,784		28,154
Other countries.....		4,175		4,208
Total		29,959		32,362
Imports				
Unmanufactured				
United Kingdom.....	2,100	1,858	2,754	2,428
United States	601	524	1,856,377	1,630,621
Total	2,701	2,382	1,859,131	1,633,049
Manufactured articles of silver including toilet articles of sterling				
United Kingdom.....		398,020		435,507
United States		185,684		195,407
Denmark...........		35,410		35,191
West Germany......		26,398		30,227
Other countries.....		30,985		19,625
Total		676,497		715,957

Silver - Production, Trade and Consumption 1948-58
(troy ounces)

	Production		Exports			Imports	Consumption[b]
	All Forms[a]	Refined Silver	In Ore and Concentrates	In Bullion	Total	Unmanufactured	
1948	16,109,982	12,185,643	3,294,691	5,434,364	8,729,055	717,817	6,559,028
1949	17,641,493	13,844,336	4,054,614	6,211,912	10,266,526	1,332,713	9,746,710
1950	23,221,431	19,435,644	3,494,107	8,355,183	11,849,290	341,605	8,668,866
1951	23,125,825	23,177,138	2,413,288	15,381,276	17,794,564	1,050,299	7,973,635
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

(a) 1. Recoverable silver in ores, concentrates and matte shipped for export.
2. Silver in crude gold bullion produced.
3. Silver in blister and anode copper made at Canadian smelters.
4. Silver in base bullion made by The Consolidated Mining and Smelting Company of Canada Limited at Trail, B. C.
5. Silver bullion produced from the treatment of cobalt-silver ores.

(b) Includes consumption for coinage.


SILVER IN CANADA
PRODUCTION
EXPORTS
CONSUMPTION
IMPORTS
THOUSANDS OF TROY OUNCES
40,000
36,000
32,000
28,000
24,000
20,000
16,000
12,000
8,000
4,000
0
'26
1930
1935
1940
1945
1950
1955
1960
SOURCE: D.B.S.
MINERAL RESOURCES DIVISION, DEPT. M.T.S.

recovered in lead and, to a lesser extent, in zinc concentrates, and 287,205 ounces were recovered in cyanide precipitates. Mill feed totalling 175,058 tons was derived from the Calumet and Hector mines and from development operations in the Elsa and Keno mines. A small amount of ore from dumps was treated. The cyanide plant, closed since 1954, was reopened in March to treat flotation tailings, which carried higher silver values owing to the increased tonnage of oxidized ore from the Calumet mine.

Northwest Territories

The small production came from four gold mines in the Yellowknife area.

British Columbia

The Consolidated Mining and Smelting Company of Canada Limited, Canada's largest producer of refined silver, recovered 12,875,160 ounces from lead-zinc smelting and refining operations at Trail. The company operated three base-metal mines during the year, the principal source of silver being the Sullivan lead-zinc-silver mine at Kimberley, from which 2,443,844 tons of ore were extracted in 1958. Ore production from the Bluebell lead-zinc mine, at Riondel, was 255,859 tons, and from the H.B. zinc-lead mine near Salmo, 458,213 tons. Silver was recovered also from domestic and foreign custom ores and concentrates, the principal custom shippers being in British Columbia and Yukon Territory.

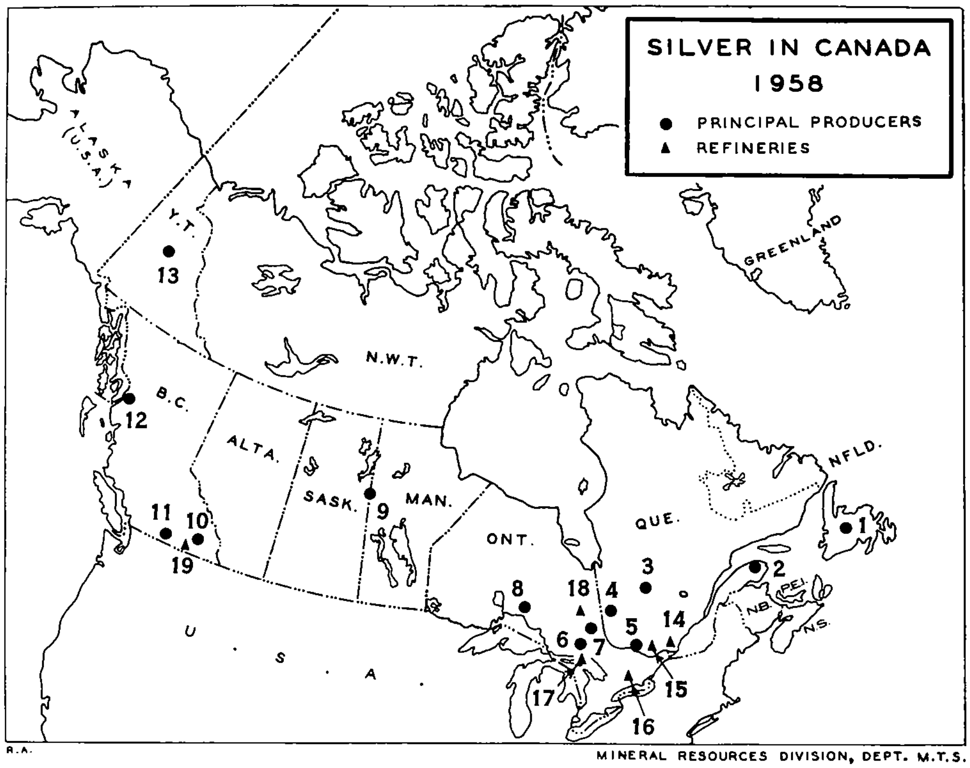
Torbrit Silver Mines Limited milled 135,892 tons of ore from its silver-lead mine near Alice Arm. From this ore were produced 1,331,088 ounces of silver in concentrate and bullion. Ore reserves at the end of 1958 were 45,582 tons grading 12.5 ounces of silver per ton.

Highland-Bell Limited, at Beaverdell, milled 18,729 tons of silver-lead-zinc ore and recovered 900,669 ounces of silver in lead and zinc concentrates. Output in 1957 was 716,546 ounces from 15,779 tons milled.

ViolaMac Mines Limited produced silver-lead-zinc ore from the Victor mine, near Sandon. The ore was treated in the 250-ton mill of a subsidiary, Carnegie Mining Corporation Limited. Silver production in ores and lead and zinc concentrates was 218,755 ounces.

Sheep Creek Mines Limited milled 192,426 tons of zinc-lead ore grading 0.5 ounce of silver per ton.

Silver Standard Mines Limited, near Hazelton, carried out salvage operations until May, and then shut down its 80-ton mill. In the fiscal year ended on March 31, 1958, the mill treated 20,169 tons of silver-lead-zinc ore, from which 706,912 ounces of silver were recovered in lead and zinc concentrates.



Producers

1. Buchans Mining Company Limited
2. Gaspe Copper Mines Limited
3. Campbell Chibougamau Mines Ltd.
   Opemiska Copper Mines (Quebec) Limited
4. Manitou-Barvue Mines Limited
   East Sullivan Mines Limited
   Noranda Mines, Limited
   Quemont Mining Corporation Limited
   Waite Amulet Mines Limited
   Normetal Mining Corporation Limited
5. New Calumet Mines Limited
6. Silver-Miller Mines Limited
   Agnico Mines Limited
   Nipissing-O'Brien Mines Limited
   Langis Silver & Cobalt Mining Company Limited
   Castle-Trethewey Mines Limited
   Siscoe Metals of Ontario Limited
7. International Nickel Company of Canada, Limited, The
   Falconbridge Nickel Mines Limited
8. Geco Mines Limited
   Willroy Mines Limited
9. Hudson Bay Mining and Smelting Co. Limited
10. Consolidated Mining and Smelting Company of Canada Limited, The (Bluebell and Sullivan mines)
    Sunshine Lardeau Mines Limited
    ViolaMac Mines Limited
    Yale Lead and Zinc Mines Limited
11. Highland-Bell Limited
12. Torbrit Silver Mines Limited
13. United Keno Hill Mines Limited

Refineries

14. Canadian Copper Refiners Limited
15. Royal Canadian Mint
16. Deloro Smelting and Refining Co. Ltd.
17. International Nickel Company of Canada, Limited, The
18. Hollinger Consolidated Gold Mines, Limited
19. Consolidated Mining and Smelting Company of Canada Limited, The

In May, Sunshine Lardeau Mines Limited, near Camborne, completed the mining of available lead-zinc-silver ore and shut down its 75-ton mill. In the fiscal year ended on October 31, 1958, the mill treated 16,443 tons grading 11.5 ounces of silver per ton, with lead and zinc. In addition, 671 tons of high-grade ore, grading 51.9 ounces of silver per ton, were shipped for direct smelting. Leasing operations continued until September, when all production stopped.

Yale Lead and Zinc Mines Limited, at Ainsworth, recovered 92,494 ounces of silver from the milling of 51,480 tons of lead-zinc-silver ore. Mining was suspended in December, but the mill continued to operate, treating custom ore.

Western Exploration Co. Ltd. closed its 250-ton mill at Silverton in December, but development work continued at the company's mining properties near Silverton.

Silver was also recovered from lead-zinc ores by Canadian Exploration Limited, near Salmo; Reeves MacDonald Mines Limited, at Remac; Carnegie Mining Corporation Limited, at Sandon; Lajo Mines Limited, at Kaslo; Slocan Van Roi Mines Limited, at Silverton; and several other operators, mostly in the Slocan mining division, who mined small quantities of high-grade ore.

Some production was obtained from copper ores by Britannia Mining and Smelting Company Ltd., at Howe Sound, which suspended operations in March, and by Cowichan Copper Company Limited, on Vancouver Island.

The rest of the output was by-product silver from gold operations.

Manitoba and Saskatchewan

Most of the output was derived from the copper-zinc mines of the Flin Flon area operated by Hudson Bay Mining and Smelting Co. Limited, which produced 1,593,329 ounces of silver contained in blister copper. The remainder was a by-product of operations of Sherritt Gordon Mines Limited at Lynn Lake in northern Manitoba and of gold mines at Rice Lake and Snow Lake.

Ontario

About 50 per cent of the province's output comes from the silver-cobalt mines of the Cobalt-Gowganda area. Most of these ores and concentrates pass through the sampling plant of Temiskaming Testing Laboratory, at Cobalt, and are then shipped to the refinery of Deloro Smelting and Refining Co. Ltd., at Deloro. Shipments made by Temiskaming Testing Laboratory in 1958, which do not necessarily reflect the total production of the companies listed, were as follows:

Silver-ore Shipments	Silver Bullion (ounces)	Silver Content of Concentrates (ounces)
Agnico Mines Limited	277,582	626,286
Castle Trethewey Mines Limited	41,503	498,497
Coballoy Mines and Refiners, Limited	7,577	10,564
Langis Silver & Cobalt Mining Company Limited	55,407	474,055
R. C. McAllister	677	4,233
R. Mercier		1,087
Nipissing-O'Brien Mines Limited	32,918	206,934
Ontario Mining Association	3,434	
J.H. Price	506	1,044
Quebec Metallurgical Industries Ltd.		15,626
Silver-Miller Mines Limited	206,977	551,327
Siscoe Metals of Ontario Limited	170,539	894,901
Temiskaming Testing Laboratory	19,431	243
Total	816,551	3,284,797
Cobalt-ore Shipments		
Quebec Metallurgical Industries Ltd.		17,462

The International Nickel Company of Canada, Limited, at Copper Cliff, recovered 1,155,000 ounces of silver from the treatment of nickel-copper ores.

Two new copper-zinc mines at Manitouwadge were in production in 1958 for their first full year. Geco Mines Limited milled 1,286,129 tons and recovered 1,498,296 ounces of silver in copper concentrates. Willroy Mines Limited treated 330,982 tons of zinc-copper-lead ore and recovered 14,000 tons of copper concentrate containing approximately 40 ounces of silver per ton, and 3,000 tons of lead concentrates containing approximately 60 ounces of silver per ton.

The rest of the Ontario production came from Falconbridge Nickel Mines Limited, Coldstream Copper Mines, Limited, Temagami Mining Co. Limited and numerous lode-gold mines.

Quebec

The production is all by-product and comes mainly from copper ores. Copper concentrates shipped to Noranda are converted into anode copper along with Noranda ores; the anode copper is refined at Canadian Copper Refiners Limited, Montreal East, where the silver is recovered.

Other amounts are recovered from the blister copper produced by Gaspe Copper Mines Limited and refined by Canadian Copper Refiners at Montreal East, and in lead and zinc concentrates obtained from several mines and shipped abroad for refining.

The principal producers in 1958 were: Noranda Mines, Limited; Manitou-Barvue Mines Limited; Normetal Mining Corporation, Limited; Quemont Mining Corporation Limited; East Sullivan Mines Limited; and Waite Amulet Mines Limited - all in the Noranda-Val d'Or area of western Quebec; New Calumet Mines Limited, 60 miles northwest of Ottawa; Gaspe Copper Mines Limited, at Murdochville; and, in the Chibougamau area, Opemiska Copper Mines (Quebec) Limited, Anacon Lead Mines Limited, Campbell Chibougamau Mines Ltd.; and Merrill Island Mining Corporation Ltd.

Some silver was obtained as a by-product from the lode-gold mines of western Quebec.

New Brunswick

Heath Steele Mines Limited, the only producer, closed its 1,500-ton mill and base-metals mine near Newcastle in March, owing to low metal prices.

Newfoundland

The Buchans unit of American Smelting and Refining Company produced silver contained in base-metal concentrates, which were exported for treatment. The mill treated 389,000 tons of zinc-lead-copper ore in 1958, 18,000 tons more than in 1957.

Developments at Other Properties

Manitoba

Hudson Bay Mining and Smelting Co. Limited continued development of the Chisel Lake zinc-copper-lead orebody 70 miles east of Flin Flon. The shaft was deepened during the year to 1,163 feet below the surface, and lateral development began on four levels. This deposit contains 3,832,400 tons grading 1.96 ounces of silver per ton.

Quebec

Exploration of the Watson Lake zinc-copper deposit, held by Mattagami Lake Mines Limited, was continued under an option by Noranda Mines Limited, Canadian Exploration Limited and McIntyre Porcupine Mines Limited. Extensive diamond-drilling indicated 20 million tons averaging 13 per cent zinc, 0.7 per cent copper and 1.3 ounces of silver per ton.

Development of the Bachelor Lake deposit held by The Coniagas Mines Limited and containing 407,310 tons of zinc-silver-lead ore grading 8.8 ounces of silver per ton, was suspended owing to low metal prices.

New Brunswick

Brunswick Mining and Smelting Corporation Limited in March suspended development of its zinc-lead-copper deposits near Bathurst, which contain more than 57 million tons averaging 1.8 ounces of silver per ton.

In mid-year, Nigadoo Mines Limited discontinued mine development at its base-metal property 14 miles northwest of Bathurst.

Domestic Consumption

Owing to a moderately decreased use of silver in coinage and in the more important industrial outlets, the consumption of silver in Canada declined by 13 per cent in 1958.

	Troy Ounces	
	1958	1957
Coinage	4,662,224	4,886,118
Silverware	1,509,971	1,896,116
Plating	1,118,390	1,662,213
Photography	1,306,300	1,493,484
Wire and rod	338,721	224,536
Grain	-	120,301
Brazing alloys	85,001	80,779
Lead-silver alloys	6,292	9,258
Sheet	2,116	638
Miscellaneous	270,794	356,812
Total	9,299,809	10,730,255

Prices

The Canadian price of silver was 88.63 cents an ounce at the beginning of 1958. It fluctuated considerably throughout the year and declined to a low of 85.25 cents at the end of July. The high for the year, 89.38 cents, was reached in January. The year-end price was 87 cents an ounce. The average price for the year was 86.87 cents an ounce.

TIN

W.H. Jackson

Tin ores are not smelted in Canada. For this reason all the virgin metal consumed by Canadian industry must be imported, the greater part being obtained from smelters in Belgium, Malaya and the Netherlands.

Imports of metallic tin amounted to 3,461 long tons,* 17 per cent less than in 1957. The decline resulted from a reduction in the demand of consuming industries, which used 3,622 tons in 1957 but only 3,293 tons in 1958. The percentage distribution of consumption by main end use is as follows: tinplate, 35.7; tinning, 15.1; solder, 35.6; babbitt, 6.9; bronze, 3.5. The remainder was used for various purposes, including the manufacture of foil and collapsible tubes.

Production and Exploration in Canada

For many years the only producer of tin concentrate in Canada has been The Consolidated Mining and Smelting Company of Canada Limited. Output is derived from the Sullivan mine at Kimberley, British Columbia. The complex lead-zinc ores at this mine contain a small amount of cassiterite, which remains with the zinc until the final stages of the mill recovery process. After the iron sulphides are removed by flotation, the tailings from the zinc circuit are passed through a series of blanket concentrators and shaking tables to produce a marketable tin concentrate. Production of tin in concentrate from this source amounted to 355 tons in 1958, a small increase over the 1957 output. Since 1952, the concentrate has been shipped abroad for refining, and no tin concentrates are now smelted in Canada.

Cassiterite, the tin mineral most commonly found in Canada, occurs in the marginal phases of certain granitic intrusives, in veins and pegmatites associated with such intrusives, in placers and as a minor constituent in some lead-zinc ores. Although most of the known occurrences have been sporadically examined by the mining industry, particularly during the war years, no workable deposit has yet been found in Canada. During the past year, one company drilled and sampled a portion of its claim group in the New Ross area of Nova Scotia. Nothing of economic significance resulted. Other than this, there has been little recorded exploration for tin.

*Long tons (2,240 pounds) are used in this review.

Tin - Production, Imports and Consumption

	1958		1957	
	Long Tons	$	Long Tons	$
Production				
Tin content of tin concentrates shipped and tin content of lead-tin alloy produced	355	625,260	317	580,342
Imports				
Blocks, pigs, bars				
Belgium	970	1,939,432	1,059	2,170,851
Malaya	937	1,951,603	1,510	3,098,599
Netherlands	740	1,517,147	680	1,390,987
United States	426	881,920	463	978,809
United Kingdom	253	511,326	342	704,204
West Germany	80	153,681	101	195,291
China	50	95,684	-	-
Hong Kong..................	5	9,594	-	-
Total	3,461	7,060,387	4,155	8,538,741
Tin plate				
United Kingdom	3,371	737,104	3,486	730,667
United States	2,589	540,475	1,398	314,882
Total	5,960	1,277,579	4,884	1,045,549
	Pounds		Pounds	
Tin foil				
United States	20,786	22,956	15,031	15,488
United Kingdom	183	141	1,229	1,092
Total	20,969	23,097	16,260	16,580
Babbitt metal				
United States	18,300	16,442	32,600	27,321
United Kingdom	4,100	3,023	4,500	2,773
Total	22,400	19,465	37,100	30,094
	Long Tons		Long Tons	
Consumption (virgin tin)				
Tin plate..................	1,176		1,275	
Tinning	497		559	
Solder	1,172		1,268	
Babbitt.....................	230		248	
Bronze	117		157	
Foil	6		13	
Collapsible tubes...........	20		12	
Galvanizing.................	14		14	
Other uses	61		76	
Total	3,293		3,622	

Tin - Production, Imports and Consumption, 1948-58
(long tons)

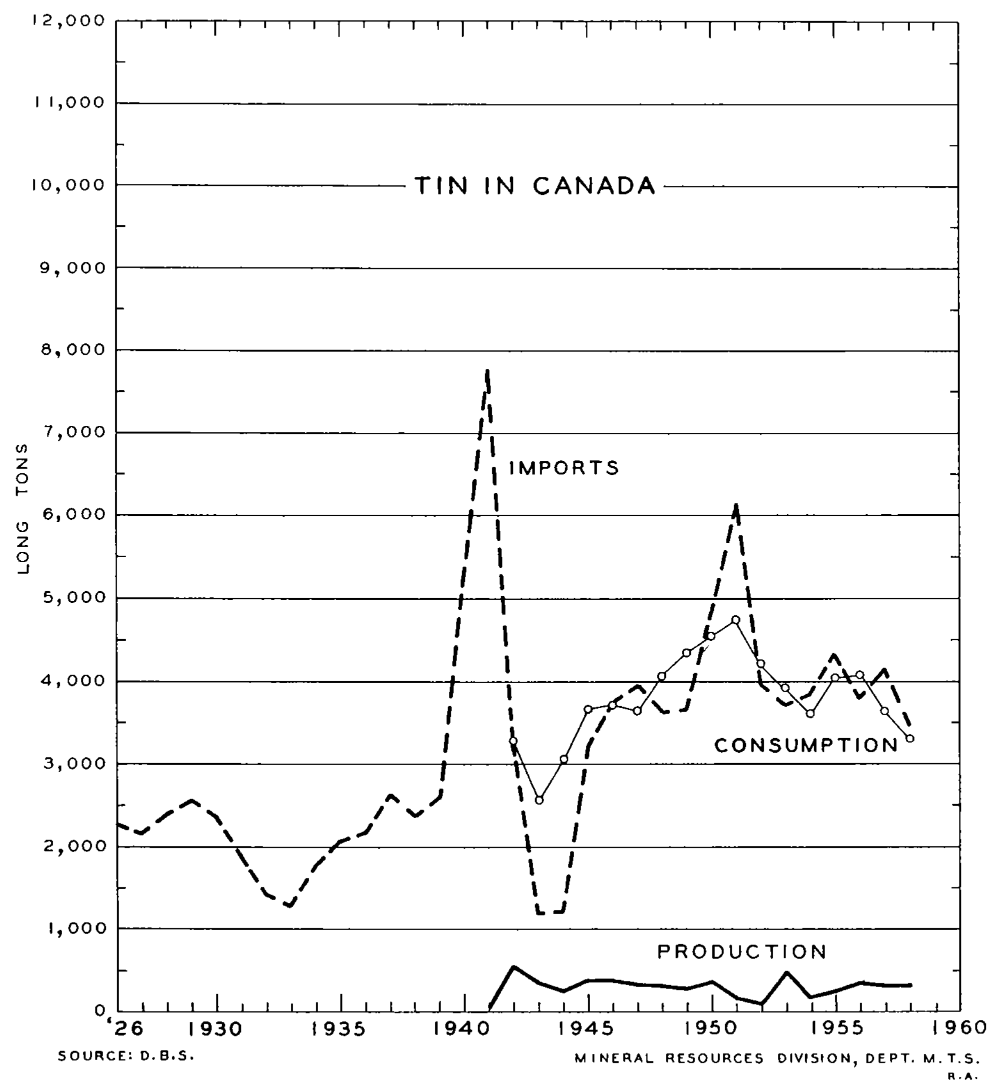
	Production	Imports				Consumption
	Concentrate	Blocks, Pigs, Bars	Tin Foil	Babbitt Metal	Tin Plate	Virgin Tin
1948	309	3,598	1	21	43,604	4,046
1949	276	3,676	3	39	23,027	4,318
1950	356	4,817	15	60	1,488	4,526
1951	155	6,135	4	13	1,531	4,731
1952	95	3,949	1	18	1,287	4,190
1953	287	3,702	7	22	6,442	3,968
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

World Mine Production and Developments

The greater part of world tin supplies comes from relatively underdeveloped countries whose economic prosperity depends largely on their ability to sell tin on a sustained basis. Grades of ore mined vary with the type and mineralogy of the deposits as well as the geographical location. At Catavi, Bolivia, for example, ore grading as low as 0.76 per cent is mined by block-caving methods. Selective mining of veins, however, might require a grade of up to 3 per cent tin. In Malaya, favourably located with respect to smelters, placer operations recover 0.25 to 1 pound of cassiterite per cubic yard depending upon the size of the operation and the influence of price on ore reserves.

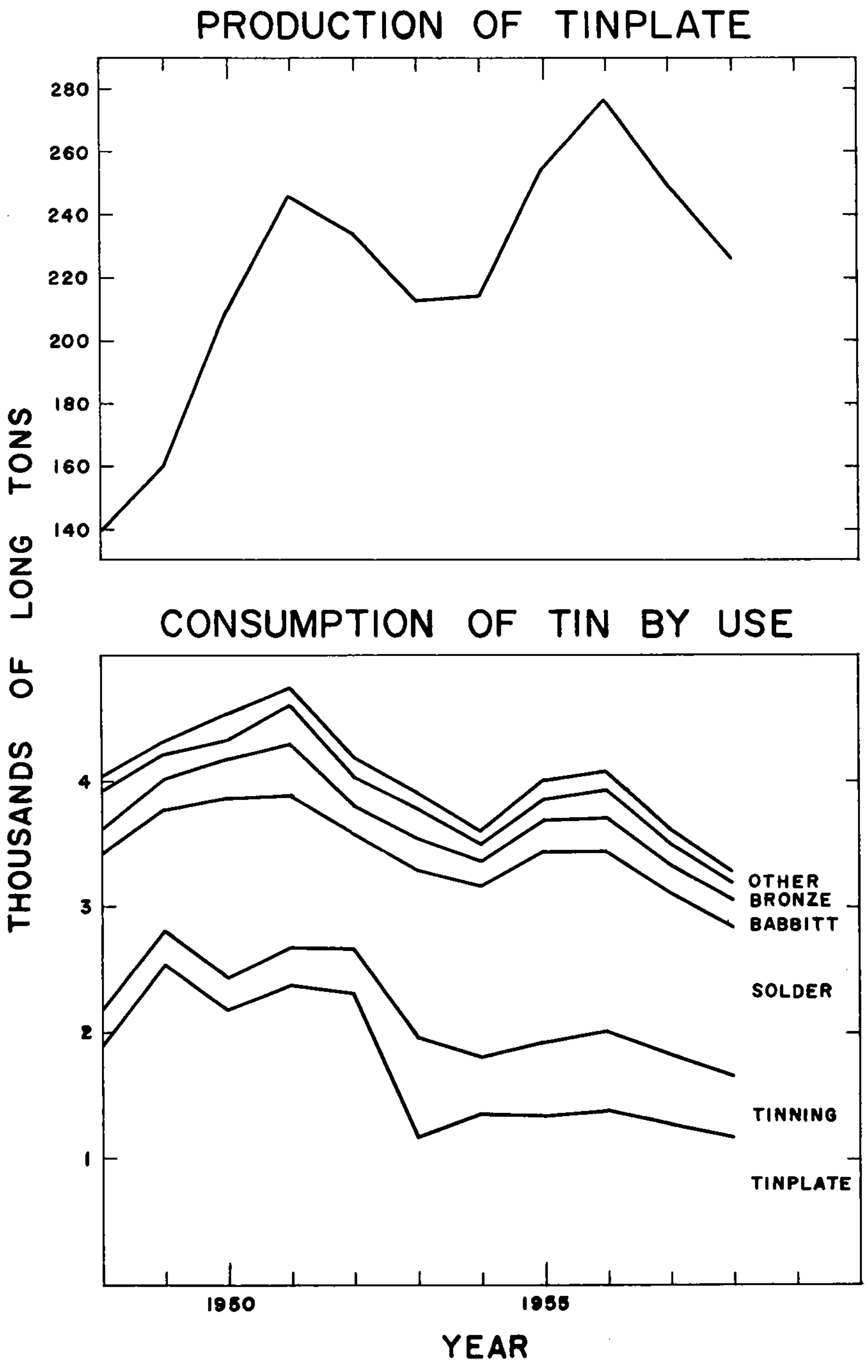
Estimates which exclude the Soviet Union's output place world production of tin-in-concentrates for 1958 at 135,000 tons. The comparable total for 1957 was 180,000 tons. This decline was caused mostly by cutbacks in producing countries signatory to the International Tin Agreement that have made a determined effort to achieve a balance between supply and demand. The 1958 production of these countries decreased to 104,500 tons from the 152,200 tons produced in 1957. World consumption of primary tin metal, as estimated from statistics published by the International Tin Council, again declined in 1958, when it amounted to 147,500 tons. The totals for 1957 and 1956 were respectively 155,000 and 160,500 tons.

The International Tin Agreement has been in operation for two years. Its objectives are to prevent excessive fluctuations in the price of tin, to



achieve reasonable stability of price and to ensure adequate supplies of tin at all times. Administration of the Agreement is vested in the International Tin Council, wherein decisions regarding price or export control may be decided by majority votes of producers and consumers. Canada, together with 13 other consuming and six producing countries, is a member of the Council. In 1958, the determination of Council members to hold to the minimum agreed price was severely tested. Despite the 40-per-cent reduction in the export quotas allowed producing members and the operations of the Buffer Stock Manager on the London market, the decline in manufacturing activity in the West combined with the unexpected impact of good-quality Russian tin on the London market kept prices close to the floor of £730 a ton. The funds available to the International Tin Council for accumulating a buffer stock became depleted after the purchase of 23,300 tons, and a special fund was set up to maintain the

CANADA



SOURCE D.B.S., I.T.C.

market. For the fourth quarter of 1958 the permissible export quota was set at 20,000 tons. This meant a 48-per-cent cutback in production on the part of producing members.

On August 29, the United Kingdom imposed licensing and import restrictions on Russian tin to the same extent as on producer members of the Agreement. Other countries, including Canada, also implemented restrictions that were still in effect at year-end. Notwithstanding these actions taken independently and outside of the formal working arrangements of the Agreement, the Buffer Stock Manager withdrew his support of the floor price on September 18. A sharp drop followed, but a week later the market had recovered. In December, prices were hovering at £750 a ton, or some £20 above the floor price. This indicated that supply was under control and that the Agreement is a useful means of controlling prices.

Uses and Consumption

The strategic value of tin had long been recognized by industry when, in World War II, continuing research was initiated to restrict its use to those purposes for which there was no available economic substitute. The postwar fruition of these efforts has affected many traditional uses of tin. The most familiar example is the change to aluminum for collapsible tubes and foils. Improved technology has resulted in the partial displacement of hot-dipped by electrolytic tin plate. This has made it possible to economize in the use of tin and, at the same time, to increase the production of plate. The development of lacquers suitable for use in the interior of cans has also materially decreased the use of tin in some food-canning applications. Counterbalancing this trend is the continued rise in world demand for products containing tin. The effects of these developments on Canadian industry are shown in the graphs on page 210 which indicate the production of tin plate and the cumulative consumption of tin by end use.

Where a durable, corrosion-resistant finish is required on fabricated metal, tinning cannot be excelled. It is also becoming an increasingly important end use in the manufacture of wire for electrical conductors, as it improves conductivity by reducing surface effects. As is evident from a comparison of the consumption figures on page 208 with the import figures on page 208, Canadian demand for tin products other than virgin tin can be filled largely from Canadian manufactures. The demand for tin alloys varies with business conditions. Solder in particular is sensitive to changes in the demand for a wide variety of durable goods, especially those connected with the electronics and construction industries.

Research by industry and by the Tin Research Institute is continually improving tin technology and developing new uses for the metal. Among the more interesting recent developments are: the use of organo-tin compounds as fungicides; the direct chloride process for hot-tinning cast iron; a method of bonding aluminum-tin alloys to steel for use in bearings; bright-surfaced electroplated tin; and the use of tin-nickel plating on watch parts.

Many companies consume tin metal or alloys in Canada. The tabulation on this page shows only the main consumers and the products with which they are concerned.

Tin plate	Tinning	Solder	Babbitt	Bronze	Foil	Collapsible Containers	Main Users of Tin in Canada
x							Dominion Foundries and Steel Limited
x							Steel Company of Canada, Limited, The
	x						General Steel Wares Limited
	x						Canada Wire and Cable Company Limited
	x						Northern Electric Company Limited
	x						Phillips Electrical Company Limited
	x						Canadian Pacific Railway Stores Department
	x						Casavant Frères Ltée
		x	x				Federated Metals Canada Limited
		x	x	x			Canada Metal Company Limited, The
		x					Kester Solder Co. of Canada Limited
		x					Metals and Alloys Limited
				x			Anaconda American Brass Limited
				x			Noranda Copper and Brass Limited
				x			McKay Smelters Limited
					x		Canada Foils Limited
						x	Sun Tube Corporation of Canada Limited

Prices

Canada

The Canadian price of Straits tin f.o.b. Montreal was 93.62 cents a pound at the beginning of the year. At year-end the price was 101.77 cents, having declined from the year's high of 102.17 in early December. The average price for 1958 was 96.7 cents a pound.

United States

The New York price for Straits tin ranged between a low of 91.75 cents a pound at the beginning of the year to a high of 99.5 at the end of November. The year-end price was 99 cents. The average for the year was 95 cents a pound.

World

The average monthly price of cash tin on the London market varied between a low of £718.1 in September and a high of £756.4 in December. For most of the year, prices were close to the floor price of £730.

The price of tin metal is normally determined by trading on the Singapore, London and New York markets. Tin prices fluctuate daily depending on considerations of supply and demand. There is usually, in addition, a price differential between these markets owing to handling and transportation charges, though fluctuating demand for a particular quality of tin may cause an imbalance. To these marketing factors must be added the manipulations of the Buffer Stock Manager, whose actions may only be speculated upon and who may operate on any of the three commodity exchanges.

Prices on the world commodity exchanges for January 13, 1959, in United States cents per pound, were as follows: Singapore - Ex-works, 94.36; London - Cash, 94.59; New York - Prompt, 98.87. The Canadian price for Grade A Spot on the same day was 102 cents a pound. Handling charges plus the increased cost of transportation in winter account for the differential between the New York and the Toronto-Montreal price.

Tariffs

Canada

	British Preferential	Most Favoured Nation	General
Tin in blocks, pigs, bars or granular form for use in Canadian manufacture	free	free	free
Tin-strip waste and tin foil	"	"	"
Phosphor tin and phosphor bronze in blocks, bars, plates, sheets and wire	5%	7 1/2%	10%
Oxide of tin	free	15%	15%
Sheet or strip of iron or steel, corrugated or not and whether or not with rolled surface pattern, coated with tin	10%	15%	25%
Sheet or strip of iron or steel coated with lead or with an alloy of lead and tin	free	free	15%
Bichloride of tin and tin crystals	"	10%	10%

United States

Tin and/or black oxide of tin	free
Tin in bars, blocks and pigs, and alloys of tin not separately provided for in which tin is the chief value; grain or granulated scrap tin (including scrap tin plate)	"
Tin foil under 0.006 inch thick	35%
Powdered tin	12¢ per lb
Tin plate, taggers tin	0.8¢ per lb
Terneplate	1¢ per lb
Chemical compounds and mixtures of tin	12 1/2%

TITANIUM

V. B. Schneider

The Canadian titanium industry is based mainly on the mining of ilmenite for the production of titanium-dioxide slag used in making pigments and, to a minor degree, as heavy aggregate. Ilmenite is mined in the Allard Lake and St. Urbain areas and, in Beresford township, all in Quebec. Most of the Allard Lake ore is smelted at Sorel, Quebec, to produce slag containing about 71.5 per cent TiO_2 and 'Sorelmetal'. Most of the slag is exported to the United States to be used as raw material for the manufacture of titanium-base pigment. Some is shipped to Canadian Titanium Pigments Limited at Varennes, Quebec. The consumption of ilmenite used as heavy aggregate is mostly domestic, but small amounts are exported to the United States.

During 1958, the demand for titanium-bearing slag used by the pigment industry declined. Quebec Iron and Titanium Corporation (QIT) suspended its electric smelter operations at Sorel on October 1. Mining operations at Lac Tio (in the Allard Lake area) and shipping from Havre St. Pierre to Sorel were suspended in November.

Shipments of ilmenite amounting to approximately 150,000 tons* for heavy-aggregate use were reported by QIT, Continental Iron and Titanium Mining Limited and Heavy Rock Mines Ltd. Heavy aggregate is used as a protective material for nuclear reactors, as a weighting material (filler) in the coating applied to oil- and gas-transmission lines and as locomotive ballast. The value of aggregate varies according to size and specific gravity but is in the order of $7 per ton f.o.b. shipping point.

Production and Development in Canada

Canadian Titanium Pigments Limited

This company, a subsidiary of National Lead Company of the United States, operates the only plant in Canada that manufactures titanium-base pigments. Its plant at Varennes, Quebec, operated continuously during 1958, producing rutile- and anatase-type titanium-oxide pigments. Production was not at full capacity, however, owing to a reduction in exports and domestic demand. Slag from Sorel and molten sulphur recovered from refinery gases at Montreal East made up the raw materials for pigment manufacture.

*Short tons (2,000 pounds) unless otherwise specified.

Titanium - Production and Trade

	1958		1957	
	Short Tons	$	Short Tons	$
Production (shipments)				
Ilmenite				
Ore received at Sorel from Havre St. Pierre	...		813,662	
Ore shipped from St. Urbain area and Allard Lake	-		10,770	
Total ore shipped	...		824,432	
Ore treated at Sorel	...		635,067	
Titanium-dioxide slag produced from Allard Lake ilmenite at the Sorel smelter	...		258,920	
Titanium-dioxide content of slag	...	6,575,077	186,422	9,740,570
Exports				
Titanium-dioxide slag				
United States	72,168	2,910,586	185,032	7,855,779
Japan	25,572	1,050,272	26,390	1,265,916
Italy	-	-	11,201	438,958
Other countries	14,676	572,744	458	21,200
Total	112,416	4,533,602	223,081	9,581,853
Imports				
Titanium oxide and pigments containing not less than 14% titanium oxide				
United States	18,550	3,814,991	22,875	6,070,811
United Kingdom	10,888	4,649,207	11,359	4,711,732
Other countries	1	492	864 (lb)	296
Total	29,439	8,464,690	34,234	10,782,839

... Not available for publication.
- Nil.

Production of Ilmenite and Titanium-dioxide Slag
and Imports of Titanium Oxide and Pigments, 1948-58

(short tons)

	Production		Imports
	Ilmenite(1)	Titanium-dioxide Slag (TiO2 content)(2)	Titanium Oxide and Pigments(3)
1948	4,441	-	19,646
1949	540	-	20,793
1950	101,970	1,596	27,125
1951	373,786	14,123	29,648
1952	266,461	30,805	24,205
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	(4)	(4)	29,439

(1) Ilmenite shipped from Allard Lake to Sorel and from the St. Urbain area to customers.
(2) Titanium-dioxide content of titanium slag produced at Sorel from Allard Lake ilmenite.
(3) Containing not less than 14% TiO_2.
(4) Not available for publication.

Quebec Iron and Titanium Corporation

Quebec Iron and Titanium Corporation, the sole Canadian producer of titanium-dioxide (TiO_2) for pigment manufacture, completed its expansion program at Sorel, begun in 1957. Three new furnaces, each of about 20,000-kilowatt capacity, have been added to the existing five. Auxiliary facilities installed included an enlarged by-product gas-handling system, improved slag-cooling and slag-handling facilities, a new 600-foot dock extension with loading and unloading tower, and increased water-pumping capacity. The first of the three new furnaces, placed in operation in December 1957, operated continuously until the October shut-down. The heating and charging of the other new furnaces was deferred until 1959. The completion of these new furnaces is expected to increase capacity to about 400,000 tons of TiO_2 and 290,000 tons of Sorelmetal (remelt iron) a year.

QIT owns one of the world's largest known reserves of ilmenite. It consists of about 150 million tons, averaging 35 per cent TiO_2 and 40 per cent iron and is situated in the Allard Lake area of Quebec, about 22 miles north of Havre St. Pierre, the company's shipping point on the north shore of the Gulf of St. Lawrence, about 500 miles downriver from the Sorel smelter site.

At Sorel, ore from Allard Lake is crushed, sized for concentration in either Dutch State Mine cyclones or Humphrey spirals and calcined in rotary kilns to eliminate sulphur. Electric smelting of this product, in arc furnaces with powdered anthracite coal, yields a slag containing about 71.5 per cent TiO_2 and an iron containing approximately 2 per cent carbon and 0.035 per cent sulphur. Processing refinements made it possible to produce additional grades of iron with carbon content ranging above 4 per cent.

Production figures for 1957 and 1958 are listed in the following table:

	Gross Tons	
	1958	1957
Ore shipped from Havre St. Pierre to Sorel	402,449	726,518
Ore smelted	340,195	560,049
TiO_2 slag produced	144,029	231,179
TiO_2 slag shipped	94,305	234,713
TiO_2 content of slag shipped	67,428	165,500
Desulphurized iron produced	105,248	167,437
Desulphurized iron shipped	100,837	169,397
High-sulphur iron shipped	127	-

Continental Iron and Titanium Mining Limited

This company, formed in 1955, holds mining rights in the St. Urbain area on the Bignell, General Electric, East and West Coulombe, and Furnace deposits. The St. Urbain area is about 8 miles north of Baie St. Paul on the north shore of the St. Lawrence River, 60 miles downriver from Quebec city.

The bulk of the 1958 shipments of 123,370 tons valued at $840,914 came from the Bignell mine; the remainder, from the Furnace mine. The company estimates its ore reserves in the St. Urbain area at 20 million tons of ilmenite.

Continental reports that it plans to construct a pilot plant in 1959 to investigate a newly developed process for the production of titanium dioxide of rutile grade.

Heavy Rock Mines Ltd.

Heavy Rock Mines Ltd., incorporated by Quebec charter on July 21, 1958, operates the 'Ivry' mine, which is approximately 45 miles northwest of Montreal in Beresford township, Terrebonne county, Quebec. During 1958, the company shipped 26,119 tons of ilmenite for use as heavy aggregate.

World Production of Titanium Ores and Concentrates

Titanium is one of the five or six most common metals in the earth's outer crust. Only two titanium minerals, however, are considered to be of commercial importance - ilmenite and rutile. Ilmenite ($FeTiO_3$) theoretically contains a maximum of 53 per cent titanium dioxide (TiO_2), and rutile (TiO_2) theoretically contains 100 per cent. Sphene ($CaTiSiO_5$), also called titanite, contains up to 41 per cent TiO_2; it is mined in the Kola peninsula of Russia.

By far the greatest percentage of ilmenite produced is used in the manufacture of TiO_2 for pigments. Pigment-grade TiO_2 is manufactured principally by treating ilmenite with sulphuric acid, removing the iron and grinding the titanium component to pigment size. Ilmenite mined by QIT does not lend itself to this process because hematite is finely disseminated throughout the ilmenite and cannot be removed by standard ore-dressing methods. At Sorel, by a pyrometallurgical process, the iron is separated from the ilmenite and associated hematite as molten metal, the remaining ingredients being contained in the slag.

The following tables show the major countries producing rutile and ilmenite concentrates in 1956, 1957 and 1958 and the consumption of titanium concentrates in the United States in 1958.

Production of Rutile Concentrates
(short tons)

	1958	1957	1956
Australia	92,900(e)	144,372	108,434
United States	7,406	10,702	11,997
Other countries	2,444	1,126	1,769
Total	102,750	156,200	122,200

Source: U. S. Bureau of Mines, Minerals Yearbook, 1958.

Production of Ilmenite Concentrates
(short tons)

	1958	1957	1956
United States	563,338	757,180	684,956
India	346,080	331,520	375,861
Canada*	144,029	231,179	195,156
Norway	233,585	231,693	209,990
Malaya	83,806	102,742	136,837
Finland	117,384	116,568	113,444
Other countries	222,678(e)	201,168(e)	75,306
Total	1,710,900	1,972,050	1,791,550

*Production of slag containing 72% TiO_2. (e) Estimate.
Source: Dominion Bureau of Statistics and U.S. Bureau of Mines, Minerals Yearbook, 1958.

Consumption of Titanium Concentrates in the United States in 1958, by Products

(thousands of short tons)

Product	Ilmenite(1)		TiO_2 Slag		Rutile	
	Gross Weight	Est. TiO_2 Content	Gross Weight	Est. TiO_2 Content	Gross Weight	Est. TiO_2 Content
Pigments (mfg. TiO_2)(2)	726.66	376.73	116.09	81.85	-	-
Titanium metal	(3)	(3)	(4)	(4)	7.88	7.52
Welding-rod coatings	0.67	0.39	0.94	0.68	11.00	10.38
Alloy and carbide	4.05	2.62	(4)	(4)	0.61	0.59
Ceramics	0.02	0.01	-	-	0.38	0.36
Fiberglass	-	-	-	-	0.87	0.85
Miscellaneous(5)	0.02	0.01	0.55	0.41	0.94	0.88
Total	731.42	379.76	117.58	82.94	21.68	20.58

(1) Includes a mixed product containing rutile, leucoxene and altered ilmenite used to make pigments and metal.

(2) Pigments include all manufactured titanium dioxide.

(3) Included with pigments to prevent disclosure of individual company operations.

(4) Included in miscellaneous to prevent disclosure of individual company operations.

(5) Includes consumption for chemical and experimental purposes.

Source: U. S. Bureau of Mines, Minerals Yearbook, 1958.

Titanium-metal Production and Fabrication

Titanium metal is produced in the United States, Great Britain, Japan, France, West Germany and the Union of Soviet Socialist Republics. Commercial producers in the United States are: Cramet Inc., Chattanooga, Tennessee; Electro Metallurgical Co., Ashtabula, Ohio; E. I. du Pont de Nemours and Co., Inc., Newport, Delaware; Mallory-Sharon Metals Corp., Ashtabula, Ohio; and Titanium Metals Corporation of America, Henderson, Nevada. Commercial producers in Japan are: Osaka Titanium Manufacturing Co., Osaka; Toho Titanium Industry Co., Tokyo; and Nippon Soda Co., Ltd., Tokyo. In Great Britain, Imperial Chemical Industries Limited, Birmingham, is the principal producer. Production in France and West Germany is on a minor scale. There is no available information about the titanium industry in the Union of Soviet Socialist Republics.

Sponge-metal production in the United States (the world's largest producer and consumer) was cut drastically from 17,249 tons in 1957 to 4,585 tons in 1958. Sponge-metal consumption dropped from 8,221 tons to 4,147 tons in the same period. The decrease in production resulted from the United States government's reduction in defence requirement for the metal.

Price has been the chief obstacle to the development of an industrial market. In 1958, however, the cost of all titanium products - sponge, ingot, strips, plate, billet and wire - continued to decline. Technological advances made in 1958 did much to increase the commercial use of titanium. Outstanding accomplishments included the lifting of the thermal-performance range of the metal by alloying, and the development of new techniques that make it possible to cast titanium into almost any size or shape.

The United States Bureau of Mines reported* that General Services Administration held 22,400 tons of titanium sponge metal at the end of 1958 and that under present contracts there will be no further deliveries of titanium to the government.

Titanium metal is not commercially produced in Canada. The Mines Branch, Ottawa, investigates various phases of titanium research, from the processing of ores to the production and fabrication of the metal and its alloys. Dominion Magnesium Limited reported that it had done a small amount of research work on the refining of titanium but that only minor quantities of low-grade titanium-metal powder had been sold on the market.

Commercial production and fabrication of titanium mill products and forgings from imported ingots and billets is carried out by several Canadian firms. These include the following companies: Thompson Products, Limited, Aircraft Division, St. Catharines, Ontario; Vanadium-Alloys Steel Canada Limited, London, Ontario; Canadian Steel Improvement Ltd., Etobicoke, Ontario; and Atlas Titanium Limited, Welland, Ontario. These firms reported total consumption of 636,500 pounds of titanium metal and titanium alloy in 1958, the greater portion being in the form of an alloy containing 6 per cent aluminum and 4 per cent vanadium.

Atlas Titanium Limited produces 8-inch to 10-inch laths turned round, 1-inch to 1 1/2-inch and 1/2-inch to 1-inch centreless ground bars and such other mill products as sheets, wires, strips, bars and billets.

Thompson Products Limited has precision forging and machining equipment. Its principal titanium product is aircraft gas-turbine blades; to date it has shipped upwards of 1,600,000 titanium forgings.

Canadian Steel Improvement Ltd. manufactures compressor disks, seal rings, housings, compressor blades and various split-die forgings in titanium alloys.

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*Quarterly Titanium Metal Report No. 8, February 17, 1959.

Macro Division of Kennametal Inc., Port Coquitlam, British Columbia, manufactures pure titanium-carbide powder and tungsten-titanium carbide powder. These carbide powders are for the fabrication of cemented hard carbide alloys used in metal-cutting tools.

Titanium in Pigments

Outstanding properties of titanium-dioxide pigments that recommend them for many applications include their high opacity and covering power, chemical inertness and low specific gravity. They are used as pigment in the manufacture of paint, ceramics, cosmetics, paper and rayon.

Consumption of Refined TiO_2,
Extended TiO_2 Pigments and Ferrotitanium in Canada

	1957		1956	
	Short Tons	$	Short Tons	$
Refined titanium dioxide (TiO_2)				
Paints	12,558	6,869,018	12,725	6,771,512
Linoleum and oilcloth	2,452	984,004	2,287	848,895
Pulp and paper	1,722	839,948	1,549	751,708
Rubber goods	720	371,696	872	429,533
Polishes and dressings	111	56,963	150	80,763
Miscellaneous nonmetallic mineral products	300(e)	150,000(e)	300(e)	150,000(e)
Extended TiO_2 pigments				
Paints	14,650	3,117,678	14,599	3,072,693
Estimated TiO_2 content	4,355		4,340	
Ferrotitanium				
Primary iron and steel	252	82,258	277	84,393

(e) Estimated.

Titanium in Other Applications

Although ilmenite, slag or manufactured TiO_2 may be used as a source of titaniferous material in welding-rod coatings, titanium dioxide in the natural form of rutile is considered to be the most desirable material for this purpose. Artificially prepared crystals of titanium dioxide have a very high index of refraction and are used as gem stones. High-, medium- and low-carbon ferro-titanium, the major grades of alloys of titanium with iron, are made for use as iron and steel additives.

Tariffs and Prices

Neither Canada nor the United States maintained tariffs on titanium ores during 1958.

The E & M J Metal and Mineral Markets of December 25, 1958, quotes the following United States prices:

Ilmenite

Per gross ton, f.o.b. cars Atlantic ports

59 1/2% TiO_2	\$23 to \$26
54% TiO_2	\$21 " \$21.50

Rutile

Per short ton, 94% TiO_2, delivered within 12 months	\$95 to \$100

	Effective Oct. 1, 1958	Effective Apr. 1, 1958	Effective June 3, 1957
Titanium metal			
Per lb A-1, 99.3% max., f.o.b. shipping point			
Max. 0.3% Fe	\$1.82	\$2.05	\$2.25
Max. 0.5% Fe	\$1.70	\$1.85	\$2.00
Ferrotitanium			
Low-carbon			
Per lb contained Ti, ton or more lots, lump (1/2 in.+) packed, f.o.b. shipping destination NE. U.S.A.			
40% Ti, max. 0.10% C	no change	no change	\$1.35
25% Ti, max. 0.10% C	" "	" "	\$1.50
Medium-carbon			
Per net ton, carload lots, lump, packed, f.o.b. destination NE. U.S.A.			
17-21% Ti, 3-5% C	no change	no change	\$290 to \$295

	Effective Oct. 1, 1958	Effective Apr. 1, 1958	Effective June 3, 1957
High-carbon			
Basis as for medium-carbon, 15-19% Ti, 6-8% C	no change	no change	\$240 to \$245

TUNGSTEN

V. B. Schneider

Canadian tungsten production has been confined in recent years to that contained in the scheelite concentrates obtained from the operations of Canadian Exploration Limited at Salmo, British Columbia. According to the Dominion Bureau of Statistics, shipments in 1958 amounted to 690,976 pounds of WO_3 valued at $1,898,455. Additional tungsten concentrate containing approximately 37,000 short-ton units of WO_3 was stockpiled at the mine awaiting a higher price. Shipments in 1957 amounted to 1,921,483 pounds of WO_3. All shipments were sent to the United States stockpile under a purchase contract Canadian Exploration had with the United States General Services Administration (GSA).

The price of tungsten ore began to rise during the latter weeks of 1958 in the markets of both the United States and the United Kingdom. From a low of $7.50 to $8.50 a short-ton unit (20 pounds) of tungsten trioxide (WO_3) f.o.b. shipping point, quoted early in October, the price by year-end reached $12 to $12.75 a short-ton unit of WO_3 for concentrates containing a 65-per-cent minimum of WO_3.

Developments in Canada

The main tungsten orebody of Canadian Exploration Limited, the Emerald, was discovered in 1942. A 300-ton mill was erected on the property in 1943 by Wartime Metals Corporation, a Crown company. The property was closed late in 1943 with the easing of the demand for tungsten supplies. Canadian Exploration Limited, a subsidiary of Placer Development Limited, purchased the property in 1947 and operated the mill until the end of 1948, when tungsten prices were too low to permit profitable operation. The mill was converted to treat lead-zinc ores from the company's nearby Jersey mine. Late in 1950, the Canadian Government purchased the remaining ore reserves in the Emerald mine and constructed a new 250-ton mill on the property. In 1951, Canadian Exploration discovered a new orebody on its Dodger property and negotiated a contract with GSA that called for 570,000 short-ton units of WO_3 from 1952 to June 30, 1958, at a price ranging from $55 to $60 a unit.

On October 1, 1952, the company purchased the new mill from the Canadian Government and the remaining ore reserves at the Emerald mine. The mine and mill were in continuous operation until July 31, 1958, when the terms of the contract with GSA were fulfilled. During this continuous operation, the

Tungsten - Production, Trade and Consumption

	1958		1957	
	Pounds	$	Pounds	$
Production (shipments)				
WO_3 content	690,976	1,898,455	1,921,483	5,279,275
Imports				
Scheelite(1)				
Bolivia	317,600	101,610	118,800	72,506
United States	304,500	127,201	44,900	34,831
Spain	82,300	30,908	22,200	10,732
Burma	70,600	5,177	-	-
Korea	56,000	20,837	44,800	29,642
United Kingdom	53,100	14,422	-	-
Total	884,100	300,155	230,700	147,711
Ferrotungsten(2)				
United Kingdom	196,300	112,961	165,600	114,367
Sweden	2,000	1,473	1,500	1,479
United States	700	1,156	3,100	6,607
Total	199,000	115,590	170,200	122,453
Exports				
Tungsten concentrates(1)				
United States	1,028,300	2,073,068	3,096,900	5,456,264
Consumption (W content)				
Scheelite	127,204		59,037	
Tungsten wire	3,312		4,077	
Ferrotungsten	68,892		47,117	
Tungsten metal	4,953		5,370	
Tungsten-metal powder	18,850		26,221	
Tungsten carbide	63,260		100,971	
Tungsten-carbide powder	22,991		29,693	
Miscellaneous(3)	7,276		5,486	
Total	316,738		277,972	

(1) Reported by Trade of Canada. WO_3 content not given.
(2) As reported by Trade of Canada. W content not given.
(3) Includes tungsten chemicals.

Tungsten - Production, Trade and Consumption, 1948-58

(pounds)

	Production(1)	Imports(2)		Exports(3)	Consumption(4)
		Tungsten Ores	Ferrotungsten	Scheelite	
	(WO_3 content)			(W content)	(W content)
1948	1,046,160	166,400	385,800		685,720
1949	252,380	55,600	301,900		298,279
1950	284,078	55,600	214,700		251,076
1951	2,833	56,400	1,008,300		290,618
1952	1,493,111	112,200	493,100	1,700,000	595,412
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

(1) Producers' shipments of scheelite.
(2) As reported by Trade of Canada. Tungsten content not available.
(3) Export shipments as reported by producers.
(4) Scheelite, ferrotungsten and other tungsten products reported by consumers. Prior to 1951, totals refer to tungsten content of ferrotungsten and scheelite only.

mill flowsheet was changed from time to time to increase recovery and eliminate the necessity of shipping low-grade flotation concentrates. During the 12-month period ending April 30, 1958, the recovery at the tungsten mill was 86 per cent. In addition to the Emerald and Dodger orebodies, a third orebody, the Invincible, was diamond-drilled in 1957. Reserves indicated in this program amounted to 386,000 tons grading 0.83 per cent WO_3. Reserves of the Emerald and Dodger orebodies were reported to be 157,420 tons averaging 0.99 per cent WO_3 at September 1, 1956.

In New Brunswick, the Burnt Hill wolframite deposit, at the junction of the Miramichi River and Burnt Hill Brook, has been investigated and partially developed. It is at present inactive, the last recorded production being two small shipments made in 1955. These shipments were made by Burnt Hill Tungsten & Metallurgical Limited, the company that operated the mine most recently.

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. None of these occurrences to date have proved to be of economic significance. Wolframite has been found in stream gravels and in quartz veins in the Atlin area of northern British Columbia.

World Production

United States

Production in 1958 in the United States, as reported by the United States Bureau of Mines,(1) was less than half that of 1957, which amounted to 8,032,000 pounds of contained tungsten. Tungsten concentrate was produced in California, Colorado, Nevada and North Carolina during the first half of the year. Only one producer in California and one in Colorado were active in the last half, and both depended largely on the molybdenum values in their ore for continued operations.

Other Countries

Production of tungsten concentrate in 1958 amounted to 63,500 tons(2) of WO_3 in concentrate containing 60 per cent or more WO_3, according to the United States Bureau of Mines(3). China produced 22,000 tons, followed by the Union of Soviet Socialist Republics (8,300 tons), North Korea (4,400 tons), Bolivia (3,867 tons), and the United States (3,788 tons), South Korea (3,621 tons) and Brazil (2,596 tons).

As in 1957, world production continued to decline in 1958 because of low prices, declining demand and the termination, for all practical purposes, of supply contracts with the United States government. Information(4) from the GSA indicates that at September 30, 1958, the United States government was committed to purchase 166,291 additional short-ton units of tungsten trioxide from foreign producers under various contracts, the last of which will terminate during 1962.

Trade, Consumption and Uses

Imports of tungsten ore and ferrotungsten were greater than in 1957, and domestic consumption, at 316,738 pounds of contained tungsten, was the highest since 1952. Exports of scheelite, at 477,079 pounds of contained tungsten, were the lowest since these figures were first published in 1952.

The United States is the largest importer and consumer of tungsten concentrate. In 1958, its consumption dropped to 5,320,000 pounds from the 8,544,000 pounds consumed in 1957 and was at its lowest since 1954.

As recently as 1943, the manufacture of ferrous alloys accounted for 90 per cent of the tungsten consumed in the United States, and the manufacture of tungsten carbides for about 5 per cent. Since then, the use of cemented

(1) U.S. Bureau of Mines, Tungsten Report No. 84.
(2) Short tons (2,000 pounds) unless otherwise specified.
(3) U.S. Bureau of Mines, Mineral Yearbook 1958, Tungsten (preprint).
(4) United States Tariff Commission Report on Investigation No. 33, Washington, November 1958.

tungsten carbide has increased tremendously through improvements in the technology of tungsten-carbide manufacture. One pound of tungsten in the form of tungsten-carbide tools does as much work in metal-cutting as 60 pounds used in tool steel that is 18 per cent tungsten. Preliminary figures for 1958 issued by the United States Bureau of Mines show that 40 per cent of all the tungsten consumed was used in the manufacture of tungsten carbides, 35 per cent in ferrous alloys, 19 per cent in nonferrous alloys and the remaining 6 per cent in such miscellaneous commodities as pigments and fluorescent powders and in electrical equipment.

Tungsten carbide is used for tipping such tools as milling cutters, reamers, punches and drills; as dies for wire- and tube-drawing; in such wear-resistant parts as gauges, valve seats and valve guides; and as cores in armour-piercing shells.

In the nonferrous or super-alloy 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-resisting alloys. The main use of the high-temperature alloys is 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 superchargers. Stellite, a nonferrous alloy containing from 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 cutting tools.

The pure 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 major consumers of tungsten in Canada are: Atlas Steels Limited, Welland, Ontario; Canadian General Electric Company Limited, A. C. Wickman Limited, Johnson, Matthey and Mallory Limited, J. K. Smit and Sons of Canada Limited, all of Toronto, Ontario; Canadian Westinghouse Company Limited, Hamilton, Ontario; Dominion Colour Corporation Limited, New Toronto, Ontario; Deloro Smelting and Refining Co. Ltd., Belleville, Ontario; Wheel Trueing Tool Company of Canada Limited, Windsor, Ontario; Kennametal of Canada Limited, Victoria, British Columbia, and Boyles Bros. Drilling Company Limited, Vancouver, British Columbia.

Atlas Steels Limited is by far Canada's largest consumer of tungsten in the form of scheelite or ferrotungsten.

Macro Division of Kennametal Inc., Port Coquitlam, British Columbia, is the only manufacturer of tungsten-carbide powder in Canada. Pure tungsten carbide in powder form is made from imported wolframite, ferberite or scheelite concentrates of standard grade. Macro also produces, directly from ores, pure tungsten-metal powders of various particle sizes and special hard carbide granules for hard-surfacing purposes.

Prices

According to E & M J Metal and Mineral Markets of December 25, 1958, tungsten prices in the United States were as follows:

Tungsten ore	Per short-ton (20-lb) unit WO_3, basis 65%, foreign, c.i.f. U.S. ports, import duty extra	
	Wolfram	\$12.00 to \$12.75
	Scheelite	\$12.00 " \$12.75
Tungsten metal	Per lb	
	98.8% min., 1,000-lb lots	\$ 3.05 to \$ 3.20
	Hydrogen reduced 99.99%	\$ 3.33 " \$ 3.80
Ferrotungsten	Per lb contained W, 70 to 80%, lots 5,000 lb or more, 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. 29, 1958)	\$ 2.15 (nominal)

Tariffs

Canada

	British Preferential	Most Favoured 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% ad valorem
Tungsten carbide, in metal tubes for use in Canadian manufacturing	"	"	free
Ferrotungsten	"	5% ad valorem	5% ad valorem

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, ferrochromium 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

The outstanding feature of the year in the uranium industry was the spectacular increase in production which put uranium in top place among the metals produced in Canada. The output (13,403 tons of uranium oxide) was double what it was in 1957, and its value ($279,538,471) was greater than that of any other metal produced in Canada during 1958. Canada ranked first among the world producers of uranium. Other leading producers, in descending order of output, were the United States, the Union of South Africa, the Belgian Congo, Australia, France, Portugal and probably the Soviet Union.

Canadian production was from mines in the Elliot Lake (Blind River) district of Ontario (69 per cent of the total), the Lake Athabasca region of northern Saskatchewan (21 per cent), the Bancroft area of Ontario (7 per cent), and the Northwest Territories (3 per cent).

All the uranium mines in the Elliot Lake district, which hold contracts with Eldorado Mining and Refining Limited, reached production in 1958. During the year 25 mines and 19 concentrating plants were in operation throughout Canada. The total milling rate of the industry at the end of 1958 was about 42,000 tons of ore a day. The increase in output is expected to level off in 1959,when all plants now in operation should reach full production. Although the plants are capable of producing in excess of the rated capacity, the annual rate of production is expected to be 15,500 tons of uranium concentrate.

The reserves of measured, indicated and inferred ore in Canada at the end of 1957 were estimated at 376,888,000 tons with a uranium-oxide content of 414,577 tons. This is considered to be the largest reserve of uranium in the world. The ore reserves in the Elliot Lake district constitute about 94 per cent of the total ore reserves in Canada. The Beaverlodge area of Saskatchewan and the Bancroft area of Ontario each contain about 3 per cent of the country's reserves.

Canadian Uranium Producers, 1958

Company and Location(1)	Contract ($)	First Production	Rated Milling Capacity (tons/day)	Approximate Year-end Mining Rate (tons/day)	Remarks
Port Radium, Northwest Territories					
Eldorado Mining and Refining Limited		1942	300	290	
Marian River, Northwest Territories					
Rayrock Mines Limited	15,792,000	1957	150	90	
Lake Athabasca, Saskatchewan					
Cayzor Athabaska Mines Limited		1957		100 to 150	Ships to Lorado.
Eldorado Mining and Refining Limited	211,000,000(2)	1953	2,000		
Gunnar Mines Limited	116,950,000	1955	2,000		
Lake Cinch Mines Limited		1957		150	Ships to Lorado.
Lorado Uranium Mines Limited	64,386,000	1957	750	125 to 150	
National Explorations Limited		1955		0	Closed. Shipped 60 tons a day to Eldorado and Lorado.
Rix-Athabasca Uranium Mines Limited		1954		250	Ships to Eldorado and Lorado.

Elliot Lake, Ontario					
Algom Uranium Mines Limited	206,800,000				
Nordic mine		1957	3,000		
Quirke mine		1956	3,000		
Can-Met Explorations Limited	79,573,000	1957	3,000		
Consolidated Denison Mines Limited	202,225,000	1957	6,000		
Milliken Lake Uranium Mines Limited	95,000,000	1958	3,000		
Northspan Uranium Mines Limited	278,471,000				
Buckles mine		1957		0	Closed. Shipped 650 tons a day to Lacnor.
Lacnor mine		1957	4,000		
Panel mine		1958	3,000		
Spanish American mine•		1958	2,000		
Pronto Uranium Mines Limited	55,000,000	1955	1,500		
Stanleigh Uranium Mining Corporation Limited	90,830,000	1958	3,000		
Stanrock Uranium Mines Limited	96,660,000	1958	3,300		
Bancroft, Ontario					
Bicroft Uranium Mines Limited	35,805,000	1956	1,000		
Canadian Dyno Mines Limited	34,876,000	1958	1,000		
Faraday Uranium Mines Limited	45,204,000	1957	1,000		
Greyhawk Uranium Mines Limited		1957		150	Ships to Faraday.

(1) See map page
(2) Contract includes Port Radium operation.

Uranium - Production and Exports

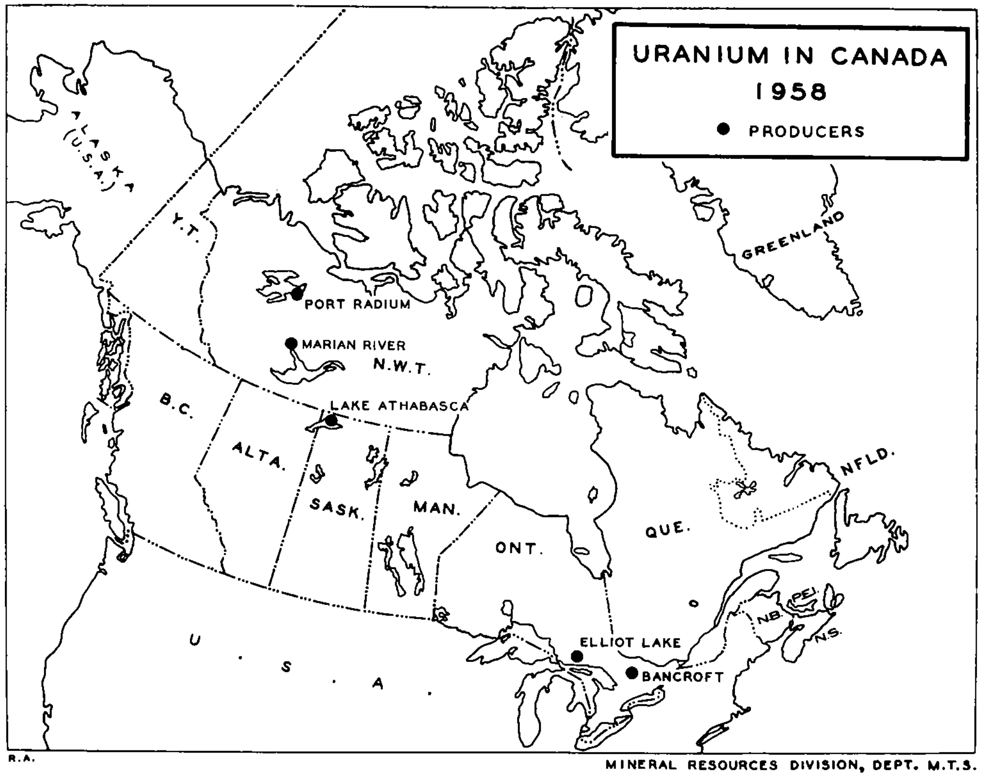
	1958		1957	
	Short Tons	$	Short Tons	$
Production (U_3O_8 - shipments)				
Ontario	9,985	210,149,700	3,985	82,940,763
Saskatchewan	2,962	59,815,924	2,231	44,561,832
Northwest Territories	456	9,572,847	419	8,801,769
Total	13,403	279,538,471	6,635	136,304,364
Exports (U_3O_8)				
United States		262,674,640		127,934,004
United Kingdom		13,502,809		800
West Germany		314,065		-
Japan		14,443		-
Total		276,505,957		127,934,804

Mine Production

Northwest Territories

The Port Radium mine of Eldorado Mining and Refining Limited, on the eastern shore of Great Bear Lake, has been producing uranium continuously since 1942. The average milling rate during 1958 was about 290 tons of ore a day. Production was derived partly from the reclamation of old mill tailings. On December 31, 1957, reserves were 131,200 tons averaging 0.58 per cent U_3O_8. On the basis of this figure and the current rate of production, the ore reserves are expected to approach exhaustion towards the end of 1960.

Production at the mine of Rayrock Mines Limited, in the Marian River area, 100 miles northwest of Yellowknife, began in June 1957. During the greater part of 1958 the plant was treating between 100 and 120 tons of ore a day. Mill recovery was reported by the company to average 96.9 per cent - the highest recovery rate of any Canadian uranium plant. Reserves, in the main (No. 6) zone on October 31, 1956, were reported by the company to be 111,200 tons averaging 0.375 per cent U_3O_8, but present reserves are below this figure.



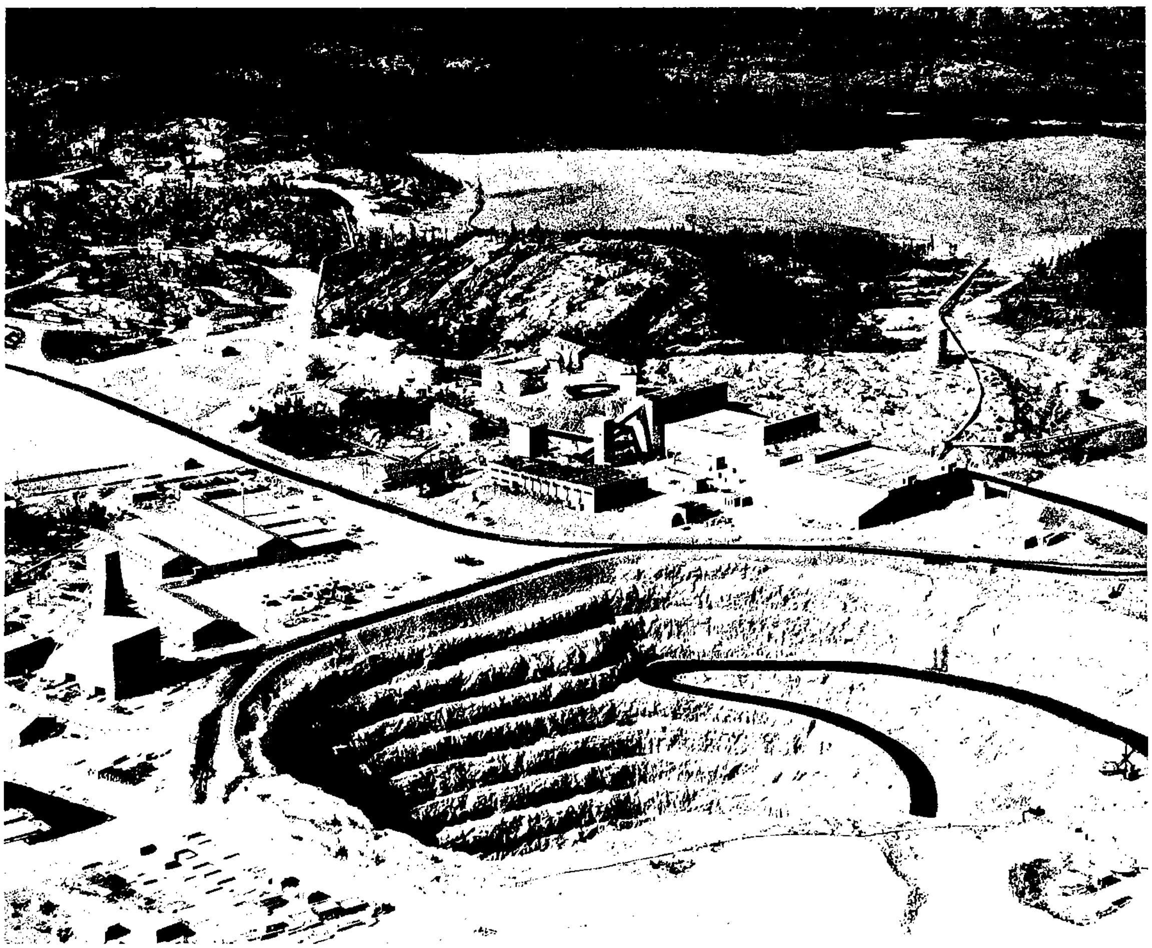
Saskatchewan

All uranium production in Saskatchewan came from mines in the Beaverlodge Lake area on the north shore of Lake Athabasca. During the year seven mines and three leaching plants were in operation. Production in this camp was higher than in the previous year.

National Explorations Limited suspended mining operations in October owing to the lack of ore. The mine had been shipping about 60 tons of ore a day to both the Eldorado and the Lorado plants.

Eldorado Mining and Refining Limited continued to mine and mill ore from the Verna and Ace orebodies at the rate of about 2,000 tons a day. It continued to mine ore from the Verna section on the Radiore Uranium Mines Limited property, which is under lease to the Crown company. Radiore ore was mined and treated by Eldorado at an average rate of 103 tons daily during the first quarter of 1958. The production rate is expected to increase to about 225 tons daily by early 1959. The company also treated, on a custom basis, small quantities of ore from Rix-Athabasca Uranium Mines Limited and National Explorations Limited.

The mill capacity at Gunnar Mines Limited was increased to 2,000 tons a day so that ore from both the open pit and the underground workings could be handled. Open-pit mining is expected to continue to a vertical depth of about 300 feet. All mining below this depth will be done by underground methods.



Courtesy of Gunnar Mines Limited
Hunter 50776

The Gunnar uranium mine in the Beaverlodge area of northern Saskatchewan. Access to the mine is by air and water only.

The original sales contract received by Gunnar, the first private company to be awarded a contract by the Crown company, was designed to terminate on October 1, 1960. The Crown company recently indicated that Gunnar will likely receive a second contract, valued at about $40 million, for delivery of uranium precipitates ending March 31, 1962. The total value of the Gunnar contract will then be $116,950,000.

The custom plant operated by Lorado Uranium Mines Limited treated ore from its own mine as well as ore shipped by Cayzor Athabaska Uranium Mines Limited, Lake Cinch Mines Limited, National Explorations Limited, and Rix-Athabasca Uranium Mines Limited. At the end of the year Cayzor and Lake Cinch were shipping ore at the rate of about 150 tons a day; Rix was shipping about 170 tons a day to the Lorado plant and 80 tons a day to Eldorado. Small lots of high-grade ore were shipped to the Lorado plant from several smaller mines. Lorado converted its pyrite-burning acid plant to an elemental sulphur-burning plant to increase acid output and obtain a more efficient and economical operation. Other changes were being made to improve milling operations so that the plant could operate at the rated capacity of 750 tons of ore a day.

Since 1955 practically no prospecting has been done in the Beaverlodge camp and no new mines have been added to the present list of producers.

Ontario

Elliot Lake District

Uranium production in Ontario reached an all-time high during the year, amounting to almost 10,300 tons of U_3O_8. The uranium-bearing conglomerates in the Elliot Lake district (also called the Blind River area or Algoma region), accounted for about 9,340 tons. The ore-bearing dykes and lenses of pegmatitic granite in the Bancroft area provided the rest of the province's production.

In the Elliot Lake district 11 mines and mills were in production. A 12th producer, the Buckles mine, owned by Northspan Uranium Mines Limited, shipped ore at the rate of 650 tons a day to the Lacnor (formerly called Lake Nordic) plant until it was mined out. Five new mines were brought into production during the year. The Panel mine, owned by Northspan Uranium Mines Limited, began production in March, and its leaching plant reached full capacity (3,000 tons a day) during the summer. Production began at Stanleigh Uranium Mining Corporation Limited in March after a two-month delay caused by a fire in the concentrator building. Stanleigh changed its mining method from room-and-pillar with trackless-haulage equipment to a form of advancing-long-wall stoping with rail haulage. The average daily tonnage treated during the year was in excess of 2,000 tons but below the rated capacity of 3,000 tons. Production at Stanrock Uranium Mines Limited began in April, but the plant was not expected to reach its full capacity of 3,300 tons of ore a day until early in 1959. In May, Milliken Lake Uranium Mines Limited and Northspan's Spanish American mine commenced operations. The former reached its capacity production of 3,000 tons a day in August.

The Quirke and Nordic mines of Algom Uranium Mines Limited settled down to a normal course of operations, and particular attention was paid to the increasing of efficiency and the control of costs. Both mines deepened their shafts to permit stoping on new levels, and both installed new pachuca tanks in their mills in place of the centre-lift agitators.

Can-Met Explorations Limited reached its full production of 3,000 tons of ore a day in September. This mine had difficulty mining the ore in the early stages of development owing to a series of faults which severely offset the orebody.

Consolidated Denison Mines Limited, the largest uranium mine in the camp, reached its rated capacity of 6,000 tons of ore a day in September. Pronto Uranium Mines Limited continued to produce at the rate of 1,500 tons of ore a day.

By the end of 1958 all mines in the Elliot Lake area were operating at or near full capacity. This camp, the largest uranium-producing area in the world, is capable of supplying 13,000 tons of uranium precipitate annually. The average grade of ore is 0.11 per cent U_3O_8.

Rio Tinto Mining Company of Canada Limited, which controls seven of the 11 producing mines in the Elliot Lake camp, joined with certain other companies in the formation of Rio Tinto Dow Limited to build a thorium-recovery plant adjacent to the Quirke mine. Algom Uranium Mines Limited and other associated uranium-oxide producers will supply barren liquors for the recovery of thorium and rare earths. The thorium plant, the first in Canada, is expected to be in production early in 1959. Full production, at the rate of 100 to 200 tons of thorium salts annually, is expected to be reached in July 1959.

Bancroft Area

Three mines, each with plants having an actual capacity of 1,200 tons of ore a day, were producing and a fourth mine was shipping ore to one of the operating plants. Canadian Dyno Mines Limited began producing in June 1958, and by the end of the year the mill was handling more than 1,100 tons of ore a day. The oldest producer in the area, Bicroft Uranium Mines Limited, operated slightly in excess of its rated capacity of 1,000 tons a day. Excess production was stockpiled pending private outside sales. The mill of Faraday Uranium Mines Limited was treating more than 1,300 tons daily at the end of the year. Faraday deepened its shaft to reach additional ore at a depth of 900 feet. A new orebody, about 1,400 feet northwest of the main workings, was indicated by surface diamond-drilling. Greyhawk Uranium Mines Limited continued to ship ore on a custom basis to the nearby Faraday plant at the rate of 150 tons a day.

Exploration and Development

No new discoveries of uranium were reported in 1958 and practically no prospecting was undertaken in new areas. Some of the operating mines carried out underground exploration and development during the year. The main reason why new discoveries have been lacking since 1956 is that the market for additional uranium has been limited.

Both Eldorado and Rayrock carried out extensive underground exploration and development at their mines in the Northwest Territories. Ore reserves at both of these mines are rapidly diminishing. Rayrock deepened its shaft to two new levels, and an area to the northeast of the main orebody was explored from the third level.

Belleterre Quebec Mines Limited completed about 3,000 feet of diamond-drilling on a highly radioactive occurrence near Lake Kipawa, Quebec, about 60 miles northeast of North Bay, Ontario. Much staking and prospecting were done in this area in 1957 and 1958, but by the end of 1958 all work had been suspended. The principal radioactive occurrences on the Belleterre property consist of small, discontinuous lenses of uraninite and other valuable minerals in a band of micaceous quartzite.

British Newfoundland Exploration Limited has developed a high-grade uranium deposit near Kaipokok Bay on the Labrador coast. Up to May 15, 1958, the ore reserves calculated from diamond-drill intersections were 206,000 tons grading 0.709 per cent U_3O_8 (uncut). Diamond-drilling and underground exploration were begun in September 1957 and have continued intermittently up to September 1958. Prospecting, geological mapping, and diamond-drilling were done on other showings in the area during 1958.

World Production

The following summary of developments in the principal uranium-producing countries provides a basis of comparison for Canadian production and reserves and shows the wide distribution of uranium throughout the world. The rate of production of uranium oxide in the Free World has increased many times in the past decade and is expected to be about 43,000 tons annually by the end of 1959. The output in such countries as Canada, the United States and South Africa could be greatly increased if the world market required it.

United States

In 1958 the United States increased its production of uranium oxide to 12,560 tons from the 9,200 tons turned out in 1957. By the end of 1958, 23 treatment plants were in operation. Full production is expected to be attained in 1959 or 1960, when, according to estimates, the output of uranium oxide will be 20,000 tons annually.

World Resources and Production of Uranium, December 1958

(principal producing countries)

Country (in order of 1958 production)	Ore Reserves (tons)	Grade (% U_3O_8)	Reserves of U_3O_8 (tons)	Concentrate Produced in 1958 (tons)	Value of Product in 1958 ($)	Number of Treatment Plants in 1958
Canada	376,888,000	0.11	414,577	13,461	277,552,876	19
United States	82,500,000	0.27	222,750	12,560	236,000,000±	23
South Africa	1,100,000,000	0.033	363,000	6,246	150,000,000±	23
Belgian Congo	?	?	6,000	3,450	?	1
Australia	7,000,000	0.14	10,000	700	?	3
France	?	?	50,000	606	?	3
Portugal	?	?	several thousand	?	?	?
Northern Rhodesia	?	?	?	51	?	1
Soviet Union	?	?	?	6,000 by 1960	?	?

Deliveries under long-term contracts from foreign producers totalled 19,000 tons of U_3O_8 during 1958. Of this total, 12,800 tons came from Canada.

South Africa

Twenty-three authorized plants were in operation in South Africa during 1958, and production totalled 6,246 tons of uranium oxide. Nearly all uranium production is a by-product of gold-mining. The South African Atomic Energy Board entered into an agreement, effective July 1, 1958, not to deliver more than 6,200 tons of U_3O_8 annually to the Combined Development Agency, which takes deliveries chiefly for the United States and the United Kingdom.

Belgian Congo

Production figures from the Belgian Congo have not been published. Although uranium production in Katanga has diminished relative to the production of the 'big three', it still ranks fourth. The reserves of the Shinkolobwe mine are believed to be low, but new deposits in the area have been reported. During 1958, the production of uranium concentrate presumably continued at its scheduled rate of approximately 3,000 tons annually.

Australia

Uranium was produced by the two government-owned mines at Rum Jungle and Radium Hill. In June, a third mine, the Mary Kathleen, owned by the Rio Tinto group, was brought into production. This plant is expected to contribute 500 tons of uranium oxide a year. Production in Australia in 1958 totalled roughly 700 tons of U_3O_8.

France

During 1958 French production increased to an estimated 606 tons of U_3O_8. By 1960 production is expected to reach about 1,100 tons. Ore reserves are estimated to contain 50,000 tons of U_3O_8.

Soviet Union

Although its production figures are not available, the Soviet Union is undoubtedly producing uranium. The annual production rate predicted for 1960 is 6,000 tons. Five satellite countries are believed to be shipping uranium to Russia. Uranium has been a main export to the Soviet Union from Czechoslovakia. East Germany, which ships to Russia, has claimed to be the leading uranium producer in Europe.

Markets

The United States continued to be the main market for Canadian uranium, but agreements were concluded to supply uranium to the United Kingdom beginning in July 1958. The United Kingdom agreed to buy uranium valued at $115 million from Canada during the period from July 1958 to March 31, 1962. This allotment will be diverted from existing contracts with the

United States. Arrangements were also made with the United Kingdom Atomic Energy Authority whereby it will obtain an additional quantity of uranium from Canada valued at $105 million. The delivery of this quantity will be made over the period from April 1, 1962, to March 31, 1963, by a diversion from quantities now under contract which are scheduled for delivery in that period. Arrangements are being made to supply the United Kingdom with uranium over the period from April 1, 1963, to December 31, 1966. Supplies for this purpose will come from quantities under option in the present purchase contracts. The Government of the United States has options to purchase Canadian uranium up to December 31, 1966.

Canada has also concluded agreements for the sale of uranium to the Federal Republic of Germany and to Switzerland. Negotiations are under way for sales to Japan and certain nations of western Europe. Canada is also endeavouring to negotiate a treaty with EURATOM to provide for the co-operative exchange of information on the peaceful uses of atomic energy and for the supply of material, particularly uranium.

In May 1958 Canada amended its purchasing policy to permit private producers to make their own arrangements for the sale of surplus uranium under certain conditions. Permits may be issued to a private producer to allow him to make individual sales of up to 250 pounds for use in testing and research, but the total of such sales to any one country must not exceed 2,500 pounds, unless the government of the recipient country has entered into an agreement with the Canadian Government for co-operation in the peaceful uses of atomic energy.

Prices

Nearly all the uranium produced in Canada is purchased by the Government through Eldorado Mining and Refining Limited. This government corporation has negotiated production contracts with the producers whereby it undertakes to purchase definite quantities of uranium in the form of 'yellowcake' (magnesium di-uranate, sodium di-uranate or a similar chemical compound), to be delivered according to a prescribed schedule and at a stated price. The prices paid to the companies are confidential and vary with each company. The prices are calculated to cover estimated operating costs, amortization of estimated amounts of certain capital and preproduction expenditures, and a profit element. The average price being paid to the producers is about $10.30 a pound, but it will be lower after 1963. The United States Atomic Energy Commission has set a price of $8 a pound for its domestic production during the period from April 1, 1962, to December 31, 1966.

Uses and Requirements

Defence purchases continue to dominate the market for uranium. However, commercial requirements for peaceful purposes have recently assumed significant proportions throughout the world. Nuclear reactors for the production of electricity and heat and for research purposes are under construction in many countries of the world, particularly in Great Britain, Europe and the United States.

The United Kingdom leads all other countries in the development and use of nuclear power for electrical-energy requirements. At least seven nuclear power stations, each of 300,000 or more kilowatts of electrical-energy capacity, are under construction or have been planned in Great Britain. The first station of this type is expected to be in operation early in 1961. Other, smaller stations are already in operation.

Canada's first atomic-power station, known as NPD-II, will go into operation in 1961, sending about 20,000 kilowatts of electricity into the power-distribution lines of the Hydro-Electric Power Commission of Ontario. This plant, which is being built near Rapides-des-Joachims on the Ottawa River, is a joint undertaking of Atomic Energy of Canada Limited, the Hydro-Electric Power Commission of Ontario and Canadian General Electric Company Limited. This is a prototype reactor for a 200,000-kilowatt plant scheduled to be built in 1965.

In the United States one commercial-type plant is in operation and several are in various stages of construction or planning. The United States led the way in the application of uranium as a fuel for reactors in submarines.

The Soviet Union has announced that the world's largest icebreaker - an atomic-powered surface ship - will soon be in operation.

In assessing the demand for uranium as a fuel for the generation of electricity, Lewis* suggests that by 1967 an inventory of 30,000 to 60,000 tons (metric) of basic uranium and an annual supply of 7,000 to 15,000 tons would be required by the Western World. He indicates that the uranium requirements predicted for 1967 are below the current production rates. He estimates, however, that by 1980 the annual supply will be 18,000 to 60,000 tons and that the inventory will be 75,000 to 500,000 tons.

The uses and possible uses of uranium are too numerous to describe in detail. The following provide some of the current applications and possible uses: military weapons other than the atomic bomb; nuclear-powered ships, locomotives, aircraft, rockets and missiles; small nuclear-power plants for use in remote areas such as the Canadian Far North; the generation of steam for industrial purposes and for the heating of entire communities remote from supplies of conventional fuel; atomic blasting for mining and harbour construction; underground contained nuclear explosions - now being studied - for power production, mining and the extraction of oil from sands and shales; the glass, ceramic, and chemical industries, in which uranium concentrates are used; and uranium-fueled reactors which are producing radioactive isotopes, which in turn are being used in industry, agriculture, and medicine. Of significant interest in the last-mentioned field is the cobalt 'bomb' used in radiotherapy. In addition, radiation can be used to sterilize biological materials and to preserve food, and radioactive isotopes can be used to study the movement of beach sands along coastal waters.

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*Lewis, W.B. Economics of Uranium and Thorium for the Generation of Electricity. World Power Conference, 1958, Paper 133.

Refining

Eldorado Mining and Refining Limited has been refining uranium at Port Hope, Ontario, since 1935. The company produces uranium metal and uranium compounds of consistent quality and the highest purity. Through its facilities and those of associated companies, the metal can be supplied in the form of machined ingots, forged and rolled shapes, and completely fabricated fuel elements. Uranium-dioxide fuel elements of ceramic grade can also be supplied.

ZINC

D. B. Fraser

Canada's production of zinc in 1958 was 425,099 tons, or 2.7 per cent higher than the 413,741 tons produced in 1957. The 1958 output of the older zinc-producing districts declined by 25,000 tons, or 9 per cent. New mines in Ontario were in production for the first full year, and their output, which was just 11,296 tons in 1957, totalled 46,239 tons in 1958, more than offsetting the losses sustained in other provinces.

The graph on page 251 shows how zinc output has varied over the years and how important the export market is to Canadian producers. Significant production began in Canada about 1920, when the Sullivan lead-zinc-silver deposit at Kimberley, British Columbia, still the country's largest producer, was developed by The Consolidated Mining and Smelting Company of Canada Limited (Cominco) for large-scale production. Additional major sources of zinc were developed in northern Manitoba and Newfoundland in the late 1920's and in western Quebec in the period since 1930. Beginning in 1948, production expanded rapidly in response to the increasing world demand for zinc, and Canadian output reached a record peak of 433,357 tons in 1955. Production in 1958, though 8,258 tons below this record, was at a relatively high level, the second highest in the history of the industry. On a mine basis, Canada was the leading producer of zinc in 1958. It was followed by Russia, the United States, Australia, Mexico, Japan and Peru.

The Consolidated Mining and Smelting Company of Canada Limited, at Trail, British Columbia, and Hudson Bay Mining and Smelting Co. Limited, at Flin Flon, Manitoba, the only producers of slab zinc in Canada, turned out 252,093 tons of refined zinc in 1958; in 1957 their output was 247,316 tons.

Zinc produced from the provinces east of Manitoba was exported in concentrate form to smelters in the United States and Europe. Most of the zinc concentrates produced by mines in British Columbia other than Cominco's were exported to the United States; the remainder, as well as concentrates from United Keno Hill Mines Limited, in Yukon Territory, were treated at Trail.

Domestic consumption of refined zinc, after dropping sharply in 1957, increased by 3,122 tons to 57,542 tons, of which 56,100 were of primary origin, and 1,445 were derived from scrap material.

(text continued on page 250)

Zinc - Production, Trade and Consumption

	1958		1957	
	Short Tons	$	Short Tons	$
Production				
All forms(1)				
British Columbia..	217,304	47,285,427	221,779	53,626,157
Quebec	56,923	12,386,340	74,295	17,964,469
Saskatchewan.....	48,328	10,516,130	45,070	10,897,967
Ontario	46,239	10,061,643	11,296	2,731,334
Newfoundland.....	33,870	7,370,102	35,698	8,631,847
Manitoba.........	11,512	2,505,054	13,729	3,319,758
Yukon Territory..	7,761	1,688,811	8,560	2,069,741
New Brunswick ...	3,162	687,989	3,314	801,260
Total	425,099	92,501,496	413,741	100,042,533
Refined(2)	252,093		247,316	
Exports				
Refined				
United States	95,395	17,820,248	104,990	22,882,621
United Kingdom...	83,854	13,168,878	86,643	18,622,851
Netherlands	4,361	706,894	1,512	337,542
West Germany....	2,380	322,651	-	-
Korea	2,108	329,473	2,492	495,373
Brazil	1,908	275,323	-	-
Pakistan	1,097	146,977	-	-
Philippines.......	1,083	165,195	2,924	551,761
Taiwan	1,035	148,13	225	46,204
India.............	980	130,736	1,596	262,661
Other countries...	1,507	213,28	1,625	282,127
Total	195,708	33,427,794	202,007	43,481,140
Zinc contained in ore and concentrates				
United States	162,849	18,744,896	147,957	18,680,091
Belgium..........	15,026	776,847	11,109	436,057
Norway	11,707	649,521	4,574	174,284
United Kingdom...	10,007	568,694	14,370	925,763
France	9,599	435,434	4,667	213,483
Other countries...	8,635	402,238	4,464	360,398
Total	217,823	21,577,630	187,141	20,790,076

Zinc - Production, Trade and Consumption (cont'd)

	1958		1957	
	Short Tons	$	Short Tons	$
Zinc scrap				
Belgium	2,036	92,683	1,009	73,261
Netherlands	1,981	95,871	1,751	161,990
United States	993	108,755	542	77,483
Japan	533	73,905	1,548	262,758
Other countries	48	7,932	507	74,504
Total	5,591	379,146	5,357	649,996
Zinc manufactures				
United States		107,222		38,296
Belgium		16,573		2,788
France		940		-
Other countries		673		155,826
Total		125,408		196,910
Imports				
Zinc in blocks, pigs, bars, rods, zinc plates, blocks, anodes, strip, sheet	1,721	675,059	1,533	712,141
Zinc dross and zinc scrap	3	266		
Zinc dust	544	154,152	676	204,227
Zinc slugs, disks, shells		234,027		194,965
Zinc manufactures not otherwise provided		2,184,964		2,342,493
Zinc chloride	112	22,741	162	34,499
Zinc sulphate	987	89,641	1,532	139,128
Zinc white	695	185,526	718	196,671
Lithopone	1,242	179,954	1,365	197,418
Total		3,726,330		4,021,542

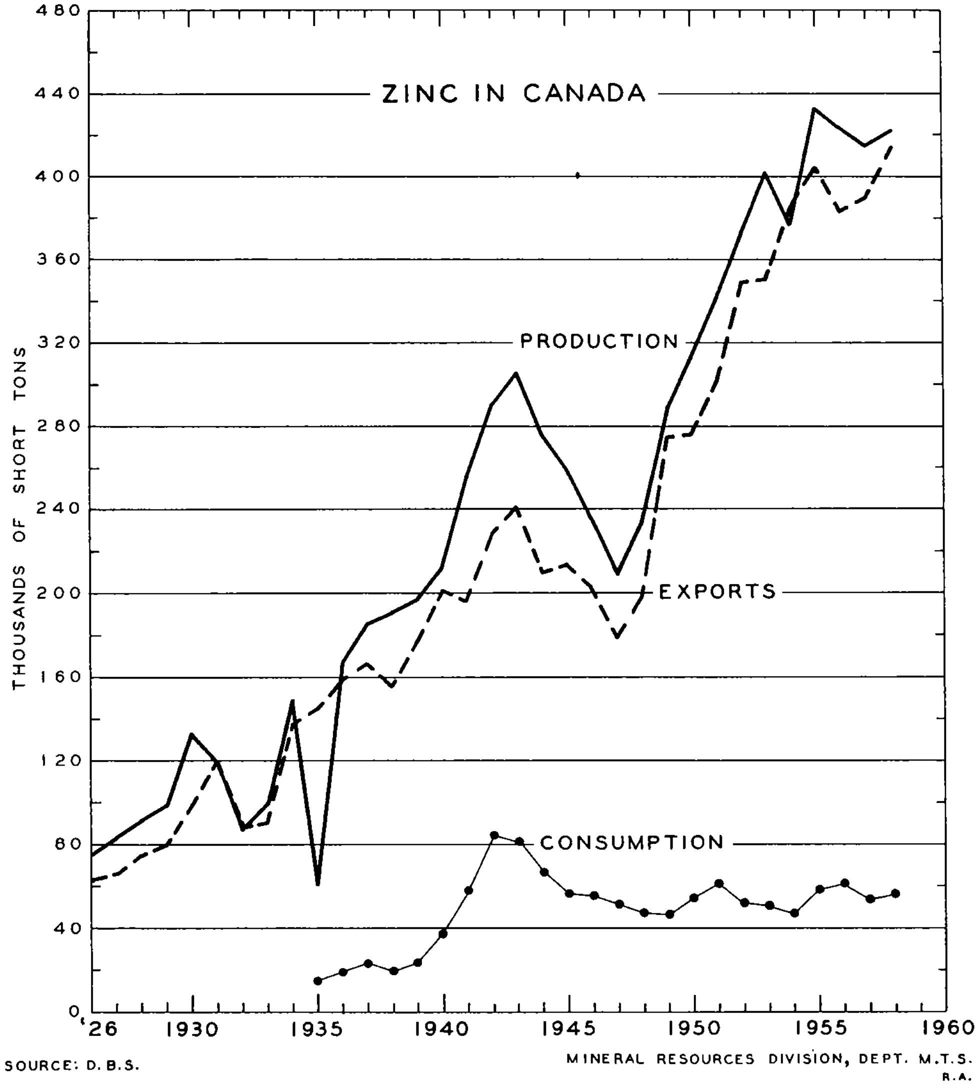
(continued on next page)

Zinc - Production, Trade and Consumption (cont'd)

	1958		1957	
	Short Tons	$	Short Tons	$
Consumption				
Refined (virgin)				
Electro-galvanizing....	916		964	
Hot-dip galvanizing....	28,458		25,616	
Zinc die-cast alloy	8,800		8,517	
Brass and bronze......	4,346		6,678	
Other alloys	2,965		639	
Rolled and ribbon zinc .	1,578		1,136	
Zinc dust.............	2		-	
Zinc oxide............	7,821		7,778	
Zinc castings	604		667	
Other uses............	607		718	
Total.................	56,097		52,713	
Refined (secondary)				
Hot-dip galvanizing....	268		356	
Zinc die-cast alloy	8		38	
Brass and bronze	19		19	
Other alloys	114		-	
Rolled and ribbon zinc .	182		273	
Zinc oxide............	821		945	
Zinc castings	6		42	
Other uses	27		34	
Total.................	1,445		1,707	
Total consumption	57,542		54,420	

(1) Refined zinc produced from Canadian ores, plus recoverable zinc in ores and concentrates exported.
(2) Refined zinc produced from domestic and imported ores.

Industrial consumption of refined zinc in the United States, Canada's major market for metal and concentrates, fell from 935,620 tons in 1957 to 868,327 tons in 1958, owing principally to a drop of 59,000 tons in the amount used in zinc-base die-casting alloys. In the United Kingdom, according to preliminary figures, zinc consumption was down to 306,100 tons from the 316,400 tons consumed in 1957.



Import quotas on unmanufactured lead and zinc were imposed by the United States government on October 1, 1958. Commercial imports were limited by an annual quota equivalent in amount to 80 per cent of the average annual commercial imports during the five-year period, 1953 to 1957. The quota was allocated among exporting countries and subdivided by calendar quarters and tariff-schedule classifications. The zinc classifications specified

(text continued on page 254)

Zinc - Production, Exports and Consumption, 1948-58
(short tons)

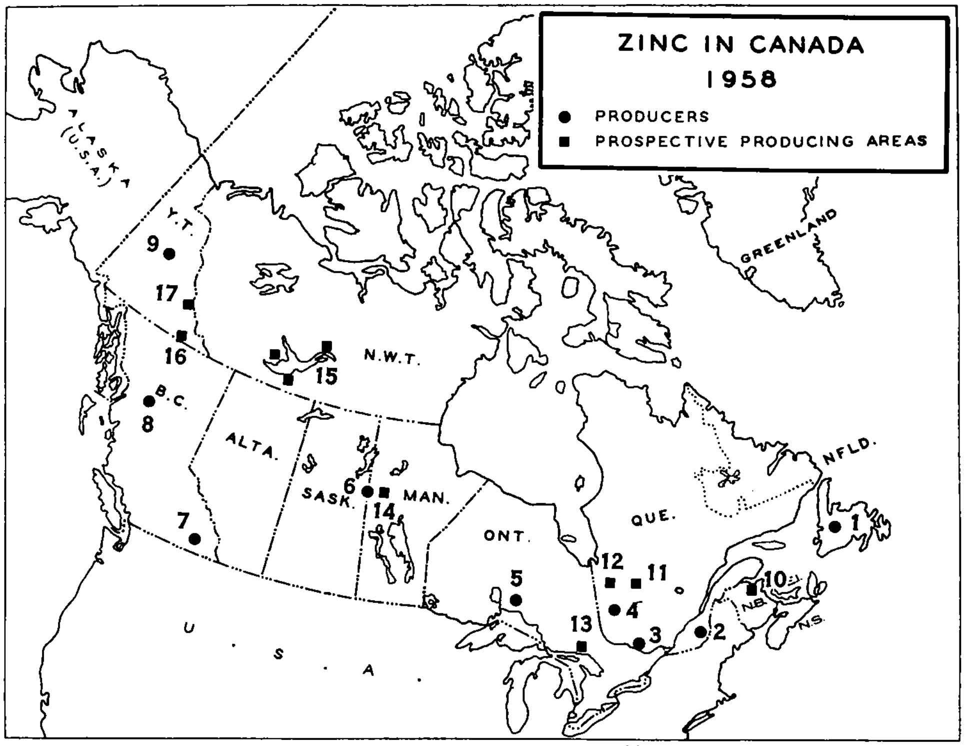
	Production		Exports			Consumption(3)
	All Forms(1)	Refined(2)	In Ore and Concentrates	Refined	Total	
1948	234,164	196,575	54,227	144,887	199,114	46,899
1949	288,262	206,045	106,684	168,307	274,991	45,670
1950	313,227	204,367	129,561	146,880	276,441	54,370
1951	341,112	218,578	154,593	146,132	300,725	61,023
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

(1) Refined zinc produced from Canadian ores, plus recoverable zinc in ores and concentrates exported.
(2) Refined zinc produced from domestic and imported ores.
(3) Refined virgin zinc only.

World Production of Zinc - Mine Basis
(short tons)

	1958*	1957	1956	1955
Canada	425,099	413,741	422,633	433,357
United States	412,005	531,735	542,340	514,671
Russia(e)	410,000	375,000	336,000	300,000
Mexico	247,031	267,889	274,348	296,959
Australia	247,472	274,320	261,620	241,376
Peru	149,093	170,257	193,038	183,072
Poland(e).........	135,000	124,500	143,500	154,500
Japan............	157,599	149,919	135,198	119,786
Italy.............	128,964	122,162	115,534	110,738
Belgian Congo	125,645	117,680	129,549	74,700
West Germany....	94,136	104,013	101,897	101,557
Other countries...	565,944	554,363	529,627	495,113
Total	3,097,988	3,205,579	3,185,284	3,025,829

Source: American Bureau of Metal Statistics.
(e) Estimated.



MINERAL RESOURCES DIVISION, DEPT. M.T.S.

Producers

1. Buchans Mining Company Limited
2. Weedon Pyrite & Copper Corporation Limited
3. New Calumet Mines Limited
4. Manitou-Barvue Mines Limited
   East Sullivan Mines Limited
   Quemont Mining Corporation Limited
   Waite Amulet Mines Limited
   West Macdonald Mines Ltd.
   Normetal Mining Corporation Limited
5. Geco Mines Limited
   Willroy Mines Limited
6. Hudson Bay Mining and Smelting Co. Limited (also refinery)
7. Reeves MacDonald Mines Limited
   Canadian Exploration Limited
   Consolidated Mining and Smelting Company of Canada Limited, The (also refinery)
   Sheep Creek Mines Limited
   Sunshine Lardeau Mines Limited
   ViolaMac Mines Limited
   Yale Lead and Zinc Mines Limited
   Slocan Van Roi Mines Limited
   Western Exploration Co. Ltd.
   Highland-Bell Limited
8. New Cronin Babine Mines Limited
9. United Keno Hill Mines Limited

Prospective Producing Areas

10. Bathurst
11. Bachelor Lake
12. Mattagami Lake
13. Sudbury Basin
14. Snow Lake
15. Great Slave Lake
16. Watson Lake
17. Hyland River
    Pelly River

were the following: 1) under paragraph 393, the dutiable zinc content of zinc-bearing ores of all kinds, except pyrites containing not more than 3 per cent zinc, and except any ores and concentrates containing less than 1 per cent zinc; and 2) under paragraph 394, all articles specified except zinc dust, namely, zinc in blocks, pigs or slabs, old and worn-out zinc fit only to be remanufactured, zinc dross and zinc skimmings, all gross weight. The Canadian quota for zinc-bearing ores was set at 33,240 short tons per quarter and, for the zinc-metal articles in 2), at 18,920 short tons per quarter.

Developments at Producing Mines

British Columbia

The Consolidated Mining and Smelting Company of Canada Limited produced 3,157,956 tons of ore from its three mines. Its ore production in 1957 was 3,273,613 tons. The 2,443,884 tons produced from the Sullivan mine at Kimberley brought its ore production since 1910 to just over 76 million tons. The open-pit section of the mine remained closed. From the H.B. mine, 22 miles east of Trail, 458,213 tons were mined, and from the Bluebell mine, on the east shore of Kootenay Lake, 255,859 tons.

Zinc concentrates from Cominco's mines, together with custom ores and concentrates from British Columbia, Yukon and foreign shippers, were treated in the electrolytic zinc refinery at Trail. Output from all sources in 1958, including some metal sold in unrefined products, was 193,514 tons; in 1957 it was 189,295 tons. Of the combined zinc and lead production of 328,341 tons, approximately 64 per cent was derived from Sullivan concentrates, 17 per cent from the concentrates of other company mines, 9 per cent from purchased ores and concentrates and 10 per cent from the retreatment of stockpiles of zinc-plant residues and lead-blast-furnace slag.

Canadian Exploration Limited mined 383,458 tons of zinc-lead ore from the Jersey mine near Salmo, and produced 24,895 tons of zinc concentrate containing 14,403 tons of zinc. Most of the tonnage was mined by underground trackless methods.

Reeves MacDonald Mines Limited, 12 miles south of Salmo, treated 417,076 tons of zinc-lead ore, from which 14,110 tons of zinc were recovered in concentrates.

Sheep Creek Mines Limited, in the Lake Windermere district, treated 192,426 tons of zinc-lead ore and produced zinc and lead concentrates, the zinc concentrate totalling 16,115 tons grading 56 per cent zinc. Production began from the lower 'A' zone during the year at a rate great enough to supply as much as 20 per cent of the ore milled.

ViolaMac Mines Limited, near Sandon, recovered 717 tons of contained zinc in concentrates produced from silver-lead-zinc ore. The ore was treated at Sandon in the 250-ton mill of Carnegie Mining Corporation Limited, a ViolaMac subsidiary. In previous years ViolaMac ore was custom-milled by Western Exploration Co. Ltd. at Silverton.

Highland-Bell Limited, at Beaverdell, milled 18,729 tons of silver-lead-zinc ore and produced 636 tons of zinc concentrate. Its principal metal production was 900,669 ounces of silver.

Britannia Mining and Smelting Company Ltd. suspended production at its Howe Sound copper-zinc mine in March 1958 owing to low base-metal prices. In 1957, the output of contained zinc was 9,403 tons. Operations were resumed early in 1959, but on a reduced scale of 1,200 tons of ore a day.

In May, Sunshine Lardeau Mines Limited, near Camborne, completed the mining of available lead-zinc-silver ore and shut down its 75-ton mill. In the fiscal year ended on October 31, 1958, the mill treated 16,443 tons grading 9.24 per cent zinc, 8.15 per cent lead and 11.48 ounces of silver per ton. In addition, 671 tons of crude silver-lead-zinc ore were shipped for direct smelting. Leasing operations continued until September, and all production then ended.

Silver Standard Mines Limited, near Hazelton, carried out salvage operations until May and then shut down its 80-ton mill. In the fiscal year ended on March 31, 1958, the mill treated 20,169 tons of silver-lead-zinc ore, from which 788 tons of zinc in concentrates were recovered.

Yale Lead and Zinc Mines Limited, at Ainsworth, milled 51,480 tons of lead-zinc-silver ore, from which 722 tons of zinc were recovered in concentrates. Zinc concentrate was stockpiled at the mine; lead concentrate was shipped for smelting. Mining was suspended in December, but the mill continued to operate, treating custom ores.

Western Exploration Co. Ltd. closed its 250-ton mill at Silverton in December, but development work continued on the company's mining properties near Silverton.

Other producers of zinc concentrate included New Cronin Babine Mines Limited, near Smithers; Lajo Mines Limited, near Kaslo; and Slocan Van Roi Mines Limited, at Silverton.

Manitoba and Saskatchewan

Hudson Bay Mining and Smelting Co. Limited, Canada's second largest zinc producer, mined 1,518,014 tons of copper-zinc ore from the Flin Flon mine on the provincial boundary and, late in the year, 6,040 tons from the Schist Lake mine, 3 1/2 miles southeast of Flin Flon. Production from the Schist Lake mine was resumed after the deepening of the main shaft to 2,281 feet below the surface, which began in August 1957. At the company's electrolytic zinc plant at Flin Flon, 94,281 tons of zinc concentrate and 55,983 tons of fume and stack dust were treated to produce 59,849 tons of slab zinc. In 1957 the production of slab zinc was 58,800 tons. There were also produced 35,364 tons of zinc-plant residue, 35,005 tons of which were treated at the copper smelter for the subsequent recovery of zinc from zinc-oxide fume. The rest was sent to stockpile.

Ontario

Geco Mines Limited, at Manitouwadge, milled 1,286,129 tons of copper-zinc ore in its first full year of operation. From the 3,300-ton mill, 35,061 tons of zinc concentrate containing 19,743 tons of zinc were produced. Zinc concentrate was shipped to a United States smelter for refining. Ore for the mill was drawn from the westerly 'A' zone, and stope development was carried out in both 'A' and 'B' zones. Preparations were begun at year-end for the sinking of an internal shaft to develop the downward extension of the 'C' ore zone.

Willroy Mines Limited, adjoining Geco on the west, milled 330,982 tons of zinc-copper-lead ore in its first full year of operation, producing 62,720 tons of zinc concentrate grading 55 per cent zinc, and smaller amounts of copper and lead concentrates. The zinc concentrate was shipped to United States and Belgian smelters for treatment. Shaft-deepening was started 800 feet below the collar with the 1,450-foot horizon as the objective.

Quebec

Quemont Mining Corporation Limited, in Rouyn-Noranda county, milled 859,170 tons of copper-zinc ore, from which 41,016 tons of zinc concentrate containing 21,146 tons of zinc were produced.

Manitou-Barvue Mines Limited (formerly Golden Manitou Mines Limited) Abitibi East county, treated 183,690 tons of zinc-lead ore and 295,790 tons of copper ore in a split-circuit mill, and produced 11,154 tons of zinc in zinc concentrate.

Normetal Mining Corporation Limited, Abitibi West county, treated 355,374 tons of copper-zinc ore and produced 21,078 tons of zinc concentrate containing 10,874 tons of zinc.

Waite Amulet Mines Limited, in Rouyn-Noranda county, milled 288,206 tons of copper-zinc ore, from which 14,548 tons of zinc concentrate containing 7,625 tons of zinc were recovered.

West Macdonald Mines Ltd., in Rouyn-Noranda county, produced zinc-pyrite ore at the rate of 730 tons a day. The ore was transported by a 6-mile aerial tramway to the Waite Amulet mill for treatment. Zinc concentrate containing 8,800 tons of zinc was produced. Reduced demand for pyrite and United States import quotas on zinc forced suspension of operations in January 1959.

East Sullivan Mines Limited, Abitibi East county, milled 896,375 tons of copper ore containing a small amount of zinc. By March of the year under review, zinc concentrates containing 375 tons of zinc had been recovered. Zinc production was then suspended because of low prices.

New Calumet Mines Limited, in Pontiac county, milled 104,844 tons of zinc-lead-silver ore in the fiscal year ended on September 30, 1958, and recovered 8,174 tons of zinc contained in concentrate. Mining was on a reduced scale owing to low zinc and lead prices.

Weedon Pyrite & Copper Corporation Limited, in Wolfe county, milled 138,594 tons of copper-pyrite-zinc ore and recovered 537 tons of zinc concentrate grading 50.1 per cent zinc, as a by-product of copper and pyrite output.

New Brunswick

Heath Steele Mines Limited suspended its breaking-in operations in March at the lead-zinc-copper mine 32 miles northwest of Newcastle because of low metal prices. The mine and 1,500-ton mill were placed on a stand-by basis pending an improvement in prices.

Newfoundland

The Buchans unit of American Smelting and Refining Company milled 389,000 tons of zinc-lead-copper ore, 18,000 tons more than in the previous year, and produced concentrates of zinc, lead and copper, the zinc concentrates totalling 66,366 tons. The estimated recoverable zinc content of all concentrates was 36,301 tons. Sinking of the MacLean shaft, designed to open up the deeper-seated orebody in the extension of the Rothermere ore zone, continued during the year and a depth of 2,146 feet was reached at year-end.

Yukon Territory

United Keno Hill Mines Limited, Mayo district, milled 175,058 tons of silver-lead-zinc ore in the fiscal year ended on September 30, 1958, and produced 9,305 tons of zinc in zinc and lead concentrates. The Calumet mine supplied 51 per cent of the mill feed, and the Hector mine 35 per cent. The rest was development ore from the Elsa and Keno mines, some ore from dumps and a small amount derived from clean-up operations at the Galkeno mine. The last-mentioned mine was purchased during the year from Northwest Mines and Oils Limited (formerly Galkeno Mines Limited) along with a 220-ton mill and other equipment and mineral claims.

Other Developments

British Columbia

The Jordan River lead-zinc prospect in the Revelstoke district, held by American Standard Mines Limited, was examined under an option by The Bunker Hill Company, which completed sampling and mapping of the property.

Manitoba

Mine development continued on two of the four Snow Lake deposits owned by Hudson Bay Mining and Smelting Co. Limited. At Chisel Lake, 5 miles southwest of Snow Lake, the shaft was deepened 676 feet to a point 1,163 feet below the surface, and lateral development was started on four levels. Drainage of Chisel Lake was partially completed. At Stall Lake, 4 miles southeast of Snow Lake, the shaft was deepened 872 feet to a point 1,585 feet below the surface, and permanent hoist and headframe installations were completed. No work was done at the Ghost Lake and Osborne Lake properties, near Snow Lake. The ore reserves of the Snow Lake deposits remained unchanged at 5,319,000 tons grading 8.7 per cent zinc, 1.37 per cent copper, 0.7 per cent lead, and 1.51 ounces of silver and 0.05 ounce of gold per ton. In the Sherridon area the company located a low-grade deposit containing approximately 3.7 million tons grading 1.1 per cent zinc and 1.42 per cent copper.

Saskatchewan

Hudson Bay Mining and Smelting Co. Limited continued underground development at the Coronation mine, 13 1/2 miles southwest of Flin Flon.

Quebec

The Watson Lake deposit in the Mattagami Lake area, held by the six-company Mattagami Syndicate, was optioned by Noranda Mines, Limited, Canadian Exploration Limited and McIntyre Porcupine Mines Limited, which carried out an extensive program of diamond-drilling. Indicated reserves were increased from the 14 million tons outlined in 1957 to about 20 million tons grading 13 per cent zinc, 0.7 per cent copper, and 1.3 ounces of silver and 0.02 ounce of gold per ton.

Orchan Mines Limited diamond-drilled an adjoining property to the south of the Watson Lake deposit.

New Hosco Mines Limited located copper and zinc mineralized zones in Daniel township, in the Mattagami area, containing an estimated 716,000 tons grading 8.2 per cent zinc and 1,600,000 tons grading 2.5 per cent copper. A total of 41,252 feet of diamond-drilling was completed by year-end.

Early in 1958, The Coniagas Mines Limited discontinued exploration and development of the Bachelor Lake deposit, about 100 miles northwest of Barraute, owing to low metal prices. Reserves to the 625-foot horizon totalled 407,310 tons averaging 15.7 per cent zinc, 1 per cent lead and 8.8 ounces of silver per ton.

New Brunswick

Brunswick Mining and Smelting Corporation Limited suspended mine development and pilot-mill testing in March at its two large zinc-lead-copper deposits 12 miles and 17 miles southwest of Bathurst, owing to the unfavourable market outlook for zinc and lead. The sinking of No. 2 shaft, at No. 12 mine, was completed to 973 feet, the depth of the first mining lift. The flotation-research program was directed towards a comparison of bulk-flotation procedures carried out on No. 12 mine ore and selective procedures previously tested. Flotation tests were run also on samples of No. 6 mine ore. Pilot-testing on the refining of Brunswick ores was carried out at Josephtown, Pennsylvania, and economic studies were continued on the relative merits of leaching techniques and improved blast-furnace methods.

Nigadoo Mines Limited, 14 miles northwest of Bathurst, continued exploration and underground development until mid-year and then suspended operations owing to the low base-metal prices prevailing. Mineral-dressing tests were carried out in the Keymet mill, 15 miles north of Nigadoo, purchased in 1957 for ore-testing purposes and eventual production.

Northwest Territories

No work was done at Pine Point, on the south shore of Great Slave Lake, on the large zinc-lead deposits of Pine Point Mines Limited, a subsidiary of The Consolidated Mining and Smelting Company of Canada Limited, previous exploration having outlined adequate reserves.

Uses

The main consuming industries and the tonnages used by each are shown on page 250.

In galvanizing, the principal use, zinc is applied as a protective coating to iron or steel to prevent rusting. This is done usually by hot-dipping methods, but for some purposes electroplating is used. The Steel Company of Canada Limited and Dominion Foundries and Steel Limited, both of Hamilton, Ontario, are the principal consumers of zinc for galvanizing. Both companies operate continuous-strip galvanizing lines.

Zinc-base alloys containing high-purity zinc, to which is added 3 to 4 per cent aluminum, as much as 1.3 per cent copper, and 0.03 to 0.08 per cent magnesium, are used extensively for die-casting complex shapes, particularly automobile parts. Schultz Die Casting Company of Canada Limited, at Wallaceburg, Ontario, and Barber Die Casting Company Limited and Pressure Castings of Canada Limited, in the Toronto-Hamilton area, are among the leading consumers of zinc for use in die-casting.

Brass, a copper-zinc alloy containing as much as 50 per cent zinc, has many industrial uses, particularly as sheets and strips, as tubes, rods and wire, and as castings and extruded shapes. Its use in the arts dates back many centuries. The principal makers of brass mill products in Canada are Anaconda American Brass Limited, New Toronto; Noranda Copper and Brass Limited, Montreal; and Canadian Arsenals Limited, Quebec.

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 Durhams Industries (Canada) Limited, both in Montreal, and Canadian Felling Zinc Oxide Limited, Milton, Ontario.

Rolled zinc is used principally for making flashlight-battery cups, terrazzo strip, articles exposed to corrosion such as weather stripping, roofing drains and gutters, and anticorrosion plates for boilers and ships' hulls. Burgess Battery Company Limited, Niagara Falls, is the only producer of rolled zinc in Canada, 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. Among 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; 'Prime Western', for galvanizing. In Canada, zinc is refined by the electrolytic process only, by which Special High Grade and High Grade zinc are produced. To meet consumer requirements for Prime Western, Canadian producers add lead in small amounts to the higher grades.

The United States regularly consumes about one third of the world's zinc production. In 1958, Canadian shipments to this market amounted to 258,244 tons of zinc. Industrial consumption of slab zinc in the United States in 1958, 1957 and 1956 was as follows:

	Short Tons		
	1958	1957	1956
Galvanizing	381,229	367,757	439,146
Zinc-base alloys	316,830	376,039	360,507
Brass products	101,375	112,390	124,004
Rolled zinc	40,616	41,269	47,359
Zinc oxide	13,331	20,428	19,160
Other uses	14,946	17,737	18,614
Total	868,327	935,620	1,008,790

Source: Mineral Industry Surveys, Bureau of Mines, U.S. Department of the Interior.

Prices and Tariffs

The Canadian price of Prime Western zinc was 10 cents a pound from the beginning of the year until the beginning of October, when it was increased to 10.25 cents. In the middle of October the price was increased to 10.5 cents and at the end of October to 11 cents. In the middle of November the price rose to 11.5 cents a pound, where it remained for the rest of the year.

The United States price of Prime Western zinc, East St. Louis, was 10 cents a pound from the beginning of the year to October 2, when it was increased to 10.5 cents. The price was increased on October 8 to 11 cents, on November 7 to 11.25 cents, and on November 10 to 11.5 cents, where it remained for the rest of the year.

Zinc ores and concentrates entered Canada duty-free; slab zinc was subject to a 0.75-cent-a-pound British preferential duty, a 1-cent-a-pound most favoured nation duty and a 2-cent-a-pound general duty. Varying schedules were applied to imports of zinc in semifabricated 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 cent a pound. Varying tariffs were applied to imports of zinc in other forms.

ABRASIVES

J.S. Ross

An abrasive product is composed completely or in part of artificial or natural abrasive materials.

A natural abrasive is any mineral or rock employed for its grinding, smoothing, polishing or eroding qualities. Such raw materials normally require beneficiation, such as crushing, sizing, separation or concentration. Few are employed solely for abrasive uses. Abrasives may be classified according to their degree of abrasive properties, the high-grade variety including diamond, corundum, emery and garnet. Many of the rocks or minerals with a high silica content, such as quartz, quartzite, flint, sandstone, pumice, pumicite and feldspar, are classed as 'low-grade'. Mild abrasives used for polishing and scouring include diatomite, tripoli, rottenstone, chalk, lime and clay. Abrasives are also classified as 'technical' and 'nontechnical', the technical variety being used in grinding wheels, coated cloths and papers, and loose grains for precise smoothing and polishing. The nontechnical variety is employed for such uses as sand-blasting and scouring.

Artificial abrasives are those that are manufactured and, like natural abrasives, may be classified as to quality and use. The most common, silicon carbide and fused alumina, belong to the high-grade class.

Although the production of natural abrasives in Canada has been small, various types have been marketed since 1886. The value of production for 1958 is insignificant and unavailable. Owing primarily to the decreased consumption of fused alumina by the iron-and-steel-products industry, the production of artificial abrasives during 1958 decreased 26.6 per cent. Canada is by far the largest producer of crude artificial abrasives, mainly because of its large supply of cheap hydro power and proximity to the United States. Fused alumina and silicon carbide are the main types manufactured.

The value of the exports of natural and artificial abrasives was 32 per cent less in 1958 than in 1957 mainly owing to a reduction in the manufacture of metallic commodities and, in particular, of automobiles and trucks. The bulk, crude variety represents 97 per cent of the value of exports, and almost all the production of crude abrasives. The value of imports, represented mostly by natural abrasives, decreased 34 per cent from 1957 to 1958. This change is due mainly to the 50-per-cent decrease in imports of diamonds used in mining and other industries.

Abrasives - Production, Trade and Consumption

	1958 Short Tons	1958 $	1957 Short Tons	1957 $
Production				
Artificial abrasives				
Crude silicon carbide(1).......	77,528	11,676,630	83,321	11,828,856
Crude fused alumina(1)	109,507	10,994,270	218,187	21,902,425
Abrasive wheels and segments.		6,013,543		7,100,348
Sharpening stones and files....		256,585		308,067
Other products (2)............		7,540,404		8,542,597
Total		36,481,432		49,682,293
Imports				
Natural and artificial abrasives(3)				
Artificial abrasive grains		1,921,437		2,199,990
Diamonds, black and bort for borers....................		5,460,487		10,825,940
Emery in bulk(4)		235,041		248,887
Grinding wheels, bonded, with natural or artificial grains...		1,818,523		1,947,311
Grinding stones or blocks, manufactured by bonding together either natural or artificial abrasive, n.o.p.(5)		292,516		407,882
Grindstones not mounted, and not less than 36 inches in diameter		9,171		12,982
Grindstones, n.o.p.		5,508		6,748
Pumice and pumice stone, lava and calcareous tuffa, not further manufactured than ground		297,964		254,427
Coated abrasive paper and cloth		799,906		725,652
Manufactures of abrasives n.o.p.		580,604		625,769
Total.......................		11,421,157		17,255,588

Abrasives - Production, Trade and Consumption (cont'd)

	1958 Short Tons	1958 $	1957 Short Tons	1957 $
Exports				
Natural and artificial abrasives(3)				
Abrasives, natural, n.o.p., in ore, bulk, crushed or ground form	23	8,861	58	19,472
Abrasives, artificial, crude	188,601	22,717,376	306,533	33,911,082
Abrasives, artificial, manufactured		41,236		24,606
Sandpaper and emery cloth		731,043		651,811
Grindstones, manufactured		71,420		45,822
Total		23,569,936		34,652,793
Consumption(6)				
Abrasives, natural and artificial, in the production of artificial abrasive products				
Natural-abrasive grains				
Garnet	252	78,781	217	59,276
Emery	43	8,938	61	10,946
Quartz or flint	145	10,004	148	10,065
Other		1,306		1,800
Total		99,029		82,087
Artificial-abrasive grains for wheels, paper, etc.				
Fused alumina	1,656	440,657	2,748	798,644
Silicon carbide	3,237	761,568	2,182	621,083
Total	4,893	1,202,225	4,930	1,419,727

(1) Includes material used in refractories and for other nonabrasive purposes.
(2) Includes abrasive cloth, abrasive paper, abrasive tiles, artificial pulpstones, boron carbide and fused magnesia.
(3) Trade of Canada.
(4) Includes also corundum and garnet. Separation not possible.
(5) n.o.p. = not otherwise provided.
(6) Does not include the consumption of such natural abrasives as diamonds, pumice and calcareous tufa, nor the consumption of natural and artificial grains for use as loose grains.

Complete statistics for the Canadian consumption of natural and artificial abrasives, which consist largely of industrial diamonds, are not available.

Domestic Producers

The natural abrasives produced in Canada are limited to the low-grade variety and are employed in nontechnical uses. The abrasive mineral commodities are quartzite, beach sand, feldspar and granite.

Dominion Silica Corporation Limited crushes and sizes quartzite at Lachine, Quebec, for use as quartz sand for sand-blasting purposes. Beach sands from local deposits are consumed in unknown amounts for the same purpose. Feldspar produced in Quebec is used in the manufacture of scouring powders, cleansers and other abrasives.

The crude artificial abrasives - fused alumina and silicon carbide - are produced by six companies in eight plants in Ontario and Quebec. Canadian Carborundum Company, Limited, has plants at Niagara Falls, Ontario, and Shawinigan, Quebec; Norton Company owns plants at Chippawa, Ontario, and Cap-de-la-Madeleine, Quebec; The Exolon Company has a plant at Thorold, Ontario; Electro Refractories & Abrasives Canada Ltd. has a plant at Cap-de-la-Madeleine, Quebec; Simonds Canada Abrasive Company Limited owns a plant at Arvida, Quebec; and Lionite Abrasives Ltd. operates a plant at Niagara Falls, Ontario.

Technology

Natural abrasives generally have many substitutes. Except in the case of diamonds, the relative importance of high-grade natural abrasives has declined greatly owing to the artificial-abrasive substitutes, silicon carbide and aluminum oxide. Since 1957, however, when General Electric Company announced the pilot-plant production of synthetic industrial diamonds of 60-mesh and finer size, there has been increasing competition in the field of industrial diamonds. The production of synthetic diamonds in 1957 was relatively small. The natural-industrial-diamond industry experienced record production, with a value 14 per cent higher than in the previous year. General Electric Company estimated that its output of synthetic diamonds in 1958 would be 3.5 million carats, approximately 20 per cent of the world supply of industrial diamonds. The company is expanding its facilities to provide an eventual rated output equal to 70 per cent of present industrial-diamond abrasive requirements.

Industrial diamonds are used in shapes and grains for grinding rock, glass and metal and for cutting such materials as metal, rock and glass.

Corundum

Corundum is a hard, brittle mineral having a hardness of 9 and consisting entirely of aluminum oxide. It is found in rocks containing relatively high amounts of alumina, and is used mainly in the manufacture of grinding wheels.

During the first quarter of this century Canada accounted for most of the world output of corundum, its chief source of supply being the Craigmont deposit northeast of Bancroft, Ontario, which has been idle since 1946. With the increased consumption of artificial abrasives and the discovery of better deposits of corundum in Africa, Canadian production ceased. None of the imported corundum was mined in the United States. It probably came from Rhodesia and Nyasaland and from the Union of South Africa.

Emery

Emery is also imported into Canada. Black emery is a natural aggregate of corundum and magnetite and may contain varying amounts of spinels and hematite. Grey emery is a cordierite-sillimanite and sillimanite-corundum mixture of varying magnetite content.

Although no emery has been produced in Canada, a coarse-grained variety occurs in southeastern Ontario east of the Madawaska River. Greece and Turkey are the largest producers of emery, and the United States is the third largest, all of its output being of the grey type.

Grey emery is used chiefly in heavy-duty concrete and asphalt to provide a nonslip smooth surface that can withstand the abuse of industry and traffic. It is also used for the same purpose on stair treads. Black emery is used in grinding wheels, abrasive sticks and coated papers.

Garnet

All garnet consumed in Canada is imported from the United States, where the chief source is the deposit near North Creek, New York, owned by The Barton Mines Corporation.

Almandite, the most common variety of garnet, is an iron-aluminum silicate which occurs in metamorphic rocks, beach sands and other alluvial deposits. In the past, relatively small tonnages of garnet have been mined in Ontario, mainly in Ashby and Dana townships. Numerous other garnet occurrences are found in British Columbia, Ontario, Quebec and the Maritime Provinces.

Garnet is employed as a technical abrasive in coated abrasives for abrading wood, leather, rubber, plastics, brass and grinding valves. Loose grains are used for polishing glass and stone. The type of garnet preferred for nontechnical uses is one that does not break down readily. Loose grains are used for sand-blasting and metal-spraying.

Pumice and Pumicite

Pumicite is fine volcanic dust composed of striated sharp angular fragments, whereas pumice is essentially the lump form of pumicite occurring as a light vesicular glassy volcanic rock.

Pumice covers an area of 100 square miles to an average depth of 1 foot in the Bridge River area, Lillooet mining division, British Columbia. An extensive deposit of volcanic ash covers much of southern Yukon Territory and adjacent parts of Northwest Territories and Alaska. The pumicite deposit is up to 400 feet thick and has an estimated volume of 12 cubic miles. Extensive but thin beds of pumicite occur in Saskatchewan, Alberta and British Columbia, generally far from markets.

Pumice is used in polishing compounds, abrasive soaps, plaster and acoustic stucco, and as a lightweight aggregate in concrete. Pumicite is employed in the preparation of wood and metal surfaces and in glass-polishing.

Fused Alumina and Silicon Carbide

Fused alumina is produced from imported bauxite by fusion in electric furnaces. Silicon carbide is manufactured in electric furnaces, essentially from the combination of silica sand with carbon. Both compounds are among the hardest materials known. When crushed and sized, they may be put to abrasive use as loose grains, in such bonded shapes as grinding-wheels and grinding-stones, or as abrasive coating on cloth or paper.

Prices

The E & M J Metal and Mineral Markets of December 4, 1958, quotes United States prices as follows:

Bauxite	Per long ton, imported abrasive grade, calcined, crushed, 86% min. Al_2O_3, f.o.b. ports British Guiana	$ 19.95		
Corundum	Per short ton, c.i.f. U.S. ports (nominal)	$100.00	to	$120.00
Pumice stone	Per lb in barrels, f.o.b. New York or Chicago			
	Powdered	3¢	to	5¢
	Lump	6¢	"	8¢

Production of Lightweight Aggregates*

	1958		1957	
	Cubic Yards	$	Cubic Yards	$
From domestic raw materials				
Expanded clay and shale	214,400	1,231,270	240,285	1,333,700
Expanded slag	188,700	434,670	189,500	443,000
	Cubic Feet		Cubic Feet	
From imported raw materials				
Exfoliated vermiculite	8,219,670	1,866,640	7,361,760	1,473,700
Expanded perlite	3,553,415	1,031,497	2,762,700	707,200
Pumice		78,000		78,000
Total		4,642,077		4,035,600

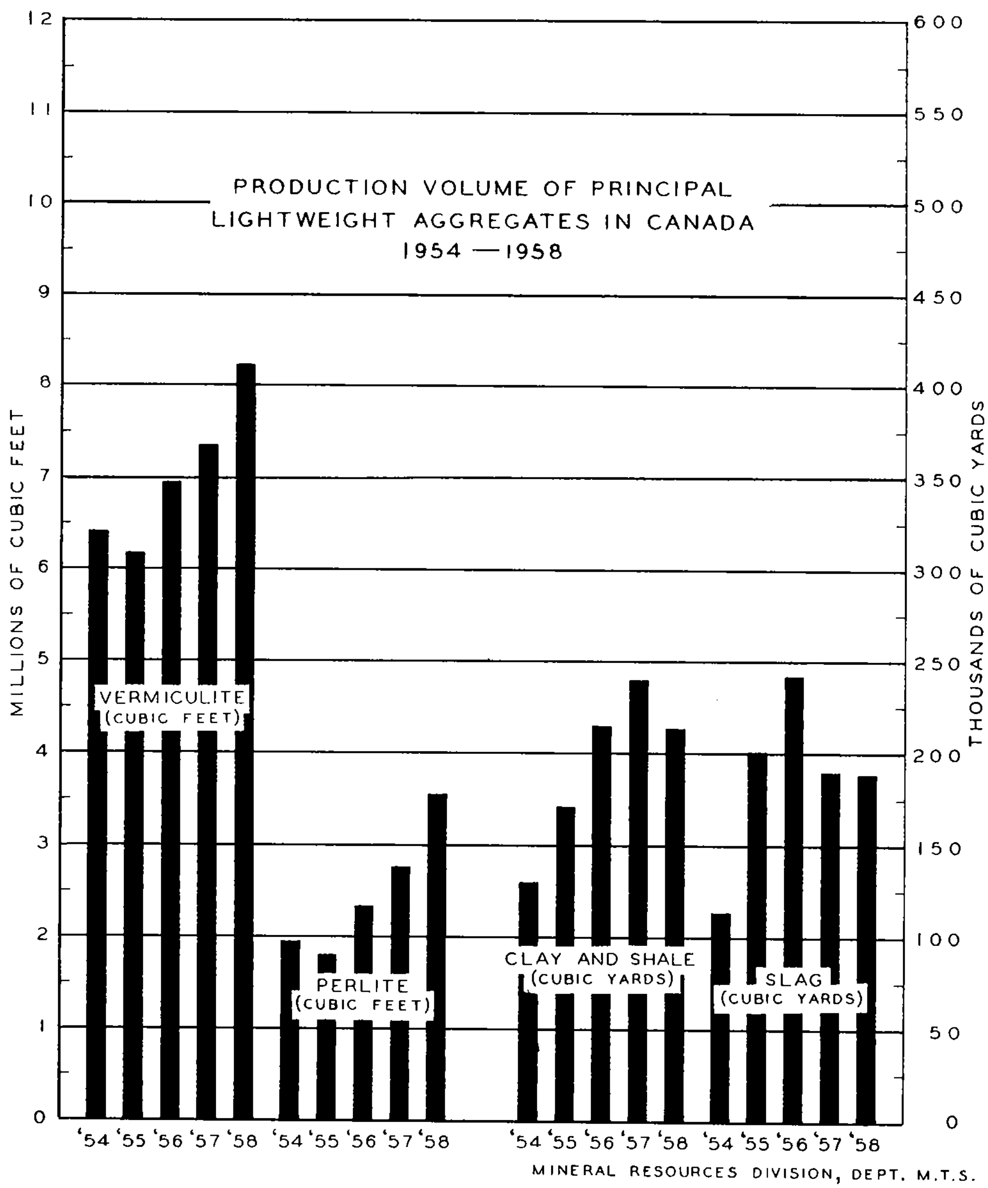
*Information supplied directly by the producers.

Raw Materials

The common clays and shales are the most widespread of the materials used in the production of lightweight aggregate. Eight plants were in operation during the year, the one longest in production being at Cooksville, Ontario. The others are at St. Boniface (near Winnipeg), Regina, Calgary and Edmonton and at Abbotsford, British Columbia. All these plants use rotary kilns to expand the raw material.

Expanded blast-furnace slag is a by-product of the iron-and-steel industry. The lightweight aggregate is processed at Hamilton, Ontario, and Sydney, Nova Scotia, where steel plants are located.

Vermiculite is a type of hydrous mica that exfoliates when heated to form a highly cellular material possessing good insulating qualities. All of the raw vermiculite exfoliated in Canada is imported from the Transvaal, Union of South Africa, and the United States. Five companies produce vermiculite from imported raw material at 11 locations, namely, Vancouver, New Westminster, Calgary, Regina, Winnipeg, St. Thomas, Cornwall, Rexdale, Toronto, St. Laurent and Montreal.



Perlite is a volcanic rock which pops when heated, the result being a white cellular product of low density. Deposits occur in central British Columbia, but they have not been developed commercially. Raw material is imported from the United States for processing. Eight plants were in operation during the year. They are located at Caledonia and Hagersville in Ontario, at Montreal, Ville St. Pierre and Beauport in Quebec, and at Winnipeg, Calgary and New Westminster.

Lightweight-aggregate Plants in Canada

Producing Plants	Location	Aggregate
Aggregates and Construction Products Ltd.	Regina, Sask.	Expanded clay
Atlas Light Aggregate Limited	St. Boniface, Man.	" "
Edmonton Concrete Block Company Limited	Edmonton, Alta.	" "
Light Aggregate (Sask.) Ltd.	Regina, Sask.	" "
Burtex Industries Limited	Calgary, Alta.	Expanded shale
Consolidated Concrete Industries Limited	Calgary, Alta.	" "
The Cooksville-Laprairie Brick Company Ltd.	Cooksville, Ont.	" "
Clayburn-Harbison Ltd.	Abbotsford, B.C.	" "
Dominion Iron and Steel Limited	Sydney, N.S.	Expanded slag
National Slag Limited	Hamilton, Ont.	" "
F. Hyde and Company Limited	Montreal, Que.	Vermiculite
	Toronto, Ont.	"
	St. Thomas, Ont.	"
Insulation Industries (Canada) Ltd.	Vancouver, B.C.	"
	Calgary, Alta.	"
	Regina, Sask.	"
	Winnipeg, Man.	"
Perlite Industries Limited	New Westminster, B.C.	"
Siscoe Vermiculite Mines Limited	Cornwall, Ont.	"
	Rexdale, Ont.	"
Vermiculite Insulating Limited	St. Laurent, Que.	"
Canadian Gypsum Company Limited	Hagersville, Ont.	Perlite
Canadian Perlite Corporation	Montreal, Que.	"

Lightweight-aggregate Plants in Canada (cont'd)

Producing Plants	Location	Aggregate
Gypsum Lime and Alabastine (Canada) Limited	Caledonia, Ont.	Perlite
Perlite Atlas Limited	Beauport, Que.	"
Perlite Industries Reg'd.	Ville St. Pierre, Que.	"
Perlite Industries Limited	New Westminster, B.C.	"
Perlite Products Ltd.	Winnipeg, Man.	"
Western Perlite Company Ltd.	Calgary, Alta.	"
McCleery and Weston Limited	Vancouver, B.C.	Pumice
Plants under Construction		
Featherock Inc.	Pierreville, Que.	Expanded clay
British Columbia Lightweight Aggregates Limited	Saturna Island, B.C.	" shale

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. None is produced in Canada, as the known deposits are either too small or too far from transportation facilities.

Uses

Clay and Shale

Approximately 92 per cent of production was used as aggregate in concrete blocks and other lightweight concrete shapes, 4 per cent in ready-mix concrete and 4 per cent as loose insulation, roofing aggregate and refractories.

Expanded Slag

Ninety-five per cent of the amount produced was used as aggregate in concrete block, 4 per cent in other precast concrete shapes and 1 per cent in roofing and in roof and floor fill.

Vermiculite

Sixty-four per cent of expanded vermiculite was used as loose insulation, 27 per cent in insulating plaster, 6 per cent as aggregate in lightweight concrete and 3 per cent in acoustic plaster and heat-insulating materials and for agricultural purposes.

Perlite

Ninety-one per cent of expanded perlite was used in lightweight plaster, 3 per cent in concrete and 6 per cent in acoustic plaster and tile, oil-field cement, stucco admix and loose insulation and for horticultural purposes.

Pumice

All pumice imported was used as aggregate in concrete block.

Prices

Expanded-clay-and-shale aggregates sold at $5 to $6.50 a cubic yard, and expanded slag at $2.25 to $3.25 a cubic yard. Vermiculite sold at 20 to 30 cents a cubic foot, and perlite at 25 to 35 cents a cubic foot. Vermiculite and perlite are marketed in bags, each containing 4 cubic feet.

ARSENIC TRIOXIDE

J.S. Ross

Refined arsenic trioxide, arsenious oxide or white arsenic, commonly more than 99 per cent pure, is a white powder produced from arsenical ores. It is the basic compound from which other arsenic compounds and arsenic metal are produced. During 1958, arsenic trioxide was the only form of arsenic sold by the Canadian producer. To prevent air and stream pollution, the commodity is recovered as a by-product from gases given off during the roasting of arsenical metallic ores. Normally, recovery far exceeds demand, with the result that much of the output has to be carefully disposed of because of its toxic effects.

Refined arsenic trioxide has been produced in Canada almost continuously since records were first kept in 1885. As in recent years, Deloro Smelting and Refining Co. Ltd., at Deloro, Ontario, is the sole producer. The shipments of 1958 were 37 per cent less in quantity than those of 1957.

Exports, down 47 per cent from 1957, represented 73 per cent of production. All exports went to the United States; none were sent, as in other years, to the United Kingdom as well.

Canada is self-sufficient in arsenic trioxide. Imports of arsenical compounds increased nearly 2 per cent in quantity.

World recovery of the commodity amounted to an estimated 40,000 short tons in 1958, the United States being the leading producer. Canadian recovery is one tenth that of the United States. Canada will be self-sufficient in arsenic trioxide for the foreseeable future.

Domestic Production

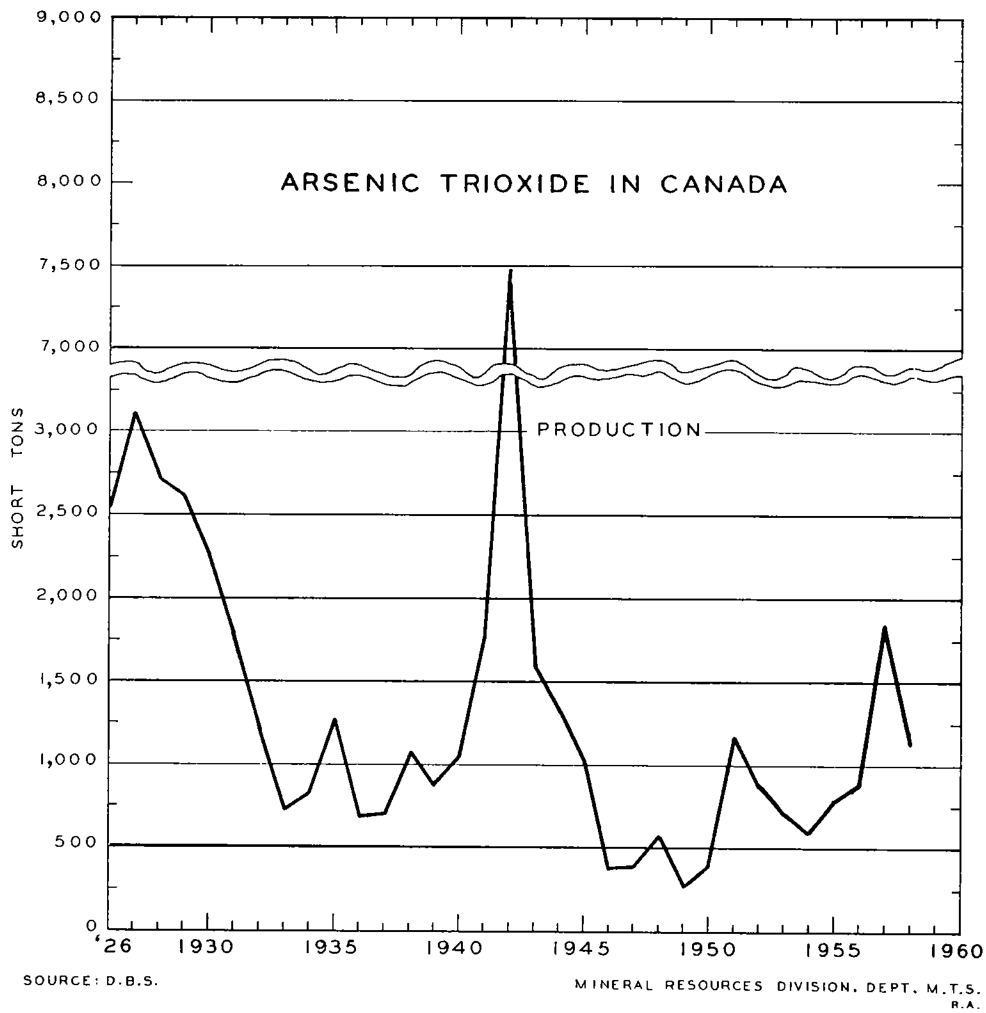
Deloro Smelting and Refining Co. Ltd. recovers refined arsenic trioxide as a by-product from the smelting of silver-cobalt custom concentrates from the Cobalt and Gowganda areas of northern Ontario. Arsenic occurs in these concentrates as arsenides and sulpharsenides of cobalt, iron and nickel. Plant output varies with the arsenic content of the custom ores. This content was relatively low during 1958 because of the tendency of the mines to produce silver concentrates rather than cobalt concentrates. When output exceeds demand, the surplus arsenic trioxide can be stored indefinitely in the sealed metal drums in which it is sold. During 1957 and 1958, however, shipments of refined white arsenic were greater than its actual recovery.

Arsenic - Production, Trade and Consumption

	1958		1957	
	Pounds	$	Pounds	$
Production (shipments)(1)				
Refined arsenic trioxide.....	2,323,320	94,542	3,697,317	137,112
Exports (2)				
United States	1,703,200	67,731	3,207,400	119,141
United Kingdom...........	-	-	22,400	475
Total	1,703,200	67,731	3,229,800	119,616
Imports				
Arsenic acid				
United States	507,657	16,011	519,631	18,262
Arsenate of lead				
United States	130,400	25,854	73,056	15,421
Arsenate of lime				
United States.............	85,500	6,142	81,000	4,952
Arsenate and binarseniate of soda				
United Kingdom...........	70,000	5,619	67,200	5,703
United States	51,921	25,787	89,202	38,182
Total	121,921	31,406	156,402	43,885
Grand Total	845,478	79,413	830,089	82,520

	1957	1956
Consumption		
Refined arsenic trioxide		
Glass	337,331	381,547
White metal alloys.........	73,668	81,144
Miscellaneous chemicals..	49,563	43,135
Total	460,562	505,826
Arsenic acid (As_2O_5)		
Miscellaneous chemicals..	533,023	376,826
Metallic arsenic		
White metal alloys........	16,848	9,310

(1) Includes some arsenic recovered from foreign ores.
(2) Does not include arsenic content of gold ores exported for treatment outside Canada.



Other Domestic Sources

Bralorne Mines Limited in British Columbia ships arsenical gold concentrates to a smelter at Tacoma, Washington, for refining. No payment is received for the arsenic content, nor is it accounted for in export figures.

Giant Yellowknife Gold Mines Limited and the Con and Rycon mines at Yellowknife, Northwest Territories, roast arsenical ores to improve gold recovery. The crude arsenic trioxide recovered at the Giant Yellowknife mine is disposed of underground in specially prepared rooms, whereas that from the Con and Rycon mines is disposed of in a dump. A FluoSolids roaster and a baghouse for crude arsenic trioxide collection were installed at the Giant mine during the year, thereby replacing the older roasters and increasing roaster capacity.

The crude variety is also recovered and disposed of at the Red Lake, Ontario, gold mines of Campbell Red Lake Mines Limited, Cochenour Willans Gold Mines, Limited, and New Dickenson Mines Limited.

Arsenical residues from the treatment of uranium ores by Eldorado Mining and Refining Limited at Port Hope, Ontario, are disposed of in insoluble form in a dump.

Minor amounts of arsenic are present in many other metalliferous deposits in Canada.

Consumption and Uses

Arsenic compounds produced from white arsenic are used throughout the world, mainly for their toxic effects in herbicides, insecticides, rodenticides and other pesticides. Calcium and lead arsenates are the compounds commonly used in these products. The consumption of arsenic as an insecticide in the United States varies with the boll-weevil menace in the southern states. In recent years organic and inorganic compounds have generally replaced calcium and lead arsenate in controlling insects, rodents and weeds. Pests, however, become immune to these new compounds, and it is necessary to use the compounds in rotation with a different type of poison. Thus, the use of arsenic for this purpose may not disappear altogether.

The glass industry, the world's third largest consumer of arsenic trioxide, uses it in the decolorizing and fining of glass. This industry accounted for 73 per cent of the arsenic trioxide consumed in Canada in 1957.

White arsenic is consumed in the manufacture of copper- and lead-base alloys and arsenic compounds.

Arsenic compounds are used in wood-preserving, hide-tanning and the manufacture of paint pigments. The newer method of killing and debarking trees with sodium arsenate is becoming more widespread. This method reduces peeling, drying and the cost of transporting the pulpwood.

The world outlook for arsenic consumption will remain relatively the same.

Prices

The price of arsenic trioxide during 1958, as quoted by E & M J Metal and Mineral Markets and Chemical and Engineering News was 5.5 cents a pound in barrels in carload lots. The nominal price has remained unchanged since it was reduced from 6.5 cents a pound in August 1952. From the statistics already given, however, the average price per pound received in Canada was 3.7 cents in 1957 and 4 cents in 1958.

Open-pit operation at the Cassiar asbestos mine, Mount McDame, northern British Columbia.

Courtesy Cassiar Asbestos Corporation Limited

ASBESTOS

H. M. Woodrooffe

In 1958, for the first time since 1954, Canadian asbestos shipments were less than 1 million tons. Sales of fibre during the first part of the year were below normal because of the industrial recession recently experienced on this continent. During the last quarter, however, the market strengthened, and the year's shipments of fibre reached 925,331 tons valued at $92,276,748.

The fibre-producing capacity of the Canadian industry increased by almost 20 per cent as three new operations in Quebec came into production. This marked the completion of an expansion and modernization program which, since its inception in 1950, has involved capital expenditure in excess of $100 million.

Domestic consumption of asbestos remains small, almost all production being exported to world markets. The value of United States imports was 53 per cent of the total value of production.

Canada again encountered strong competition from Russian asbestos in the European markets.

The term 'asbestos' is applied to a number of minerals occurring in fibrous form. Of these, the most widely used commercially is chrysotile, a hydrous magnesium silicate. Canada's production is entirely of this variety. Two other varieties, amosite and crocidolite, are also of considerable importance, having characteristics not found in chrysotile. Canada imports its requirements for both from the Union of South Africa.

Chrysotile occurs in several places in northern Ontario, Quebec, Newfoundland, British Columbia and Yukon Territory, but most of the occurrences are not of economic grade. Consequently, production is restricted to British Columbia, Ontario and Quebec, the last 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 Chaudière River southwest almost to Sherbrooke, approximately 80 miles east of Montreal. All the producing deposits in the province are in this region. The persistence of the mineral at depth, as established by drilling, indicates that reserves are sufficient for many years.

(text continued on page 285)

Asbestos - Production and Trade

	1958		1957	
	Short Tons	$	Short Tons	$
Production				
By shipments				
Crude	605	599,066	622	589,410
Milled fibres	342,562	62,697,511	404,016	73,219,785
Shorts and refuse	582,164	28,980,171	641,448	30,680,236
Total	925,331	92,276,748*	1,046,086	104,489,431**
By provinces				
Quebec	873,603	82,028,699	993,425	93,616,875
British Columbia	30,078	6,398,679	31,714	7,342,986
Ontario	21,650	3,849,370	20,947	3,529,570
Total	925,331	92,276,748	1,046,086	104,489,431**
Exports				
Crude				
United States	285	258,684	233	197,432
United Kingdom	95	126,100	146	173,708
West Germany	37	31,242	32	23,894
Japan	27	27,707	82	70,251
Hungary	17	13,167	-	-
Other countries	22	22,076	145	102,446
Total	483	478,976	638	567,731
Milled fibres				
United States	131,938	24,815,414	139,200	25,702,535
United Kingdom	27,086	5,799,091	28,262	6,190,473
West Germany	25,683	5,368,725	30,608	5,965,602
Australia	20,097	3,486,833	18,869	3,335,847
France	19,182	4,234,339	30,821	6,408,703
Japan	17,550	2,624,011	25,121	3,792,439
Belgium	11,276	2,305,272	20,490	4,008,821
Other countries	65,468	12,696,347	99,940	18,544,269
Total	318,280	61,330,032	393,311	73,948,689

Asbestos - Production and Trade (cont'd)

	1958		1957	
	Short Tons	$	Short Tons	$
Short-fibre grades				
United States.....	450,143	23,351,902	505,124	25,122,789
United Kingdom ..	38,123	1,934,722	37,809	1,645,007
West Germany ...	18,358	980,457	30,350	1,610,115
Japan	10,416	892,594	13,522	1,097,680
France..........	8,255	412,250	11,774	673,585
Netherlands	5,729	251,697	10,649	496,530
Other countries ..	16,843	1,112,383	27,383	1,896,283
Total............	547,867	28,936,005	636,611	32,541,989
Total exports, unmanufactured asbestos	866,630	90,745,013	1,030,560	107,058,409
Asbestos brake linings and clutch facings				
Colombia........		128,337		131,782
Cuba............		47,414		49,110
Venezuela		30,516		26,287
Syria............		29,946		8,315
Ecuador.........		28,777		24,414
Other countries ..		182,684		297,964
Total............		447,674		537,872
Asbestos packing				
Pakistan.........		2,028		-
Peru.............		1,077		495
Other countries ..		833		13,658
Total............		3,938		14,153
Asbestos manufactures, including asbestos roofing				
United States.....		292,040		1,289,810
Sweden..........		11,487		58
Switzerland......		8,699		10,623
Jamaica.........		7,517		16,391
Other countries ..		5,610		11,190
Total............		325,353		1,328,072

Many of the uses of asbestos are a result of the mineral's physical properties rather than of its chemical composition. These properties vary with the occurrence. Whereas Quebec is able to produce a fine, silky fibre ideally suited for spinning and being 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.

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

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. Occurrences of crocidolite are known to exist in the iron-ore region near the Labrador-Quebec boundary.

Production and Development

Newfoundland

This province has several occurrences of chrysotile asbestos. One important deposit of semiharsh fibre, which occurs near Baie Verte, on the Burlington peninsula, in the northeastern part of the island, is being developed by Advocate Mines Limited. In October, control of the company passed to an international group of asbestos companies headed by Canadian Johns-Manville Company. The plans call for an expenditure of $19 million for further exploration and development and the eventual establishment of a 3,000-ton-a-day mill.

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.

The world's largest asbestos mine, the Jeffrey, is operated by Canadian Johns-Manville Company at Asbestos, Richmond county, 80 miles east of Montreal. For many years it was an open-pit mine, but since the war extensive underground workings have been installed. During 1958 most of the production was obtained from underground by the block-caving method.

Asbestos Corporation Limited has three mills in operation in the Thetford Mines area. Two - the British Canadian at Black Lake and the Normandie in Ireland township - process ore recovered from adjacent open pits. At Thetford Mines, the company completed reconstruction of its Beaver mill, thus increasing its milling capacity to 5,000 tons a day. The mill processes the combined ore from the Beaver pit, the open pit and the underground workings of the King mine.

Johnson's Company Limited, the oldest in the industry, has an underground mine at Thetford Mines. Its associate, Johnson's Asbestos Company, produces the mineral from an open pit at Black Lake, where a 4,000-ton mill was placed in operation in 1954.

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

Flintkote Mines Limited and Nicolet Asbestos Mines Limited recover 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, in July commenced production from 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 Limited, a subsidiary of Philip Carey Manufacturing Company, in mid-year commenced production from a 2,500-ton mill at its new property near Tring Junction in Beauce county, east of Thetford Mines.

Also, during 1958, National Asbestos Mines Limited, a subsidiary of National Gypsum (Canada) Limited, came into production at a deposit on the Pennington Dyke, east of Thetford Mines. The capacity of the recovery plant is 3,000 tons of mill feed daily.

Ontario

During 1958, Canadian Johns-Manville Company completed the conversion of its Munro mine to underground mining. The mine, which is east of Matheson in northern Ontario, is the only producing asbestos mine in the province.

British Columbia

Cassiar Asbestos Corporation Limited recovers long- and medium-fibred asbestos from a deposit on Mount McDame in northern British Columbia. The fibre is shipped over the Alaska Highway to Whitehorse, Yukon, on the White Pass and Yukon Railway to Skagway, Alaska, and then by boat to Vancouver. The company is exploring other deposits in northern British Columbia and Yukon Territory.

World Review

Since no reliable statistics are available on the asbestos output of the Union of Soviet Socialist Republics, it is possible only to estimate world production. Thirty-five countries mine asbestos in varying amounts, but Canada contributes approximately one half of the world's annual output of 2 million tons of all varieties. After Canada, the major producing countries are the U.S.S.R., Rhodesia and the Union of South Africa.

Russia has extensive deposits of chrysotile in the Urals and elsewhere and has developed an extensive asbestos mining industry that annually exports more than 110,000 tons to both Iron Curtain and Free World markets. It is of particular significance to Canada that higher-quality grades imported by several European countries in increasing quantities have been competing with Canadian exports. Russia's actual production is not known, but it probably approaches 550,000 tons.

In 1958 Southern Rhodesia produced 127,115 tons. Rhodesian fibre, because of the freeness of its magnetic iron, finds a ready market in the manufacture of woven-asbestos products for electrical uses.

The Union of South Africa produces some chrysotile and a large part of the world's requirements of amosite and crocidolite.

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. Chrysotile is carded, spun and woven into cloths of different weights, thicknesses and qualities. These cloths are used in the manufacture of heat-resistant clothing, protective curtains and mats, electrical insulation and heat-resistant friction materials.

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 of asbestos has grown considerably since the war, and its products are well established throughout the world. Although many asbestos-cement products are used in the construction of buildings, other industrial applications are growing, particularly in the electrical field. The use of asbestos-cement pipe in municipal water supply and distribution and in the disposal of sewage waste is now well established.

Asbestos also finds wide application in thermal insulation in the form of paper. It is also widely used in combination with other materials as 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 all other grades combined. It is used in the moulding of plastics, the manufacture of floor tiling, the manufacture of protective coatings in the paint industry, and other applications requiring a fibrous filler with the physical characteristics of asbestos.

The automobile industry uses a large quantity of asbestos products, including woven and moulded brake linings, clutch facings and pressure gaskets. Undercoating compounds provide an important use for very short grades of fibre.

Prices

The price of Canadian asbestos was constant throughout the year. Prices per short ton in Canadian funds for the different grades, carload lots f.o.b. Quebec producers, were as follows:

No. 1	crude		$1,480
2	"		798
3D	fibre		640
3F	"		593
3K	"		504
3R	"		428
3T	"		402
3Z	"		370
4D	"		218
4K	"		200
4M	"		200
4T	"	$181 to	203
5D	"		142
5K	"		142
5M	"		134
5R	"		120
6D	"		86
7D	"		75
7F	"		71
7H	"		61
7K	"		50
7M	"	44 "	45
7R	"	43 "	44
7T	"		41
7RF	floats		44
7TF	"		44
8S	"		27

The prices per ton and the grades of the sole producer in British Columbia, f. o. b. Vancouver, as published at the end of 1958, are as follows:

No. 1 crude	$ 1,522
AAA fibre	787
AA fibre	682
A fibre	494
AC fibre	325
AK fibre	220

BARITE

J.S. Ross

Barite, also known as barytes and heavy spar, is the naturally occurring form of barium sulphate. The only barium mineral of economic importance in Canada, it is consumed mainly because of its relatively high specific gravity, which varies from 4.3 to 4.6. Barite occurs in all provinces except Alberta, Saskatchewan and Prince Edward Island. During 1958, it was produced in Nova Scotia and British Columbia, and a new producer, Giant Mascot Mines Limited, commenced milling operations in British Columbia in August. Canadian reserves will be adequate to normal domestic requirements for many years.

The volume of production, which came mainly from Nova Scotia, decreased 14 per cent from that of 1957 and was the lowest since 1952. The United States, the world's largest producer, had a decrease of 63 per cent in production. There was a slight increase in Canada's mine shipments of domestic crude but a marked decrease in its shipments of the higher-valued ground variety. This decrease reflects the decrease in oil-well-drilling in North and South America. Growing interest in oil and gas leases in Alaska, on the other hand, is giving an incentive to the industry in British Columbia.

Estimates indicate that Canada was in fifth place among barite-producing countries. World output, which amounted to 2,600,000 short tons in 1958, is produced mainly by the United States, West Germany and Greece, in that order of importance.

The prosperity of the Canadian barite industry depends upon exports and oil-well-drilling activity. Normally, approximately 90 per cent of production is exported, mainly in the crude form. Imports are small and consist of the ground variety. Detailed consumption statistics are not available for 1957 or 1958 but are estimated at 24,000 short tons for each year, most of which is consumed in the oil-well-drilling industry.

Productive Deposits

Nova Scotia

The largest Canadian barite mine, operated by Magnet Cove Barium Corporation Ltd., is near Walton, Hants county, at one of the world's largest known barite deposits. The latest published estimate (1958) places ore reserves at 1,800,000 tons. In 1958, this mine produced more than 90 per

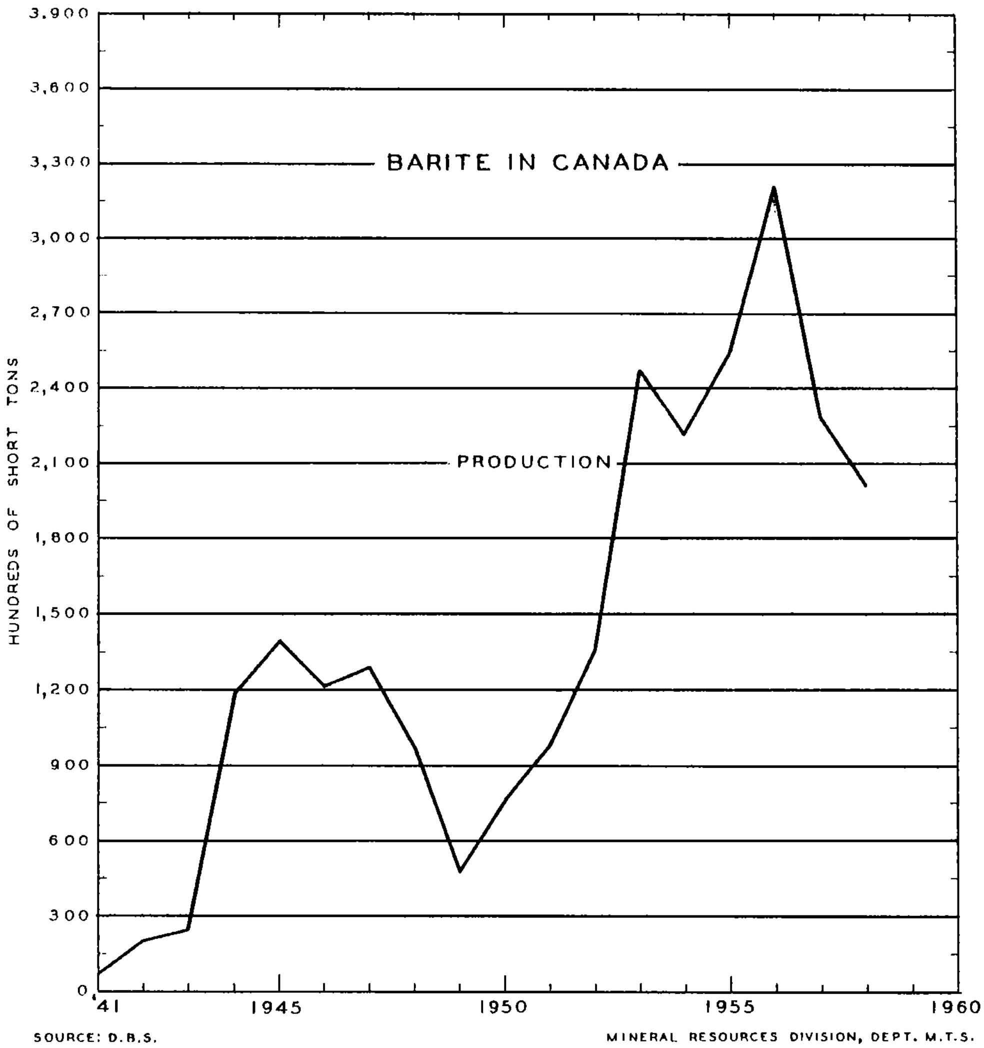
Barite - Production, Trade and Consumption

	1958		1957	
	Short Tons	$	Short Tons	$
Production (mine shipments)				
Crude....................	165,687		140,243	1,099,506
Ground...................	30,032		87,805	1,893,407
Total....................	195,719	2,196,384	228,048	2,992,913
Imports (ground)				
United States..............	835	42,111	1,427	47,682
West Germany	547	14,533	364	9,037
Italy			40	1,290
Total.....................	1,382	56,644	1,831	58,009
Exports(1)				
United States (crude)	114,299	870,862	109,180	745,394
Consumption (2)				
Paints	805		962	
Rubber goods	387		525	
Glass	215		301	
Miscellaneous chemicals ...	12		-	
Asbestos products	30		-	
Miscellaneous nonmetallics.	600(e)		600(e)	

(1) Not recorded separately in the official Canadian trade statistics. The figures shown are reported by the United States import statistics. Barite is shipped to other countries also, but the quantities are not available.
(2) Exclusive of well-drilling.
(e) Estimated.

cent of the barite mined in Canada. Most of the ore was mined from underground blast-hole-stope developments, the remainder being recovered by open-pit operations, which were discontinued before the year ended. During the year, the vertical five-compartment shaft was bottomed at a depth of 929 feet, its 350-, 520-, 690- and 850-foot levels were advanced, and underground development and mining were carried out.

Construction of a beneficiation plant with a rated capacity of 100 tons an hour was completed near the mine site in February. Although crude barite is the main product, both crude and ground varieties are shipped from the


BARITE IN CANADA
PRODUCTION
HUNDREDS OF SHORT TONS
3,900
3,600
3,300
3,000
2,700
2,400
2,100
1,800
1,500
1,200
900
600
300
0
'41
1945
1950
1955
1960
SOURCE: D.B.S.
MINERAL RESOURCES DIVISION, DEPT. M.T.S.

nearby port of Walton to the United States, Trinidad, Venezuela, Colombia, the Middle East and other parts of Canada, mainly for use in the oil-well-drilling industry.

British Columbia

Mountain Minerals Limited mines two barite vein deposits near Brisco and Parson in the Kootenay district by open-pit methods. The barite from the Parson deposit is of a high-quality white variety. Virtually all the ore mined is shipped by rail to the plant at Lethbridge, Alberta, where it is ground, mainly for use in oil-well-drilling muds. The remainder is sold as crude. During 1958, underground development of adits at both properties was continued.

Giant Mascot Mines Limited converted its former base-metal mill near Spillimacheen, Kootenay district, for the production of barite concentrates by flotation. Production commenced in August at a rated capacity of 50 tons a day, the mill feed consisting of tailings from former base-metal milling operations. The reserve of tailings, totalling some 800,000 tons, contains from 35 to 45 per cent barite. The concentrates were trucked to a plant at Spillimacheen, where they were dried, sized and bagged for use in oil-well-drilling mud in Alaska and Canada. This plant was destroyed by fire in December, with the result that the operations of Giant Mascot Mines were suspended. In the Giant Mascot mine, which ceased production in 1957, there is an undetermined amount of material containing approximately 1 per cent lead and 30 to 50 per cent barite.

Quebec

A plant at Montreal operated by Industrial Fillers Limited occasionally crushes and grinds barite ore as the market requires.

Other Occurrences

Several smaller barite deposits have been mined intermittently. They were mined particularly during the early part of the century. There are numerous other barite occurrences in most provinces, the more noteworthy being near Lake Ainslie and Brookfield, Nova Scotia; near St. Fabien, Quebec; on McKellar Island, in Lake Superior; in Penhorwood township, Sudbury district, and Langmuir township, Timiskaming district, Ontario; and at Mile 397 on the Alaska Highway, British Columbia. Witherite (barium carbonate) occurs with fluorite, quartz and barite in a large deposit at the Liard River crossing on the Alaska Highway in British Columbia.

Exploration work and some prospecting were done on barite deposits in Nova Scotia, New Brunswick, Quebec and British Columbia.

Uses and Specifications

Barite is marketed as crude in bulk, and as ground in bulk or in bags.

Most of the barite produced in the world is used in oil-well-drilling, as a heavy medium in muds, where it assists in controlling oil and gas pressures and in floating drill cuttings. Barite is the most desirable commodity for this purpose and is not likely to be replaced by substitutes in the near future. More than 95 per cent of Canadian production is consumed in drilling muds. Specifications, which vary according to the particular needs of the consumer, may require a minimum specific gravity of 4.2, a minimum of 90 per cent $BaSO_4$ and a mesh size of minus 325. Soluble salts are objectionable but several per cent of iron is not.

Barite used in the chemical industry for the manufacture of barium chemicals must be in lump form and have a minimum of 94 per cent $BaSO_4$ and a maximum of 1 per cent Fe_2O_3. The more common barium compounds manufactured and some of their uses are: precipitated barium sulphate or blanc fixe, used as an extender and pigment in paints and a filler in paper; lithopone, a mixture of barium sulphate and zinc sulphide, employed as a white pigment in paints; barium chloride, for case-hardening and preventing scumming of brick; and barium carbonate, used to reduce scumming on brick and ceramics and in oil-well-drilling fluids. Barium oxide, hydrate, titanate, chlorate, nitrate, sulphide and phosphate are also manufactured. Because barium titanate has a high dielectric constant and piezoelectric and ferroelectric properties, its use in relatively minor amounts has become widespread, particularly in the miniature-electronic-components and communications industry.

As a filler in paints, rubber and paper, barite must have a high reflectivity and usually a minimum of 95 per cent $BaSO_4$ and a mesh size of minus 200.

In the glass industry, barite acts as a flux and makes glass more brilliant and workable. It must contain a minimum of 98 per cent $BaSO_4$, less than 0.15 per cent Fe_2O_3 and be between 20- and 200-mesh.

Pieces of barite under three quarters of an inch in size are used as heavy aggregate in concrete to assist in the shielding against atomic radiation.

Lithopone, previously the major source of white pigment for paint, has been extensively replaced by titanium oxide, which has greater covering power. The steady decrease in the consumption of lithopone in Canada is expected to continue.

Barium Compounds - Imports and Consumption

	1958		1957	
	Short Tons	$	Short Tons	$
Imports				
Lithopone (70% $BaSO_4$)	1,242	179,954	1,365	197,418
Blanc fixe	448	49,236	371	41,557
	1957		1956	
Consumption of the main barium compounds in the chemical and-allied-products industries				
Barium chloride	361		328	
Barium nitrate	86		83	
Barite....................	970		962	
Blanc fixe	301		472	
Lithopone	1,379		1,845	

Prices

Prices quoted in E & M J Metal and Mineral Markets on December 4, 1958, were as follows:

Canada

Crude, in bulk, f.o.b. shipping point, per long ton	$11
Ground, in bags, per short ton	$16.50

Missouri

Water-ground and floated, bleached, car lots f.o.b. works, per short ton	$45 to $49
Crude, minimum 94% $BaSO_4$, less than 1% iron, per short ton	$16 to $18
Crude, oil-well-drilling, minimum specific gravity 4.3, per short ton	
Bulk	$18
Some restricted sales	$11.50
Ground, oil-well grade, per short ton	$26.75

U.S. Gulf ports

Foreign, crude, oil-well grade, minimum specific gravity 4.25, per short ton	
Bulk, c.i.f. ports	$16 to $18

Tariffs

A 15-cent-a-ton decrease in the United States tariff on crude barite went into effect on June 30, 1956, the first of three such decreases to be made in successive years. On July 1, 1958, when the last reduction took place, the United States tariff was $2.55 a long ton for crude barite and $6.50 a long ton for the ground product.

BENTONITE

R.M. Buchanan

The term 'bentonite' is herein used in its widest sense and includes all clay materials in which the principal constituent is a member of the montmorillonite group of clay minerals. This definition likely includes most fuller's earths, absorbent clays, clays that can be activated, and decolourizing clays and earths. Although bentonites vary greatly in properties, they are usually loosely classified as swelling (sodium) bentonite or nonswelling (calcium) bentonite. The chief feature of the first group is the ability to swell greatly in water and to form permanent colloidal suspensions. The second group is characterized by the property of decolourizing, by absorption, many types of oils and other liquids, either in the natural state or after acid activation.

Canadian Occurrences

Bentonite deposits occur in many areas. The favourable rocks appear to be those of Cretaceous age or younger, and there is no known deposit east of Manitoba.

Manitoba

A prominent bentonite horizon occurs near the bottom of the Pembina member of the Vermilion River formation (Upper Cretaceous). It has been traced from the United States border northward to Miami, a distance of about 35 miles, and contains the nonswelling type. The deposits being mined by Pembina Mountain Clays Ltd., in the Thornhill-Miami area, are in this horizon, and another promising deposit has been reported as occurring on Deadhorse Creek. Other occurrences have been reported as far to the northwest as Swan River. One of these is on Henderson Creek, about 6 miles west of Laurier.

Saskatchewan

The largest known deposits of nonswelling bentonite occur north of Pelly, on the Swan River, in the Vermilion River formation. Similar material is found in the Riding Mountain formation (later Upper Cretaceous), which underlies a large area in the eastern part of the province. Swelling types occur in the St. Victor-Pickthall area, in the Ravenscrag formation; nonswelling bentonite occurs near Rockglen, also in the Ravenscrag formation (Tertiary). A large deposit of 'semibentonite' is known to exist at Knollys, in the Butler formation (Upper Cretaceous).

Alberta

Of the many known deposits of bentonite, none is significantly decolourizing in the natural state. The ones shown to have the best swelling characteristics occur in the Edmonton and Bearpaw formations (Upper Cretaceous). Several occurrences are known to exist in the Drumheller-Rosedale area, mostly in association with coal seams. One 3-foot bed not associated with coal has been mined intermittently for several years on a small scale. Other deposits in the Edmonton formation occur at Sheerness and near Busby, north of Edmonton. Near Dorothy, in the Bearpaw formation, there is a 20-foot bed of material that appears to be very pure but has been shown to be of poor quality. In the Upper Wapiti formation, which is northeast of Grande Prairie and is similar to the Edmonton formation, there is a 4-foot bed of bentonite that has been found to have fairly good swelling properties. A 6- to 8-foot bed of almost pure-white material occurs near Bickerdike, in the Saunders formation (Paleocene and/or Upper Cretaceous). It has been mined in the past for use in cosmetics, but the swelling and decolourizing properties are inferior.

British Columbia

Tertiary formations containing bentonite deposits are widely distributed in the interior plateau of British Columbia. A 14-foot bed, one of the thickest known deposits in Canada, is exposed in a railway cut south of Princeton. Test work has shown it to be a nonswelling bentonite that possesses some natural decolourizing power but is not amenable to acid activation.

Other deposits are located about 5 miles south of Princeton and at Quilchena, 15 miles east of Merritt. Occurrences have also been reported northwest of Kamloops, at the mouth of Gorge Creek in the Deadman River valley; at 17 Mile House on the Cariboo Highway and in the banks of the Nechako River west of Prince George.

Production

Statistics on production in 1958 are not available for publication. Production in recent years has been confined to two localities. In Manitoba, an activated clay comparable to the best of imported bleaching earths is produced by Pembina Mountain Clays Ltd., 945 Logan Avenue, Winnipeg. Nonswelling bentonite is mined in the Thornhill-Miami area about 60 miles southwest of Winnipeg. After drying and crushing at Morden, the raw clay is shipped to Winnipeg, where it is activated with sulphuric acid. Most of the company's output is used for mineral-oil clarification and the remainder for decolourizing vegetable and animal oils.

Although no production has been reported for 1958, small quantities of swelling bentonite have been produced, intermittently, near Drumheller. After being dried, ground and bagged in Calgary, most of this material was

Uses

The nonswelling types of bentonite are used, in both the natural and the activated conditions, almost exclusively for the filtering and decolourizing of mineral, animal and vegetable oils. Smaller amounts are used for the clarification of food products such as wine, vinegar, corn syrup and sugar.

The principal uses of the swelling types are in oil well drilling fluids and in the moulding sand used in foundries. In drilling fluids, the bentonite serves to control the viscosity and to form an impervious cake on the wall of the hole to prevent loss of the fluid to porous formations.

Swelling bentonites have a great variety of less important uses. They are used in the bonding and plasticizing of ceramic and refractory bodies; as the fillers in paper, rubber and other products; as detergents in soaps and cleansers; as stabilizers in certain hydraulic cements; as carriers for insecticides and other pesticides; and in toiletries and medicinal preparations. The grouting of dams and irrigation channels and the prevention of seepage around the foundations of buildings are other significant uses. Treated bentonite is used as a desiccant to prevent atmospheric moisture from entering packaged goods and as a coating for small seeds to increase their bulk.

Developments in recent years have opened new fields of application for certain bentonites. The exchangeable cations are replaced by long-chain organic molecules, with the result that the bentonite swells in organic liquids and not in water. With these 'bentones' are produced lubricants that have no melting point and give promise of wide application in high- and low-temperature greases as well as in general lubrication.

Two other Canadian industrial developments are bringing about increased consumption of bentonite. In the pelletizing of iron-ore and pyrite concentrates for sulphuric-acid manufacture, about 0.5 to 0.6 per cent of a swelling bentonite is added to the concentrate as a binder.

Prices

The prices of bentonite materials vary widely depending on the amount of processing required. No prices have been published for Canadian materials, but activated bentonite has usually been delivered to points in Ontario and Quebec for about $60 to $80 a ton, in carload lots.

In the United States, the price of domestic bentonite, according to the Oil, Paint and Drug Reporter, remained unchanged at $14 a short ton (minus 200 mesh, bagged, carload lots, at mines).

CEMENT

V.A. Haw

Keeping pace with the high level of construction maintained in Canada during 1958, the cement industry supplied greater quantities of its product to customers than in any previous year. As reported by the Dominion Bureau of Statistics, production rose to 6,316,569 tons from the 6,248,718 tons produced in 1957, and shipments increased from 6,049,098 to 6,153,421 tons. This record level of production was made possible by the great increase that has taken place over the past five years in the installed capacity of Canada's cement industry.

The housing boom, which in 1958 broke all previous records, contributed substantially to the continuing high level of cement consumption. Another important factor was road construction, which was valued at more than $1,000 million, surpassing the 1957 record of $979 million.

It is evident that cement capacity has exceeded demand for the time being, and that stiff competition exists within the industry. The long-term outlook, however, continues to show promise and even now plans are being considered for two new plant projects, one in Ontario and the other in Quebec.

Production

In 1958, cement clinker was produced in 16 plants with a combined installed capacity of about 42 million barrels (7,350,000 tons) a year. The last-mentioned figure and a production of 6,316,569 tons for the year indicate that the industry operated at about 86 per cent of its capacity. Plants are located in all provinces except Nova Scotia and Prince Edward Island, as shown on the map on page 307. They are concentrated mainly in the industrialized areas of Quebec and Ontario.

Two new plants were brought into operation in 1958. In March, Lafarge Cement of North America Limited started operations on Lulu Island, 10 miles southeast of Vancouver, with an annual plant capacity of 1.5 million barrels. Lake Ontario Portland Cement Company Limited brought its 1.8-million-barrel-a-year plant into production in May at Picton, Ontario. The table on page 306 lists the companies, plant locations and approximate capacities of each plant.

Cement - Production and Trade

	1958		1957	
	Short Tons	$	Short Tons	$
Production*				
Ontario	2,400,158	35,195,552	2,211,887	33,505,994
Quebec	1,903,635	28,686,095	2,051,201	30,267,092
Alberta	635,516	10,676,668	556,962	8,802,914
British Columbia	409,397	6,755,619	443,469	7,078,108
Manitoba	378,823	6,580,276	412,998	6,820,383
Saskatchewan	194,734	4,506,803	150,664	2,861,615
New Brunswick	180,166	2,934,058	163,640	2,646,293
Newfoundland	50,992	1,079,071	58,277	1,185,078
Total	6,153,421	96,414,142	6,049,098	93,167,477
Exports				
Portland cement				
United States	141,137	2,465,058	333,874	5,959,536
Other countries	113	2,432	4,442	92,955
Total	141,250	2,467,490	338,316	6,052,491
Imports				
Portland cement				
United States	18,754	479,680	41,121	934,844
United Kingdom	13,476	275,425	27,233	450,143
West Germany	4,931	111,419	4,632	116,573
Belgium	2,427	70,597	4,353	141,717
Other countries	1,967	61,737	15,041	227,041
Total	41,555	998,858	92,380	1,870,318
Portland-cement clinker				
United States	21,100	346,702	13,941	292,912
West Germany	2,694	60,536	-	-
Total	23,794	407,238	13,941	292,912

*Producers' shipments plus quantities used by producers.

Cement - Production, Trade and Consumption, 1948-58

(short tons)

	Production(1)	Exports	Imports(2)	Apparent Consumption(3)
1948	2,472,246	12,775	196,117	2,655,588
1949	2,785,399	3,362	399,700	3,181,737
1950	2,929,820	4,184	242,588	3,168,224
1951	2,976,367	453	407,300	3,383,214
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

(1) Producers' shipments plus amounts used by producers.
(2) Does not include cement clinker.
(3) Production plus imports less exports.

Two separate clinker-grinding plants were also operated. The Canada Cement Company Limited grinds clinker from Exshaw, Alberta, at a plant near Edmonton. The Medusa Products Company of Canada Limited grinds clinker imported from York, Pennsylvania, for the production of white portland cement.

Developments

The cement industry is faced with the problem of handling and blending large volumes of raw materials of low unit value with great accuracy to ensure uniform products of high quality. To help overcome this problem, together with that of increasing production costs, two features have been incorporated in more recent plant installations. The first is an increase in instrumentation at all stages of manufacture and the introduction of automation to an increasing degree, especially in the raw materials blending systems. The second is equipment of larger capacity: kilns up to 455 feet in length and 12 to 13 feet in diameter capable of producing 6,000 barrels or more a day are now in use. Grinding mills of 2,000 horsepower are now in operation, each having the grinding capacity of more than 10 of the smaller units formerly used. This high-capacity equipment has tremendously increased productivity per man-shift.

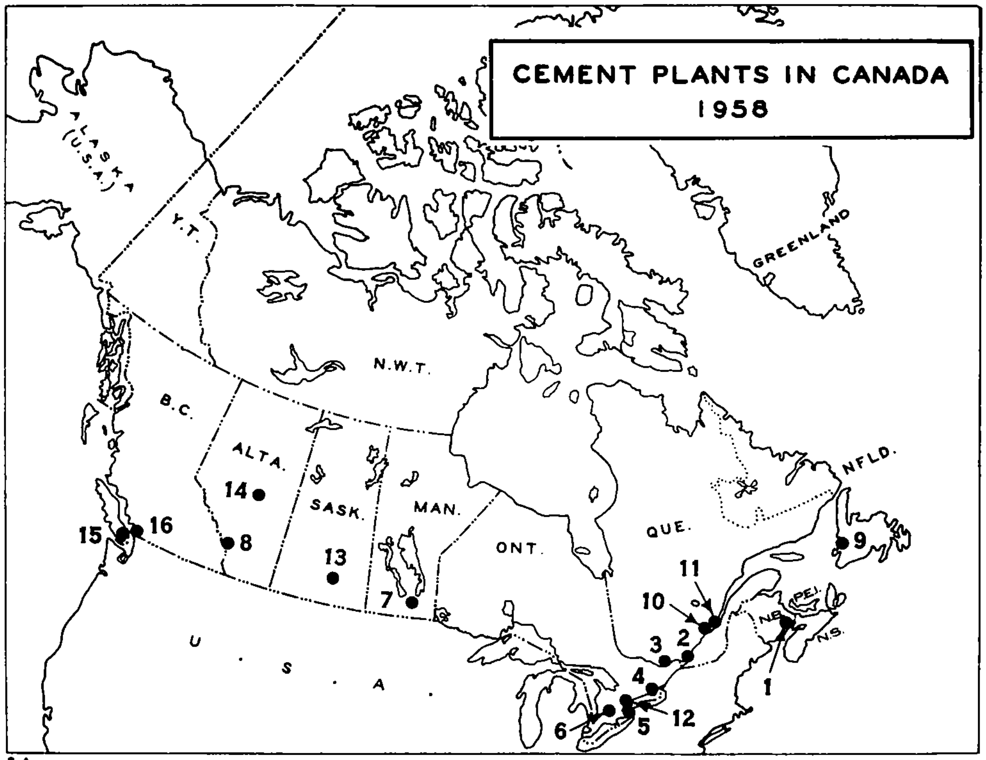
One of the plants that came into operation in 1958 is the third of its kind in Canada to use the dry process, the successful application of which is possible only because of new silo blending methods introduced within the past few years.

Plant Capacities

(bbl/yr)

Company*	Approximate Capacity (end of 1958)
Canada Cement Company Limited	
(1) Havelock, N.B.	850,000
(2) Montreal, Que.	7,500,000
(3) Hull, Que.	1,100,000
(4) Belleville, Ont.	4,000,000
(5) Port Colborne, Ont.	1,200,000
(6) Woodstock, Ont.	3,250,000
(7) Fort Whyte, Man.	3,100,000
(8) Exshaw, Alta.	3,000,000
North Star Cement Limited	
(9) Corner Brook, Nfld.	600,000
Ciment Quebec Incorporated	
(10) St. Basile, Que.	700,000
St. Lawrence Cement Company Limited	
(11) Villeneuve, Que.	1,500,000
(12) Clarkson, Ont.	3,500,000
St. Mary's Cement Co. Limited	
(6) St. Mary's, Ont.	3,000,000
Saskatchewan Cement Corp. Ltd.	
(13) Regina, Sask.	800,000
Inland Cement Company Limited	
(14) Edmonton, Alta.	2,200,000
British Columbia Cement Company Limited	
(15) Bamberton, B.C.	3,300,000
Lake Ontario Portland Cement Company Limited	
(4) Picton, Ont.	1,700,000
Lafarge Cement of North America Limited	
(16) Lulu Island, B.C.	1,500,000
Totals	42,800,000

*Numbers in brackets refer to locations on map.



Consumption

Construction expenditures in Canada were higher in 1958 than in any previous year and about 1.2 per cent higher than in 1957. Cement consumption, as in the past, closely paralleled the construction pattern, and its volume, compared with that of 1957, was up about 4.3 per cent. The amount of cement used depends considerably on the type of construction being undertaken: non-residential construction requires greater quantities per unit of value than residential, which in turn requires more than engineering construction. The most important factor in the year's cement consumption, however, was the 20.7-per-cent increase in the value of housing construction over that of 1957. Some of the large engineering projects under way at the beginning of 1958 helped sustain construction expenditure, and more money was spent on roads and associated structures than ever before. Because of a decline in the volume of commercial and industrial construction, on the other hand, the total value of nonresidential construction was slightly below its 1957 level.

Cement being a material of low unit value, transportation charges are critical in the cost of cement to the consumer. Markets for cement must therefore be considered on a regional basis related to the locations of cement plants. This situation may give rise to temporary local shortages. During 1958, as already indicated, cement was generally in easy supply throughout the country.

The concrete-products industry accounts for about one third of the annual consumption of cement. In 1958 shipments of products were substantially greater than in the previous year - concrete brick by 47 per cent, concrete block by 21 per cent, pipe by 48 per cent and ready mix by 31 per cent. All figures are approximate, being based on returns of about 85 per cent to the Dominion Bureau of Statistics.

Trade

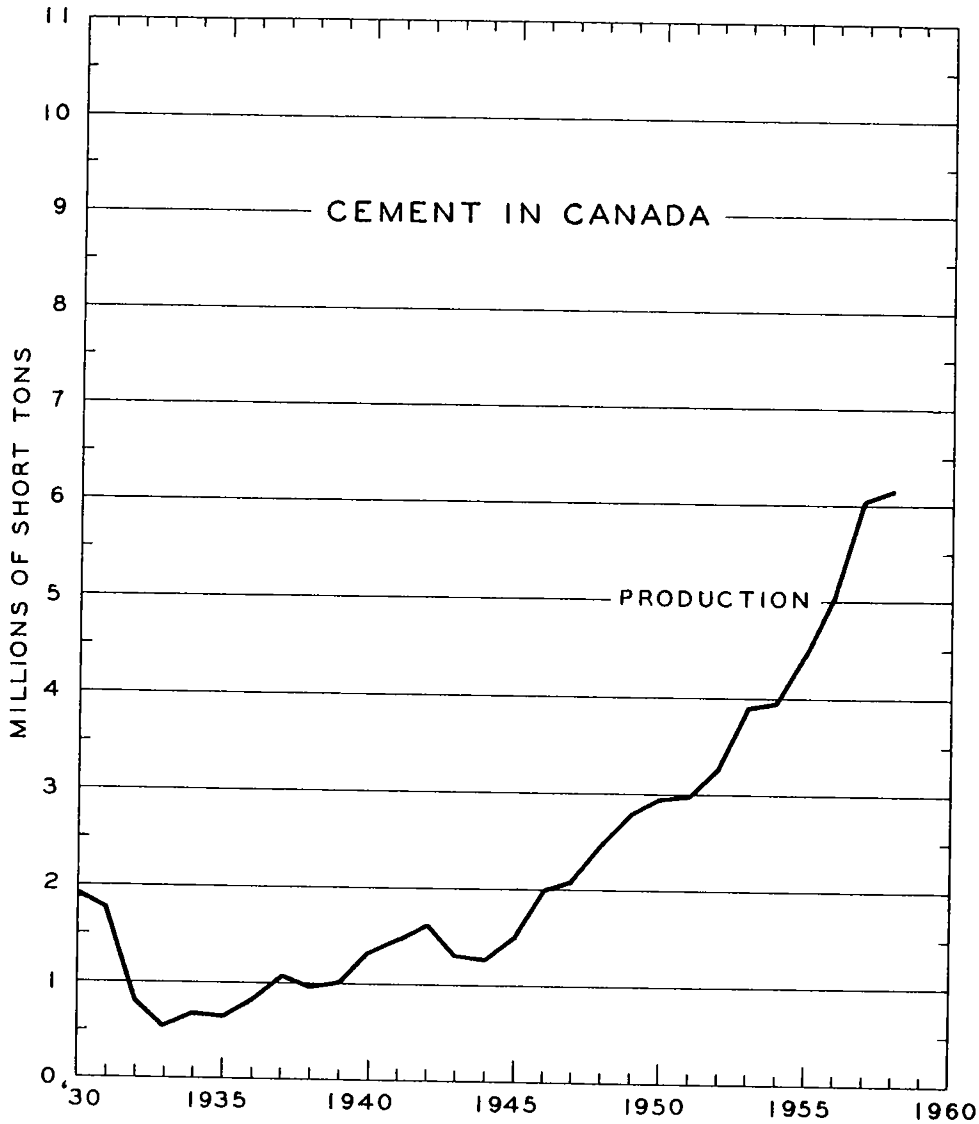
As cement is a bulky commodity of low unit value, it does not normally enter to any great extent into international trade. Prior to 1957, owing to insufficient plant capacity, Canada imported about 10 per cent of its requirements. Because of a temporary shortage in the United States, exports increased in 1957 to about 338,000 tons. In 1958, however, both imports and exports were negligible, as shown in the table on page 304.

Throughout the world cement production has been increasing rapidly over the last few years as installed plant capacity has kept pace with the demand created by the social and economic growth of countries everywhere. During 1958, however, the growth of the industry slackened, as shown by the statistics of the Organization for European Economic Co-operation published in November 1958. World production, which totalled 195 million metric tons in 1954, amounted to 263 million metric tons in 1958.

Specifications and Prices

The great bulk of the cement manufactured in Canada is of Type I, which is used in general construction. High-early-strength (Type III), sulphate-resisting (Type V) and masonry, oil-well and air-entraining cement are also produced and readily available. When particular projects, such as large dams, require moderate- to low-heat-of-hydration cement, plants normally have to make special runs. These types and varieties of cement are sold under various company trade names.

Increased labour, transportation and materials costs have placed some pressure on prices, but no general increase was noted although some local variations occurred.



SOURCE: D.B.S.

MINERAL RESOURCES DIVISION, DEPT. M.T.S.
R.A.

CLAY AND CLAY PRODUCTS

J.G. Brady

Imported goods and goods manufactured from imported clays accounted for approximately 60 per cent of the value of the clay products used in Canada during 1958. This is due principally to the scarcity in this country of deposits of high-grade china clay (kaolin), fireclay and ball clay, which are used in the higher-fired clay products. Owing to their mineralogical composition and their lack of alkali and alkaline materials, iron-bearing minerals and other impurities, clays of this type have special properties. Good-quality, highly refractory fireclays are used in high-duty, super-duty and special refractories. Kaolins and ball clays are used in refractories, and in such whiteware bodies as electrical porcelain, floor and wall tile, sanitary ware and dinnerware. Crude kaolins are beneficiated for commercial use, whereas fireclays are rarely beneficiated. To date, the rigid requirements for raw materials of this type have been met in only a few localities in Canada.

The value of clay products made from imported clays, plus the value of imported clay products, was $64.3 million. Production from domestic clays and shales was valued at $41.7 million and consisted principally of such structural-clay manufactures as brick and tile, which are made chiefly from common clays and shales. The total value of production from domestic and imported clays surpassed the previous high of $58.7 million, established in 1956, by approximately $6.7 million. Imports were reduced in value by approximately $7.6 million from the 1956 high of $52.4 million.

Refractory products containing clay have widely divergent applications. In general, they are used in furnaces, boilers and high-temperature melting units that are frequently subjected to corrosive conditions. In common use are firebricks of various grades, refractory castables, refractory mortars, plastic firebrick and such special refractory equipment as laboratory ware, crucibles and insulating firebrick.

Because of the higher temperatures of many processes, the requirements for most refractory products are becoming more stringent. The more severe conditions call for the use of higher-grade clays in which quality control is maintained. In 1958, Canada had 14 refractory plants using refractory clay as one of the principal ingredients in their products. Only four of these, all in western Canada, were utilizing domestic clay.

All Canadian kaolin requirements are imported. Kaolin is used principally as a filler and coater in the manufacture of paper, the clay being

Clay and Clay Products - Production and Trade

Production	1958 ($)	1957 ($)
Domestic sources		
Clays including bentonite	569,469	555,634
Clay products from:		
Common clay	34,275,592	29,232,455
Stoneware clay	5,535,404	4,355,352
Fireclay	638,817	913,559
Other products	690,621	865,158
Total	41,709,903	35,922,158
Foreign sources - from:		
Stoneware clays	678,483	740,700
Fireclays	2,733,497	2,909,514
China clays	20,274,990	16,282,574
Total	23,686,970	19,932,788
Total production	65,396,873	55,854,946
Imports		
Clay		
Fireclay, ground	426,623	475,147
China clay, ground	2,272,731	2,068,242
Pipe clay, ground	17,207	39,552
Clays, ground, not otherwise provided	498,492	528,876
Activated clay for refining of oils	980,585	1,536,512
Total	4,195,638	4,648,329
Clay products		
United States	21,526,611	26,225,378
United Kingdom	14,982,633	12,840,999
Other countries	4,122,380	3,672,741
Total	40,631,624	42,739,118
Exports		
Clay unmanufactured		
United States	302,713	280,224
Other countries	3,943	107
Total	306,656	280,331
Clay products		
United States	2,554,824	2,335,402
India	334,171	390
West Germany	120,762	287,273
Union of South Africa	118,389	115,372
Brazil	136,126	190,905
Other countries	654,504	1,132,496
Total	3,918,776	4,061,838

Clay and Clay Products - Production and Trade, 1948-58
($ millions)

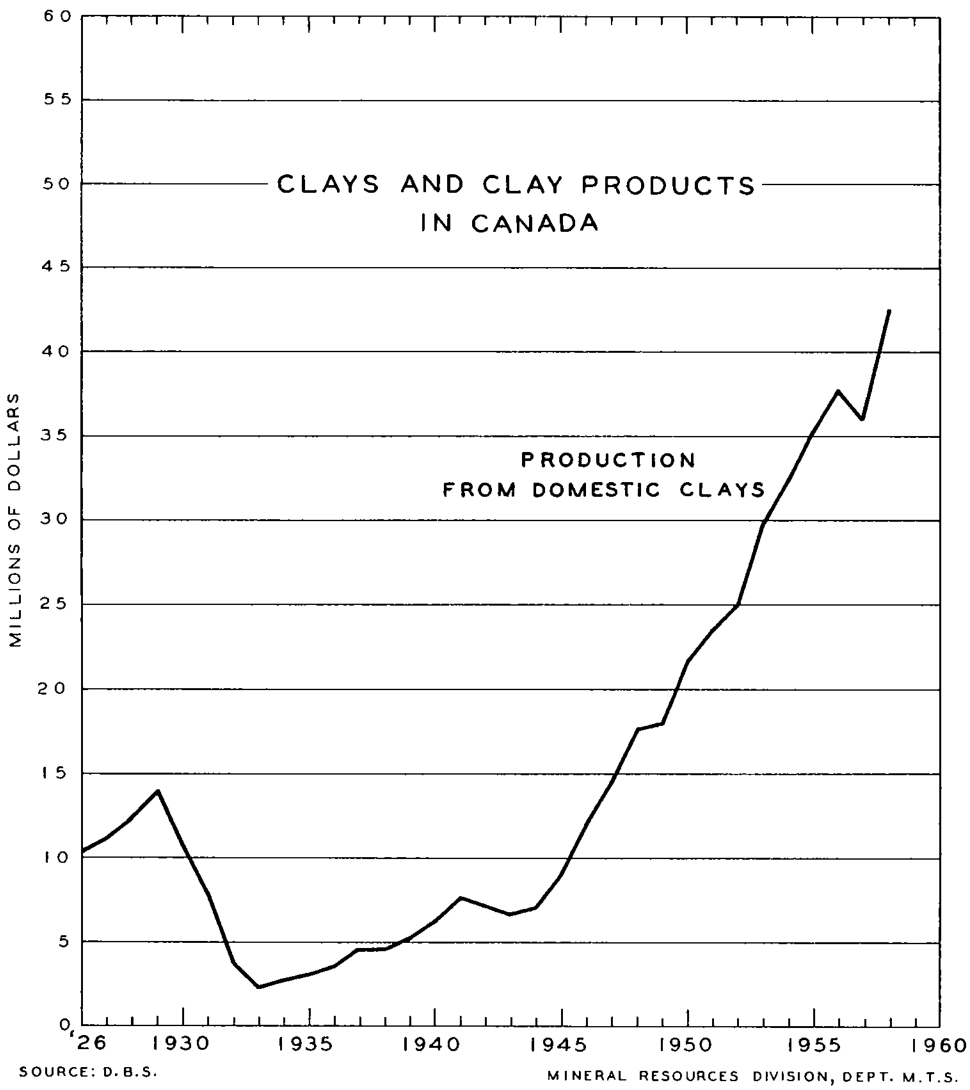
	Production			Imports	Exports
	From Domestic Clays	From Imported Clays	Total		
1948	17.6	12.4	30.0	27.5	1.5
1949	18.0	14.5	32.5	30.8	1.7
1950	21.8	15.1	36.9	31.5	2.2
1951	23.5	16.9	40.4	39.8	2.5
1952	25.0	15.7	40.7	33.5	2.5
1953	29.8	14.9	44.7	36.5	1.9
1954	32.4	16.0	48.4	35.0	2.2
1955	35.3	18.4	53.7	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

used in the unfired condition. The main properties needed include intense whiteness, freedom from abrasive grit and high retention. Kaolin is used as a source of alumina and silica in the whiteware industries. It also provides a degree of plasticity to the unfired body and helps to maintain a white fired colour. Three sanitary-ware plants, seven electrical-porcelain plants, three wall-tile plants, three dinnerware plants and numerous art potteries were the principal users of ceramic-grade kaolin.

Most of the ball clay used in Canada is imported. This type of clay is frequently used by the plants that use ceramic-grade kaolin. Ball clays are highly plastic, have a large proportion of very fine particles and fire to a white colour. They provide certain whiteware bodies with needed workability, plasticity and other properties.

Eleven plants manufactured sewer pipe and flue-liners in 1958. Plants of this type use mainly domestic stoneware clays, low-grade fireclays, or common clay and soft shale that extrude satisfactorily. Low-grade fireclays were imported for the manufacture of sewer pipe at three plants in Ontario and Quebec. The fireclay is mixed with domestic clay to form the sewer-pipe body.

From domestic clay or shale, 83 plants manufactured such clay products as face brick, face tile, structural tile, common brick and drain tile. Their output had a value of approximately $40 million. Nearly 50 per cent of these plants operate on a large scale and, for 12 months of the year, are engaged mainly in the manufacture of face brick. Twenty-eight Ontario plants were engaged in the manufacture of drain tile only. The drain-tile plants are



frequently small and usually do not operate during the winter. Most of their products are manufactured from common domestic clays and shales. The products of domestic clay or shale, particularly face brick, are also made in certain localities from domestic low-grade fireclays and, to a limited extent, from imported clays of a similar nature.

Nature and Location of Deposits

Common Clays and Shales

Common clays and shales are the principal type of raw material available in Canada at present for the manufacture of clay products. Their fusion points are low - usually well below cone 15 (approximately 2,595°F), which is considered to be the lower limit of the softening point for fireclays. They are principally red-firing because of the presence of iron from various sources. Ordinarily, they are a heterogeneous mixture including clay minerals, quartz, feldspar, various micas, goethite, siderite, pyrite, carbonaceous material, gypsum, calcite, dolomite, hornblende and many other minerals. The clay minerals contained in Canadian common clays and shales are principally illitic, chloritic or illitic-chloritic, although occasionally a member of the montmorillonite or kaolinite group is found in them.

Clays or 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 mix is reduced and the quality of the ware is lowered. Many clays and shales contain calcium carbonate, which has a marked effect on the fired properties if its proportion exceeds a limit of approximately 10 per cent. When they contain excess calcium carbonate, they fire to a buff colour and are very difficult to fire to a hard, dense, uniformly sized product. Common clays and shales are usually higher in alkali and alkaline materials and iron-bearing minerals and are usually much lower in alumina than the higher-quality stoneware and fireclays. Silica is the principal oxide constitutent. Since shales are less plastic than clays, they must be finely ground when used for extruded ware so that their plasticity may be developed, if possible, or they must be combined with a plastic clay or some other plasticizer.

Common clays and shales, which are found in all parts of Canada, are used for manufacturing such relatively low-priced articles as brick and tile. Thus, it is usually not economical to ship either the raw materials or the finished product any great distance. Consequently, deposits are developed close to centres of population. Because they are poor in plasticity, drying qualities or firing characteristics, most materials of this nature are not suitable for the manufacture of clay products. Deposits having excellent properties are generally scarce in Canada and new deposits are constantly being sought. Good plasticity, drying properties and firing characteristics are all essential for such extruded products as stiff-mud brick, building tile and drain tile. In the process of manufacturing dry-press face brick,the raw materials used need not be very plastic and drying is not a critical problem. Soft-mud bricks are made in Canada only in negligible quantities and the process by which they are manufactured is, on the whole, falling into disuse.

Stoneware Clays

Stoneware clays are buff-firing and plastic, have a long-firing range, and are similar to low-grade plastic fireclays. They contain less alkali, alkaline material and iron, and have more alumina than the common clays and shales. Silica is the principal oxide constituent. The main clay mineral found in Canadian stonewares 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 at Eastend, Saskatchewan. The clay is selectively mined and shipped to Regina, and to Medicine Hat, Alberta, for the manufacture of sewer pipe and flue-liners. It is also used at Medicine Hat for face brick and such stoneware products as crocks and pottery. In addition, Saskatchewan stoneware is used for art pottery.

For many years the Whitemud formation has been known to extend, under a large amount of overburden, into the Cypress Hills of Alberta, which lie close to the Saskatchewan border. The first area suitable for development was found in 1957, and a pit was opened that year. The clay, which is of a stoneware type, is trucked to Medicine Hat and used in the production of sewer pipe and buff face brick.

Stoneware, or low-grade, fireclays occur on Sumas Mountain, near Abbotsford, British Columbia. They are used in the manufacture of sewer pipe, flue-liner, face 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 face brick. Musquodoboit clay is used in small quantities by foundries in the Maritimes. Other deposits of similar clays occur at Swan River, Manitoba, where some buff brick has been manufactured, and at Chimney Creek bridge and Williams Lake, in British Columbia. Quebec and Ontario import their requirements of stoneware and low-grade fireclay.

Fireclays

Various grades of refractories are manufactured from fireclays. The refractoriness of these materials more or less determines the type and quality of the products manufactured from them. Economically, however, the important fireclay deposits must have heat-softening points above cone 29 (approximately 2,955°F), and the most valuable clays have heat-softening points at cone 31 1/2 (approximately 3,060° F) or higher. Good-quality fireclays are low in alkali and alkaline materials and iron-bearing minerals and have a higher alumina content than the stoneware clays. Silica is the chief oxide constituent. The Canadian fireclays are made up principally of a kaolinite-group clay mineral and quartz. The clays usually fire to a cream or buff colour and the products generally have small dark specks on them owing to the presence of iron-bearing minerals. Most good-quality fire bricks of uniform shape are power-pressed. Some special shapes are hand-moulded; other, uniform shapes are extruded.

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

DIATOMITE

J.S. Ross

Diatomite or diatomaceous earth, also known as kieselguhr, is essentially composed of opaline silica from fossil remains of diatoms. Diatoms are microscopic fresh- or salt-water plants of the order Algae. The natural material varies from white to black in colour, is chalk-like and friable, and has a specific gravity of less than 1 when dry.

Although diatomite has numerous uses, relatively small tonnages are produced throughout the world. Canadian production has been negligible and intermittent since 1896. The United States produces nearly half the world's supply and Denmark approximately 20 per cent followed by West Germany and France. United States diatomite reserves appear adequate for many years.

Canada has been essentially dependent upon imports from the United States, which reached a new high in 1958, increasing 8 per cent in quantity over those of 1957. The gradual increase in consumption during the past few years is attributed to the expanding Canadian economy. Although figures are not available, consumption of diatomite for filtration is expected to have increased in 1957, mainly owing to the demand for it by the uranium industry.

Domestic Sources

A small tonnage of diatomite was produced from a deposit 6 miles north of Quesnel, British Columbia. The deposit is leased by Fairey and Company Limited, who quarry the material and ship it to Vancouver, where it is dried, ground and screened. The company sells the finished product locally as a filler, concrete admixture and special insulating brick.

By far the largest Canadian diatomite deposits are in the Quesnel area along the Fraser River. One of these is being mined at present. All are of fresh-water origin, Tertiary in age, and relatively free of grit and organic matter and are in beds up to 60 feet in thickness. The diatomite here is essentially uniform in type and has a cream colour.

Other Occurrences

Other fresh-water diatomite deposits have been observed in British Columbia, Ontario, Quebec, Newfoundland and the Maritime Provinces. No deposits of salt-water origin have been noted.

All occurrences of Tertiary age are in the interior of British Columbia in the Quesnel mining division. Those of recent age are in the

Diatomite - Production, Imports and Consumption

	1958		1957	
	Short Tons	$	Short Tons	$
Production (shipments)	27	540	120	2,400
Imports				
United States	27,225	1,183,704	25,256	1,076,891
Denmark	33	723	30	637
West Germany	-	-	2	129
Total.................	27,258	1,184,427	25,288	1,077,657
			1956	
Consumption(e)				
Fertilizer dusting			8,650	
Filtration.............			8,000	
Fillers			3,000	
Insulation.............			175	
Miscellaneous.........			100	
Total.................			19,925	

(e) Estimated. No figures available for 1957 or 1958.

Kamloops and Ashcroft mining divisions, along the coastal areas of British Columbia, and in the aforementioned provinces. The deposits are small, commonly contain much organic material and are forming at the present time. More than 90 per cent of Canadian production has come from this type of occurrence, mainly from Nova Scotia, with a minor amount from the Muskoka district. In Nova Scotia, various small concentrations of diatomite have been worked in the past, but recently a minor output of calcined material came from a stockpile at one occurrence on Digby Neck.

No significant prospecting or exploration for diatomite deposits was recorded for the year.

Uses and Specifications

The physical properties of diatomite account for most of its uses. However, its chemical inertness at normal temperatures, when not in the presence of alkalis for long periods of time, and its ability to react chemically with alkalis at normal and elevated temperatures are also important. Natural diatomite may contain more than 15 per cent impurities. It is first dried and, depending upon the desired specifications, may then be calcined and gently crushed. Higher grades are produced by acid-leaching, calcining with or without fluxing agents, gentle grinding and air classification.

Because of its high porosity and chemical inertness, approximately half the diatomite produced in the world is used as a filtering medium. It can be subjected to maximum compression and retain up to 90 per cent voids, and remove solid particles 0.1 micron in size. In filtration, the shape and size distribution of diatoms and the purity and porosity of the material when consolidated are important. The clay and iron-oxide content must not be more than 6 and 1 per cent respectively. Diatomite is used in sugar refining, antibiotic production, dry cleaning, brewing, uranium extraction, petroleum and oil-and-fat processing, and in the manufacture of varnish. Large amounts are also used in water filtration and in metallurgy.

Approximately 25 per cent of the diatomite produced in the world is used as a filler and extender in rubber, asphalt tile, paper, paints, varnishes, plastics, insecticides, fertilizers, etc., where colour, purity, density, inertness and particle size and shape are important.

In insulation, diatomite is employed either in the calcined form with fireclay as a brick refractory or in general-purpose block composed of diatomite and an inorganic binder. Diatomite insulation is applied to boilers, furnaces, kilns, ovens, tanks, kettles, etc. High porosity and freedom from impurities are important properties here.

Diatomite is also used as a mild abrasive in metal polishes and dentifrices, and as a concrete admixture in all types of masonry work. It has recently been used in the manufacture of silicates of high liquid absorption and a low bulk density.

In 1956 the largest consumer of diatomite in Canada was the fertilizer industry. The Consolidated Mining and Smelting Company of Canada Limited at Trail, British Columbia, and Calgary, Alberta, and Cyanamid of Canada Limited at Welland, Ontario, use diatomite for coating nitraprills in ammonium-nitrate fertilizers to absorb moisture and prevent the nitraprills from sticking. The diatomite is in the lowest-priced, commercial form - uncalcined material of 95 per cent minus 325 mesh.

The expanding uranium industry is using an increasing amount of the commodity as filter cake.

Consumption figures for 1957 and 1958 are not yet available.

Prices

Prices of imported grades of diatomite vary widely according to type, grade, quantity and location of the market. Prices f.o.b. Toronto and Montreal of diatomite bagged and in carload lots vary from \$56 to \$160 a ton. Diatomite silicate mixtures are priced correspondingly higher.

FELDSPAR

J. E. Reeves

Canadian production in 1958 remained virtually at the same level as in the previous year, still considerably below the high levels attained prior to 1952; its value declined by about 8 per cent from 1957. Export figures for the year were more than double those of 1957, mainly because of further shipments of glass-grade feldspar by Spar-Mica Corporation Ltd. to the United States. Imports, consisting of the higher-priced, more finely ground grades from the United States, increased nearly fivefold owing to an increase in the manufacturing of whiteware products on the west coast.

Consumption of Canadian feldspar, both in the domestic and in the export markets, has been limited considerably by the substitution of nepheline syenite in a number of uses. This is particularly so in the case of glass-grade material, Canadian glass-manufacturers having virtually converted to the use of nepheline syenite.

Producers

The Canadian Flint and Spar Department of International Minerals & Chemical Corporation (Canada) Limited, Ottawa, was the largest producer of ground feldspar. Its output was mainly for use in the manufacture of domestic whitewares, porcelain enamel and abrasives. The grinding mill is located at Buckingham, Quebec, about 20 miles northeast of Ottawa, and crude is obtained chiefly from the company's Back mine in Derry township a few miles to the north of the mill, and to a lesser extent from other sources in the same area.

Spar-Mica Corporation Ltd., with head office in Montreal, produced from a large granitic pegmatite deposit near Baie Johan Beetz on the north shore of the Gulf of St. Lawrence. The mill, capable of large production, employs the principle of electrostatic separation to remove the associated quartz. A glass-grade product was shipped by cargo vessel to the eastern seaboard of the United States.

In the concentration of the lithium mineral, spodumene, from granitic pegmatite, a large amount of associated feldspar is encountered. At its plant near Barraute, Quebec, about 20 miles north of Val d'Or, Quebec Lithium Corporation has installed milling equipment for the production of feldspar as a flotation by-product. Small, initial shipments were made during the year.

Feldspar - Production, Trade and Consumption

	1958		1957	
	Short Tons	$	Short Tons	$
Production (shipments)				
Quebec......................	20,387	359,966	20,450	393,284
Imports				
Ground				
United States................	1,140	22,753	241	5,562
Exports				
United States................	9,924	158,071	4,017	69,738
Israel......................	32	2,550	-	-
West Germany	-	-	20	1,600
Netherlands	-	-	10	860
Total	9,956	160,621	4,047	72,198
Consumption, domestic (available data)				
Glass......................	974		5,316	
Clay products (pottery, tile, insulators, etc.)......	7,723		6,297	
Scouring powders, cleansers.	422		1,371	
Miscellaneous	753		974	
Total	9,872		13,958	

Bon Ami Limited, Montreal, purchased crude feldspar and produced ground material for use in its own brand of cleanser.

History and Occurrences

Almost all the feldspar mined in Canada to date has come from southeastern Ontario and southwestern Quebec, where there is an abundance of granitic pegmatites. Hundreds of properties have been operated since 1890, when production in Canada - in Quebec - was first recorded. With the exception of a few years near the beginning of the present century, production from Quebec has been continuous. In the early 1920's shipments were made from the vicinity of

Feldspar - Production and Trade, 1948-58

(short tons)

	Production	Imports	Exports
1948	54,851	207	31,467
1949	36,948	228	17,570
1950	35,548	144	15,465
1951	40,749	194	19,832
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

the present site of Spar-Mica Corporation's operation, but, because of the intimate association of quartz with the feldspar, production was very small. Deposits of a similar nature occur in the vicinity of the Saguenay River.

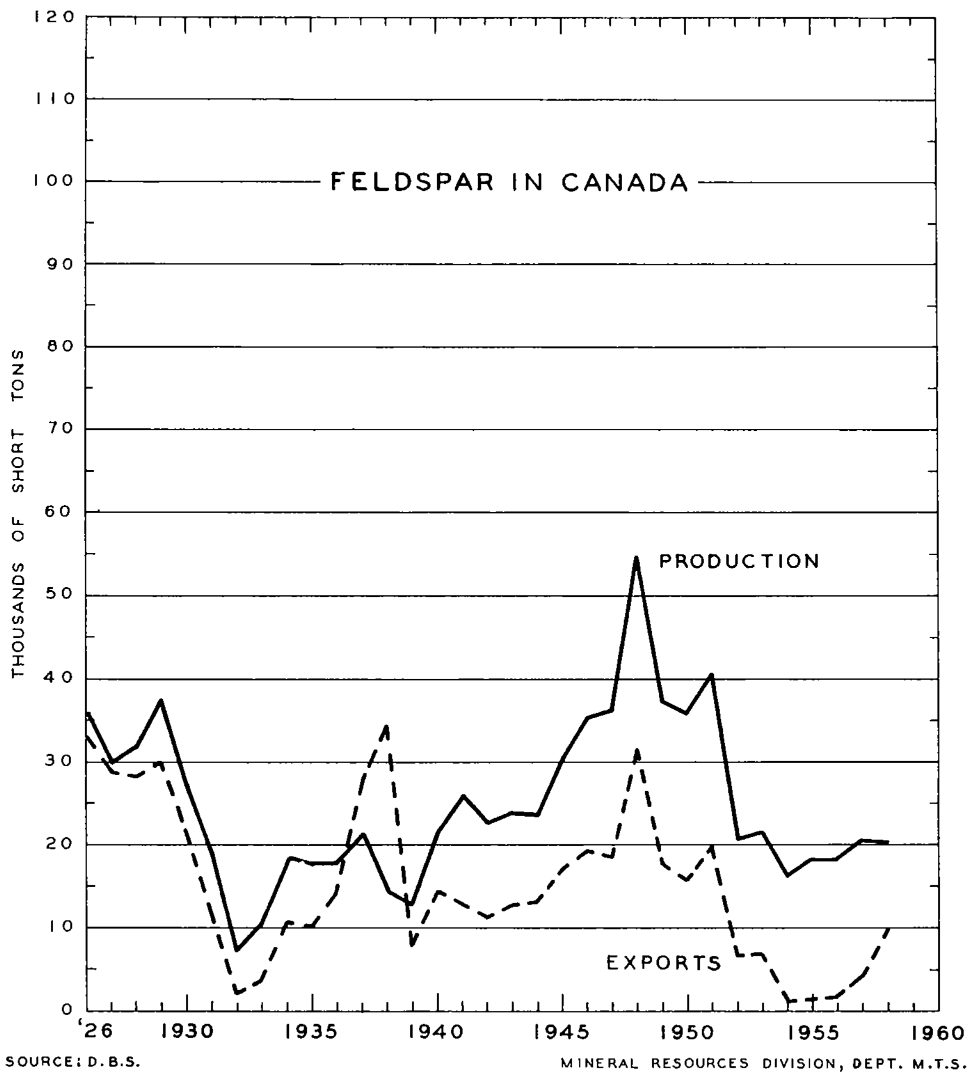
Production in Ontario commenced in 1900 and was continuous until 1954. More than one half of this came from the Kingston-Perth area in the southeastern part of the province. In addition, shipments have been made from the vicinity of Bancroft, Sudbury, Mattawa and Parry Sound and, to a very minor extent, from Falcon Island in Lake of the Woods.

Granitic pegmatites occur in abundance in other parts of Canada, notably in southeastern Manitoba, where some production is possible, especially as a by-product of an operation producing lithium minerals, beryl or other economic minerals of pegmatitic origin. Between 1933 and 1939, more than 5,000 tons were produced in the vicinity of Pointe du Bois.

Attempts have been made periodically to produce a marketable feldspar from coarse-grained granites and pegmatites that occur in both British Columbia and Nova Scotia, but as yet no commercial production has resulted.

Technology

The name 'feldspar' refers to a group of very common minerals which are essentially aluminum silicates of potassium, sodium and calcium. The potash variety and, to a lesser extent, the soda variety have industrial uses. They are found mainly as small grains closely associated with other minerals in many types of rocks, but significant concentrations occur only in some granitic pegmatites.



It has been customary to rely on such concentrations as sources of feldspar and on hand-cobbing as a means of obtaining an acceptable material. This is still done, but in recent years there has been a trend toward the use of pegmatitic sources in which feldspar occurs more intimately mixed with quartz and other minerals, and the application of milling techniques for the manufacture of a suitable product. The dry process of Spar-Mica Corporation is a new method of preparing Canadian feldspar for market. The use of flotation for concentrating feldspar from such mixtures, now in use at Quebec Lithium's plant, has found wide acceptance in the United States in the last few years.

Feldspar is commercially important because of its content of alumina and alkalis (potash and soda), its relatively low firing temperature, and its hardness and particle shape.

Uses and Specifications

Feldspar is used chiefly by the ceramic industry in the manufacture of glass, whiteware, pottery and porcelain enamel, and by the cleanser trade in making scouring soaps and powders. Some select material is used in the manufacture of artificial teeth.

Feldspar is a source of the alumina and alkalis used in glass. The iron-oxide content should be less than 0.1 per cent. Glass-grade feldspar is used in a relatively coarse, minus 20 mesh grain size to minimize the loss in the glass furnace due to fines.

For whiteware bodies and glazes, feldspar is used as a flux. It must be very finely ground (mostly minus 200 mesh), be essentially free of quartz and iron-bearing minerals and contain a high potash-soda ratio. Colour is of no importance providing the fired product is white.

In the manufacture of porcelain enamels, potash feldspar is used as a source of alumina, potash and silica. It must become white upon burning, have a very low iron-oxide content and be at least minus 120 mesh.

Dental spar is a selected potash feldspar of high purity. As much as 0.1 per cent iron oxide is tolerated but no tourmaline, biotite or other dark mineral that would leave specks in the product.

For cleansers, the material should be free of quartz and have an acceptable white colour. Either potash or soda feldspar can be used.

Markets and Prices

International Minerals & Chemical Corporation (Canada) Limited, 77 Metcalfe Street, Ottawa, is the principal purchaser of crude feldspar in Canada. Bon Ami Limited, 13719 Notre Dame Street East, Montreal, purchases white spar for cleanser use.

Buyers of dental-grade spar include: Myerson Tooth Corporation, Cambridge, Massachusetts; Dentists' Supply Company, 220 West 42nd Street, New York; and Universal Dental Co., Brown at 48th Street, Philadelphia, Pennsylvania.

Prices in the United States per short ton, according to E & M J Metal and Mineral Markets of December 4, 1958, were:

200-mesh, f.o.b. point of shipment, North Carolina	\$18.50
325-mesh	\$22.50
Glass, No. 18 grade	\$12.50
Semigranular	\$10.00 - \$11.00

FLUORSPAR

C.M. Bartley

A decrease in the pace of industrial activity during 1958, particularly in the aluminum industry, and the competition of foreign producers resulted in a lower-than-normal demand for Canadian fluorspar and consequently in lower production than in 1957. In 1958, fluorspar production was valued at $1,542,589; in 1957 its value was $1,756,841. Exports were lower and imports higher than in any year since 1949.

While the long-term prospects for fluorspar are very promising, particularly in the fluorine-chemical industry, producers are at present experiencing marketing problems. The industrial recession has lessened demand, and expanded low-cost production in Mexico and Spain has been successfully competing with Canadian output for markets on the North American continent.

Production and Trade

Fluorspar production during 1958 was reported from Newfoundland, Ontario and British Columbia. Newfoundland production, from the Burin Peninsula, was by far the largest. Metallurgical grade was again produced at Madoc, Ontario, and a small tonnage of metallurgical fluorspar was produced as a by-product of silica-quarrying in British Columbia.

The virtual elimination of Canadian fluorspar exports after 10 years of active trade with the United States is worthy of note. During the past decade, the increasing demand in that country has encouraged the discovery and development in Mexico of fluorspar deposits that are less costly to mine than the known occurrences in the United States and Canada. Similar economic conditions exist in Spain. Fluorspar from these sources has consequently captured markets formerly served by Canadian producers. This is reflected both in the increase in imports into Canada and the reduction of exports from Canada to the United States.

Producing Companies

In the Burin Peninsula of Newfoundland, the most important fluorspar-producing area in Canada, two companies produced some 139,801 short tons of fluorspar during 1956, and production to the end of 1956 totalled more than 1,200,000 short tons. Large reserves are believed to be available. In the Madoc area of Ontario, fluorspar has been produced almost continuously for

Fluorspar – Production, Trade and Consumption

	1958		1957	
	Short Tons	$	Short Tons	$
Production (shipments)*				
Newfoundland..........		1,483,368		1,662,602
Ontario		57,834		94,239
British Columbia		1,387	-	-
Total		1,542,589	66,245	1,756,841
Exports				
United States	7	980	23,630	590,750
Imports				
Mexico	21,250	498,075	11,514	270,196
United States	6,019	202,628	1,578	71,824
Spain	2,750	48,864	-	-
United Kingdom	209	8,401	364	14,770
Union of South Africa ...	180	5,470	1,091	20,916
Total	30,408	763,438	14,547	377,706
Consumption				
Steel furnaces	14,539		16,935	
Glass	455		628	
Heavy chemicals	74,939		53,198	
Total	89,933		70,761	

*Quantity of shipments not available for publication.

the past 50 years, although the mines are small and the annual production has rarely reached 10,000 tons. British Columbia has produced more than 40,000 tons of fluorspar in past years, and small shipments have been made from the Lake Ainslie district of Nova Scotia, the Wilberforce area of Ontario, and Quebec.

Newfoundland Fluorspar Limited, a subsidiary of Aluminum Company of Canada, Limited, operated its property at St. Lawrence, Newfoundland, during 1958. Mining and development was carried on underground and fluorspar concentrate was shipped to the parent company's plant to make artificial cryolite for the production of aluminum. Fluorspar from this property is used entirely in the manufacture of aluminum, and the production of fluorspar is therefore more or less controlled by activity in the aluminum industry.

Fluorspar - Production, Trade and Consumption - 1948-58
(short tons)

	Production(1)	Exports(2)	Imports	Consumption
1948	11,340	(3)	48,925	54,109
1949	64,477	15,344	2,510	54,826
1950	64,213	14,238	1,572	52,137
1951	74,211	21,461	8,188	57,526
1952	82,187	18,675	22,714	68,748
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	(4)	7	30,408	89,933

(1) Producers' shipments.
(2) Exports for 1948 to 1954 inclusive to United States recorded in United States import statistics. Not available from the official Canadian export statistics. Export figures for 1955, 1956, 1957 and 1958 as recorded in Trade of Canada.
(3) Less than 1 ton.
(4) Quantity not available for publication.

Huntingdon Fluorspar Mines Limited, at Madoc in eastern Ontario, produced metallurgical-grade fluorspar during 1958 for use in Canadian steel mills.

Pacific Silica Limited, at its silica quarry near Oliver, British Columbia, recovered a few tons of fluorspar as a by-product and sold it as metallurgical-grade.

St. Lawrence Corporation of Newfoundland Limited, although not in production during 1958, owns mines and a mill on the Burin Peninsula and in past years has produced large amounts of fluorspar of various grades. Marketing problems forced the closing of operations in mid-1957. At the end of 1958, the company was completing arrangements to produce metallurgical- and ceramic-grade fluorspar on a limited scale during 1959.

Other Occurrences

Other occurrences of fluorspar have been found in Canada and a few of these have been worked, but none are of economic interest now.

Fluorspar and barite occur together near Lake Ainslie in Nova Scotia, but the low grade has limited production to a few tons recovered during wartime. An occasional small shipment has been made from the Wilberforce area of

Ontario and from western Quebec, but the occurrences have not been capable of sustained production. Numerous small occurrences of fluorspar found along the north shore of Lake Superior are of interest but not of importance at present.

In British Columbia, considerable amounts of fluorspar were produced in past years from the Rock Candy mine of The Consolidated Mining and Smelting Company of Canada Limited. Between 1918 and 1943, a total of more than 42,000 tons was reported and large reserves are still believed to be available at the mine. Fluorspar occurs at the property of Rexspar Uranium and Metals Mining Co. Limited near Birch Island, British Columbia. The mineral is finely disseminated and, although the total tonnage is large, no economic method of recovering the fluorspar has yet been found.

A large deposit of fluorspar, barite and witherite has been discovered in northern British Columbia, but its remote location makes it of little interest at the present time.

World Review

United States chemical companies have recognized the problem of fluorspar supply and have been active in finding and developing new deposits, particularly in Mexico. Production resulting from these efforts and substantial imports from Europe have satisfied consumer demand in the United States but indicate that country's dependence on foreign sources of supply.

The consumption decrease resulting from the recent recession and the price depression caused by market competition among producers tend to hide the gap that has been growing between the fluorspar supply and the generally rising demand. As industrial activity increases and the fluorine-chemical industry continues to expand, the problems of fluorspar supply will reappear.

World Fluorspar Trade, 1956*
(short tons)

Country	Production	Imports	Exports	Consumption
Mexico	360,117	-	342,133	minor
United States	329,719	485,552	minor	621,354
West Germany	170,858	33,500	21,042	148,000
U. S. S. R.	150,000(e)	118,400	-?	218,700
Canada	140,071	28,148	78,380	96,126
Italy	136,675	-?	53,346	?

* Data from published reports of Dominion Bureau of Statistics, the U.S. Bureau of Mines and various European sources. Some European figures are estimates.

(e) Estimated.

The preceding table lists the main producers and consumers of fluorspar and shows that the two nations using the largest amounts import more than half of their requirements. Production is also significant in the United Kingdom, France, East Germany and Spain. It should be noted that Mexican production is now the largest in the world although only minor amounts of fluorspar are used in Mexico. Large amounts are exported to the United States and some goes to Canada.

The United States demand for fluorspar has encouraged production in low-wage countries to such an extent that United States producers have requested tariff increases in order to retain some of the domestic market. Up to now these requests have been refused. A similar request was made by Canadian fluorspar producers but the Tariff Board recommended no change. It is unlikely that fluorspar will long continue to be abundant and low-priced. At present, however, Canadian and United States producers have serious marketing problems. For example, a group of Canadian mining companies, including Waite Amulet Mines Limited and The Tech-Hughes Gold Mines Limited, owns and operates a large fluorspar mine in northern Mexico. The metallurgical- and acid-grade fluorspar produced there is exported to Canada and other countries. This mine, in fact, supplies most of Canada's metallurgical-fluorspar requirements.

In Europe, fluorspar supplies are adequate to the present demand, and substantial amounts have been exported in recent years from Spain, Italy and East Germany. Any large-scale increase in demand, such as is expected in the United States, would curtail exports.

Japan, the only other large consumer, imports almost all its requirements.

On a world basis, fluorspar supplies are at present adequate but do not appear sufficient for the future demand expected.

As conditions change, the deposits in Newfoundland will become more important. They contain large reserves, are well located to serve North American industry and are of the type best suited to the large-scale production of acid-grade fluorspar.

Technology

The recovery of fluorspar and its classification into three grades for use in various industries have become standard practice, and no changes in processes have been reported. Continuing efforts being made in the United States to recover fluorine in a usable form from the processing of phosphate rock for fertilizer are based on two important considerations - the development of an alternate source of fluorine and the reduction of toxic fluorine in plant gases wasted to air.

Significant progress has been made in recent years in the development of practical methods of handling corrosive fluorine gas and hydrofluoric acid.

With acid-grade fluorspar as raw material, hydrofluoric acid is made and used in the production of fluorine gas and the many fluorine chemicals and fluorine-based products. Production of all these was slow and expensive until safe and efficient methods of handling and shipping fluorine and hydrofluoric acid were developed.

Reports from Europe indicate that fluorine compounds are being recovered in the processing of nepheline-apatite rock for fertilizer and aluminum ore at a plant in the Kola Peninsula. Production, analogous to that from phosphate rock in the United States, is significant only when large tonnages are being processed.

Uses and Specifications

Fluorspar is consumed in two general ways - as a metallurgical and 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 and elimination of associated waste. When it is a source material for chemicals, preparation of the raw material is more detailed and the specifications are 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 none are comparable to fluorspar in efficiency. Fluorspar for metallurgical purposes must be in coarse sizes (2in. to 3/8 in.), 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 as a flux in glass and in enamel melts.

Large amounts of fluorspar are consumed in aluminum production, and no adequate substitute is known. Fluorspar is processed to acid-grade purity and is 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.

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, propellent gases, chemicals and the numerous fluorocarbon-plastic intermediates and fluorocarbon-plastic consumer articles. It has been estimated that fluorspar requirements for chemical purposes will more than double in the next 10 years. For these various uses, the following three grades of fluorspar are marketed.

Standard-fluxing-gravel or lump grade - Used for metallurgical purposes, this is usually sold on a specification of a minimum of 85 per cent

CaF_2 (fluorspar) and a maximum of 5 per cent SiO_2(silica) and 0.3 per cent sulphur. Fines should not exceed 15 per cent.

Ceramic, glass or enamel grade - This calls for not less than 94 per cent CaF_2 with a maximum 3.5 per cent $CaCO_3$ (calcium carbonate), 3 per cent SiO_2 and 0.1 per cent Fe_2O_3 (ferric oxide). The material must be in mesh sizes ranging from coarse to extra-fine.

Acid grade - This has the most rigid specifications. It must be more than 97 per cent CaF_2 and not more than 1 per cent SiO_2. Like ceramic grade, it is used in powdered form.

Prices

Canada

At the end of 1958, prices of coarse ceramic-grade fluorspar per net ton f.o.b. Arvida, Quebec, as quoted by Aluminum Company of Canada Limited, were as follows: 100-lb bags - minimum carload or truckload, \$61.50; less-than-carload lots to 1 ton, \$70.70; less than 1 ton, \$76.85; in bulk - minimum carload or truckload, \$57.75.

United States

Fluorspar prices per short ton as quoted in E & M J Metal and Mineral Markets at the end of 1958, were as follows: metallurgical grade, effective CaF_2 content, f.o.b. Illinois and Kentucky - 72 1/2%, \$37 to \$41; 70%, \$36 to \$40; 60%, \$33 to \$36.50; pellets - 65%, \$33; acid grade, concentrates, bulk, carload lots, f.o.b. Illinois, Kentucky and Colorado - \$50; in bags, \$4 to \$5 extra; ceramic grade - 95% CaF_2, \$45 to \$48; 93% to 94% CaF_2, calcite and silica variable, Fe_2O_3 0.14%, \$43 to \$46; in 100-lb bags, \$4 to \$5 extra.

European Fluorspar

Prices per short ton, c.i.f. U.S. ports, duty paid, were as follows: metallurgical grade, 72 1/2% effective CaF_2 - spot, \$34 to \$35; contract, \$30 to \$33; acid grade, 0.3% moisture maximum - contract, \$50 to \$52; spot, \$1 more.

Mexican Fluorspar

The price per short ton, f.o.b. border, all rail, duty paid, was as follows: metallurgical grade, 72 1/2% effective CaF_2 content, \$25.

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 ton	\$2.10

GYPSUM AND ANHYDRITE

R.K. Collings

GYPSUM

Gypsum, a hydrous calcium sulphate, is one of the more important of the nonmetallic minerals. Large quantities are produced annually at numerous locations throughout Canada. Most of the Canadian output is exported to the United States; the remainder is used in Canada in the manufacture of plaster of paris, wallboard and other gypsum products.

Canadian production of crude gypsum dropped to 3,964,129 short tons in 1958, an amount 13.4 per cent below that of 1957. This decrease was the direct result of a prolonged strike by workers at the quarries of Canadian Gypsum Company, Limited, in Nova Scotia.

Exports of crude gypsum dropped to 2,898,230 short tons in 1958. This was 15 per cent less than the 1957 exports. This gypsum, quarried from deposits in Nova Scotia, was shipped to markets along the eastern seaboard of the United States. Imports of crude gypsum, mainly from Mexico for use by a gypsum-product plant in British Columbia, totalled 108,038 short tons in 1958.

Exports of finished gypsum products amounted to only 16 tons in 1958; imports totalled 56,099 short tons. These imports, practically all of which were from the United States, were used mostly to supply consumer demand in Ontario, British Columbia and Quebec.

Occurrences

Gypsum deposits occur at numerous locations throughout Canada. Some are impure; others are too far from markets to be of economic importance. Many, however, are pure and well situated with respect to transportation facilities and centres of population. Deposits suitable for use in the gypsum-products industry exist in all provinces except Prince Edward Island and Saskatchewan. Gypsum-recovery operations, however, are carried on in only six provinces, namely, Newfoundland, Nova Scotia, New Brunswick, Ontario, Manitoba and British Columbia.

The largest deposits are in the Maritime Provinces. They are flat-lying and generally have 10 to 15 feet of overburden. The Newfoundland deposits are confined to the St. George's Bay area in the southwestern section of the island; those in Nova Scotia occur throughout the central and northern parts of the mainland and on Cape Breton Island; in New Brunswick, the chief occurrences are near Hillsborough in the southeastern part of the province.

Gypsum - Production and Trade

	1958		1957	
	Short Tons	$	Short Tons	$
Production (shipments)				
Crude gypsum				
Nova Scotia	3,149,719	3,259,423	3,842,027	6,005,640
Ontario	425,733	1,059,590	379,621	853,199
Manitoba	176,123	343,266	183,708	458,368
New Brunswick.......	105,749	170,876	93,249	163,146
British Columbia	70,498	211,494	49,422	142,952
Newfoundland	36,307	144,510	29,465	121,800
Total	3,964,129	5,189,159	4,577,492	7,745,105
Imports				
Crude gypsum	108,038	609,106	92,139	359,615
Plaster of paris, wall plaster				
United States	31,611	726,836	17,401	456,459
United Kingdom	159	1,697	5	210
West Germany	137	4,669	6	120
Other countries	15	777	12	1,649
Total	31,922	733,979	17,424	458,438
Wallboard and lath				
United States	24,177	786,928	4,648	160,536
Total imports	164,137	2,130,013	114,211	978,589
Exports				
Crude gypsum				
United States	2,898,230	4,871,440	3,410,684	5,905,051
Plaster of paris, wall plaster				
New Zealand	16	361	5	156
United States	-	-	18	1,165
Total	16	361	23	1,321
Total exports	2,898,246	4,871,801	3,410,707	5,906,372

Gypsum - Production and Trade, 1948-58
(short tons)

	Production(1)	Imports(2)	Exports(2)
1948	3,216,809	1,031	2,628,065
1949	3,014,249	566	2,544,617
1950	3,666,336	848	2,969,974
1951	3,802,692	1,700	3,028,336
1952	3,590,783	649	2,763,492
1953	3,841,457	547	2,769,990
1954	3,950,422	4,958	2,830,945
1955	4,667,901	16,104	3,039,192
1956	4,895,811	70,436	3,840,721
1957	4,577,492	92,139	3,410,684
1958	3,964,129	108,038	2,898,230

(1) Producers' shipments. These tonnage figures include both crude and calcined to the end of 1951. Beyond 1951 only crude-gypsum tonnages are included.
(2) Include crude and ground but not calcined.

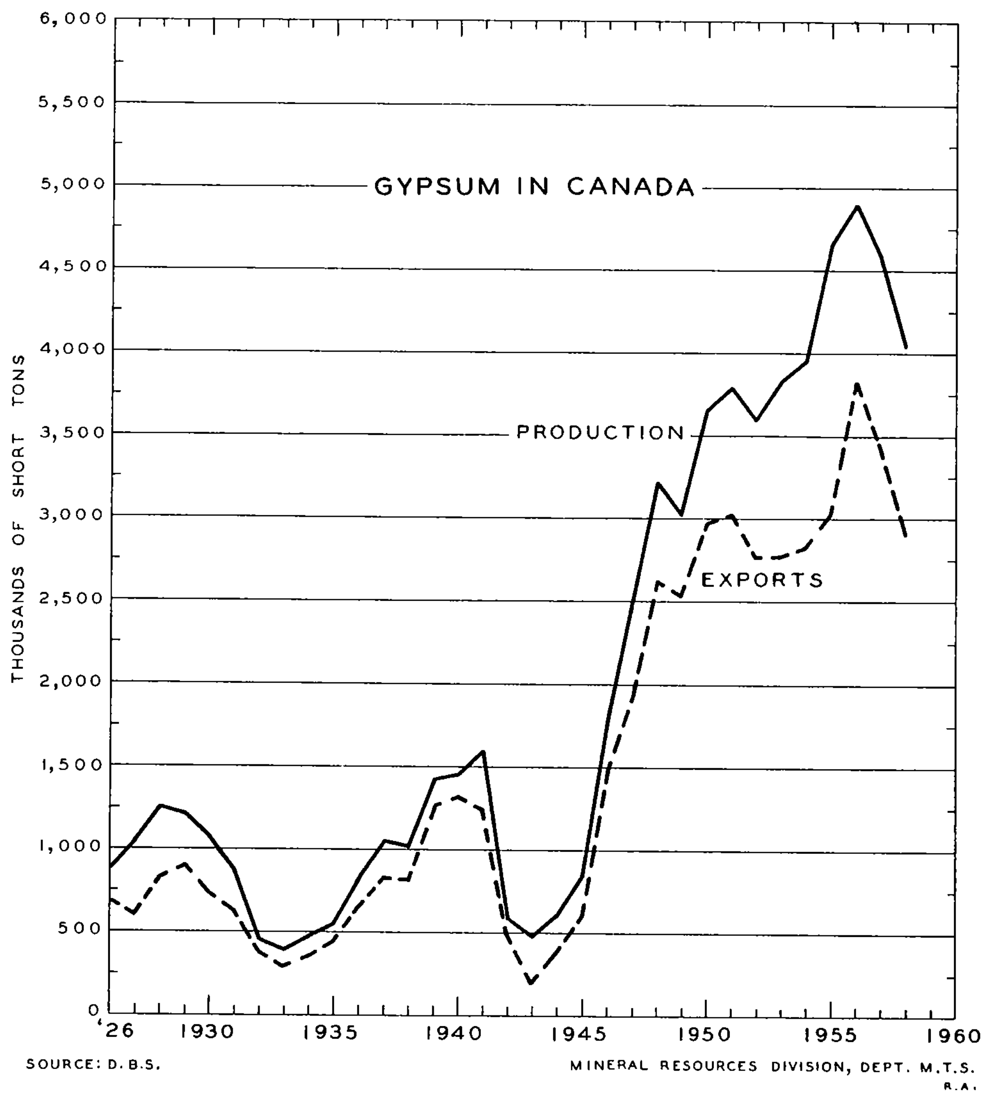
Consumption of Crude Gypsum
(short tons)

	1958	1957
In gypsum-products industry	971,982	831,910
In cement-manufacturing industry	293,514	287,786
Total	1,265,496	1,119,696

In Quebec, the only known deposits are on the Magdalen Islands in the Gulf of St. Lawrence. They outcrop over wide areas and are up to 50 feet or more in thickness.

The chief deposits in Ontario are in the Moose River area in the north-eastern part of the province, and in the Grand River area south and west of Hamilton. The Moose River deposits are 15 to 20 feet thick and usually have 10 to 30 feet of overburden; those of the Grand River area are narrow and lens-like, and occur at depths up to 200 feet.

Both Manitoba and Alberta have large gypsum deposits. In Manitoba, the main occurrences are at Gypsumville, where beds 30 feet or more in thickness are exposed, and at Amaranth, where a 40-foot seam is found at a depth of 100 feet. In Alberta, the main occurrences are in Wood Buffalo Park, where gypsum is well exposed along the banks of the Peace River between Peace Point and Little Rapids. Gypsum also occurs along the banks of the Slave and Salt rivers north and west of Fort Fitzgerald, and narrow seams of gypsum are



interbedded with anhydrite at a depth of 500 feet at McMurray in the northeastern part of Alberta.

In British Columbia the main deposits are at Windermere, Mayook and Canal Flats in the southeastern part of the province, and at Falkland near Kamloops.

Producers*

Nova Scotia

Nova Scotia accounted for more than 79 per cent of Canada's output of crude gypsum in 1958. Most of the gypsum quarried in this province is exported to the United States.

Canadian Gypsum Company, Limited, a subsidiary of United States Gypsum Company of Chicago, Illinois, operates quarries for export purposes at Wentworth and Miller Creek, near Windsor.

National Gypsum (Canada) Limited, a subsidiary of National Gypsum Company of Buffalo, New York, operates a large gypsum quarry at Milford Station, 30 miles north of Halifax. Most of the production from this quarry is exported to the United States although periodic shipments are made to Montreal. Gypsum for export is also obtained from quarries at Walton and Cheverie, in Hants county.

Little Narrows Gypsum Company Limited, a subsidiary of United States Gypsum Company of Chicago, Illinois, quarries gypsum at Little Narrows on Cape Breton Island. Crude gypsum is shipped to the United States and Montreal for use in the manufacture of plaster and plaster products.

Gypsum, Lime and Alabastine, Canada, Limited, with head offices in Toronto, operates a calcining mill at Windsor. Gypsum from quarries at McKay Settlement, near Windsor, is calcined at the Windsor plant and shipped to consumers in Nova Scotia, eastern Quebec and Ontario. This company recently acquired a gypsum deposit, near Nappan, which is to be developed to supply crude gypsum to a company-owned gypsum-products plant in Montreal.

The Bestwall Gypsum Company (Canada) Ltd., a subsidiary of Bestwall Gypsum Company, Ardmore, Pennsylvania, completed exploratory work on several gypsum deposits in Inverness county, Cape Breton Island in 1958. No decision has yet been made regarding the development of these deposits for export.

Ontario

Gypsum is mined at Caledonia, near Hamilton, by Gypsum, Lime and Alabastine, Canada, Limited, and at Hagersville southwest of Caledonia, by Canadian Gypsum Company, Limited. This gypsum is used in the manufacture of plaster and wallboard at company-owned plants near the respective mines.

National Gypsum (Canada) Limited has discovered a large gypsum deposit near Princeton, east of Woodstock, which will be developed to supply crude gypsum to a gypsum-products plant to be constructed in this area.

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*See map on page 340.

Manitoba

Gypsum is obtained from an underground deposit at Amaranth by Western Gypsum Products Limited and is shipped to Winnipeg for use in the manufacture of plaster and wallboard at a company-owned plant. Western Gypsum Products Limited is a subsidiary of British Plaster Board (Holdings) Limited, of London, England.

Gypsum is quarried at Gypsumville by Gypsum, Lime and Alabastine, Canada, Limited, for use in the manufacture of plaster and plaster products at company-owned plants in Winnipeg and Calgary.

New Brunswick

Gypsum is quarried near Hillsborough by Canadian Gypsum Company, Limited, for use in the manufacture of plaster and wallboard at a company-owned plant at Hillsborough.

Canada Cement Company Limited obtains gypsum from a quarry near Havelock, west of Moncton, for use in the manufacture of cement at Havelock.

British Columbia

Western Gypsum Products Limited operates a gypsum quarry near Windermere, in southeastern British Columbia. This quarry supplies crude gypsum to the company's gypsum-products plant at Calgary and to cement plants in British Columbia and Alberta. Western Gypsum Products Limited is currently constructing a new gypsum-products plant in Vancouver. This plant, scheduled for completion late in 1959, will manufacture gypsum plaster and wallboard for domestic consumption.

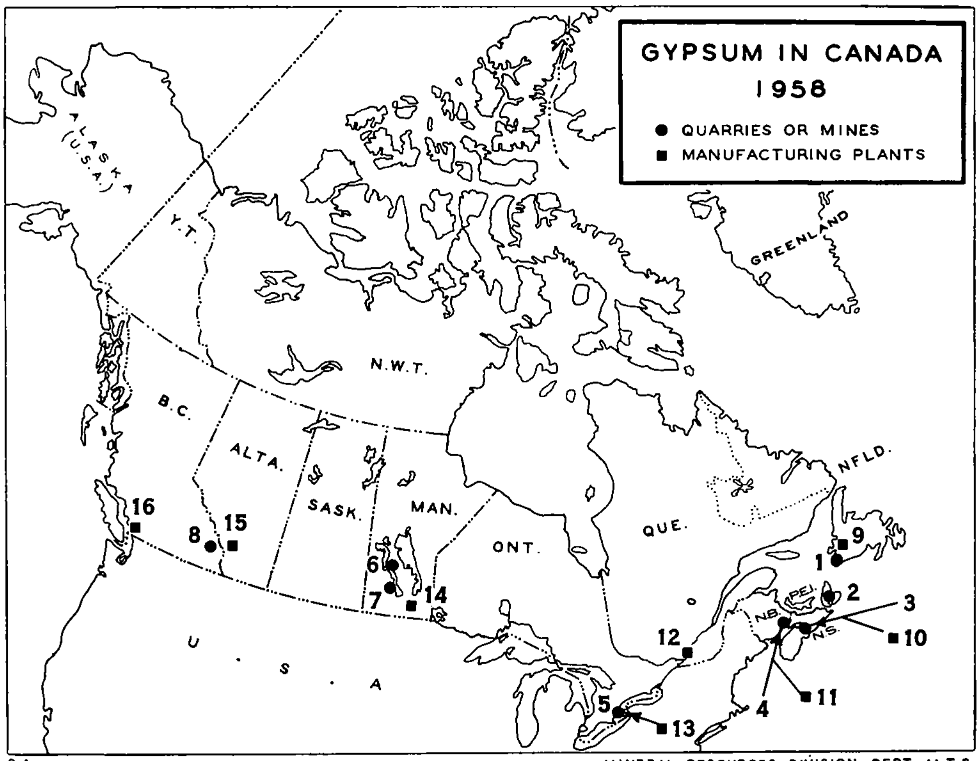
Newfoundland

Atlantic Gypsum Limited, operated by Bellrock Gypsum Industries, of London, England, produces gypsum plaster and wallboard at a plant at Humbermouth on the west coast of Newfoundland. This plant, owned by the Government of Newfoundland, obtains crude gypsum from a quarry, also government-owned, at Flat Bay Station, 62 miles by rail southwest of Humbermouth. Plants to manufacture 'Bellrock' preformed gypsum panels for construction purposes have been set up by Atlantic Gypsum Limited at St. John's and Corner Brook, Newfoundland, and at Montreal, Quebec.

Other Processing Plants

Quebec

Gypsum, Lime and Alabastine, Canada, Limited, and Canadian Gypsum Company, Limited, operate gypsum-products plants in Montreal East. Crude gypsum from quarries in Nova Scotia is used by these plants in the manufacture of plaster of paris, wallboard and other gypsum products.



Quarries or Mines

1. Atlantic Gypsum Limited, Flat Bay Station
2. Little Narrows Gypsum Company Limited, Little Narrows
3. Canadian Gypsum Company, Limited, Wentworth and Miller Creek
   National Gypsum (Canada) Limited, Milford Station and Walton
   Gypsum, Lime and Alabastine, Canada, Limited, Brooklyn
4. Canadian Gypsum Company, Limited, Hillsborough
5. Canadian Gypsum Company, Limited, Hagersville
   Gypsum, Lime and Alabastine, Canada, Limited, Caledonia
6. Gypsum, Lime and Alabastine, Canada, Limited, Gypsumville
7. Western Gypsum Products Limited, Amaranth
8. Western Gypsum Products Limited, Windermere

Manufacturing Plants

9. Atlantic Gypsum Limited, Humbermouth
10. Gypsum, Lime and Alabastine, Canada, Limited, Windsor
11. Canadian Gypsum Company, Limited, Hillsborough
12. Canadian Gypsum Company, Limited, Montreal
    Gypsum, Lime and Alabastine, Canada, Limited, Montreal
13. Canadian Gypsum Company, Limited, Hagersville
    Gypsum,Lime and Alabastine, Canada, Limited, Caledonia
14. Gypsum,Lime and Alabastine, Canada, Limited, Winnipeg
    Western Gypsum Products Limited, Winnipeg
15. Gypsum,Lime and Alabastine, Canada, Limited, Calgary
    Western Gypsum Products Limited, Calgary
16. Gypsum,Lime and Alabastine, Canada, Limited, Port Mann

Alberta

Gypsum, Lime and Alabastine, Canada, Limited, produces plaster at its plant in Calgary, using raw gypsum from company quarries at Gypsumville, Manitoba. This company is now expanding its Calgary operation to include the production of gypsum wallboard and lath. Western Gypsum Products Limited manufactures plaster and wallboard at a plant in Calgary. Raw gypsum for this plant is obtained from a company-owned quarry at Windermere, British Columbia.

British Columbia

Gypsum, Lime and Alabastine, Canada, Limited, operates a plaster-and-wallboard plant at Port Mann, about 10 miles east of Vancouver. The gypsum requirements of this plant are met by imports from San Marcos Island, Mexico.

Uses

Calcined gypsum, or plaster of paris, is the main constituent of gypsum board and lath, gypsum tile, roof tile and all types of industrial plasters. Gypsum plaster is mixed with water and aggregate (sand, expanded perlite or vermiculite) 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 also is used to a limited 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 soils, and as a fertilizer for peanuts and other leguminous crops.

Prices

The nominal price of crude gypsum in 1958 was $3 to $5 a ton f.o.b. quarry or mine. Under large contracts with seaboard quarries, however, prices were much lower.

Tariffs

Canada

	British Preferential	Most Favoured Nation	General
Gypsum			
Crude	free	free	free
Ground	10% ad valorem	12 1/2% ad valorem	15% ad valorem

United States

Gypsum	
Crude	free
Ground, per long ton	$ 1.26

ANHYDRITE

The mineral anhydrite, which is anhydrous calcium sulphate, usually occurs in the massive form and is commonly associated with gypsum. It is produced in small amounts at one or two gypsum quarries in Nova Scotia for export to the United States, where it is used as a fertilizer for peanut crops.

Anhydrite is used to a limited extent as a soil conditioner. Gypsum and anhydrite are potential sources of sulphur compounds. As yet, however, these minerals have not been utilized for this purpose 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 by-product cement. The gases are then converted into sulphuric acid.

LIME

J.S. Ross

Lime, the most common and lowest-priced alkali chemical, has numerous uses. It is a product of the complete calcination of limestone or dolomite and is marketed either as quicklime, the oxide, or as hydrated lime. Quicklime may be classified as (1) high-calcium, containing 90 per cent or more calcium oxide and up to 5 per cent magnesia, (2) magnesian, containing 5 to 25 per cent magnesia, and (3) dolomitic, containing 25 to 45 per cent magnesia.

Quicklime and smaller amounts of hydrated lime are the products of the Canadian lime industry. The general rise in lime production that started in 1932 reached a peak in 1958 at 1,596,422 tons. This represents an increase of 16 per cent over the peak output of 1957. United States lime production in 1958 decreased approximately 10 per cent from that of the previous year, mainly because of lower consumption by the steel industry. For the same period, Ontario production (63 per cent of the Canadian total) increased 32 per cent, largely owing to the needs of the Ontario uranium industry. Because of greater industrial productivity, Canadian shipments are expected to increase slightly in 1959.

Canada, as a whole, is self-sufficient in lime, but, because of the inconvenient locations of certain consuming areas, some lime is imported into Canada, although in decreasing amounts. In 1958, there was a decrease in exports, most of which go from British Columbia to the State of Washington. The low price tends to hinder international trade.

Domestic Production

Lime is produced in six provinces although all provinces except Prince Edward Island have limestone deposits from which lime could be produced. Many high-quality limestone occurrences, however, are some distance from the greater industrial areas, while most Canadian lime plants are near the larger centres of population and most of the output is from the more industrialized provinces, 90 per cent being from Ontario and Quebec.

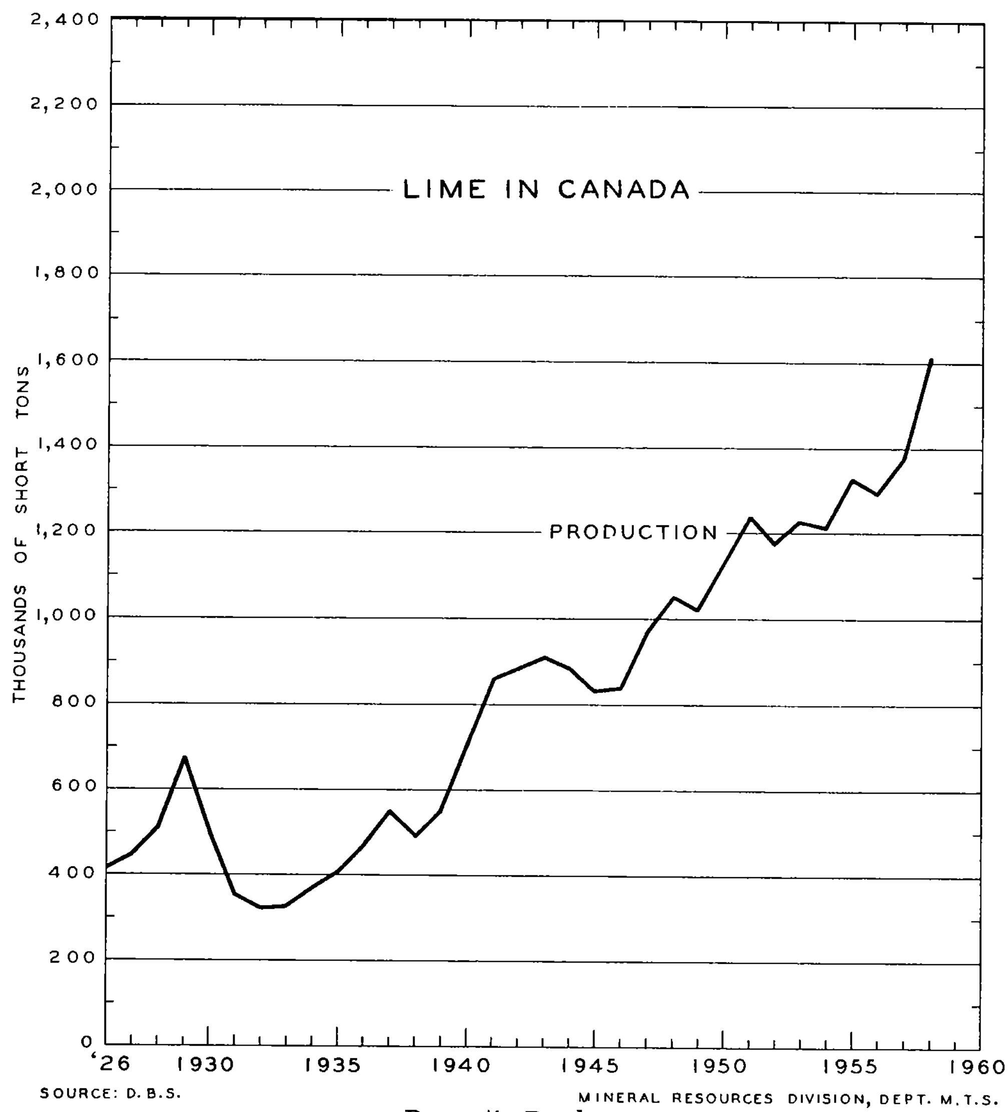
High-calcium lime is produced in British Columbia, Alberta, Manitoba, Ontario, Quebec and New Brunswick, and dolomitic lime in Manitoba, Ontario and New Brunswick. During 1958, 2,831,886 tons of limestone were used for the manufacture of lime in Canada. Thirty-eight

Lime - Production and Trade

	1958		1957	
	Short Tons	$	Short Tons	$
Production (shipments)				
By product				
Quicklime	1,258,089	15,371,452	1,074,338	13,048,505
Hydrated lime	338,333	4,094,371	304,279	3,630,109
Total	1,596,422	19,465,823	1,378,617	16,678,614
By province				
New Brunswick	17,614	394,239	14,895	342,054
Quebec.............	421,652	3,985,234	443,964	4,295,102
Ontario	1,009,916	12,644,925	766,143	9,416,868
Manitoba...........	72,561	1,168,514	64,922	1,089,728
Alberta	47,112	767,612	42,223	678,237
British Columbia....	27,567	505,299	46,470	856,625
Total	1,596,422	19,465,823	1,378,617	16,678,614
Imports				
United States	15,395	200,281	27,865	338,576
United Kingdom	238	3,073	318	4,305
Total	15,633	203,354	28,183	342,881
Exports				
United States	17,222	361,996	36,179	741,804
St. Pierre..........	3	115	5	165
Total	17,225	362,111	36,184	741,969

plants containing 125 vertical and 25 rotary kilns and having a total rated output of 7,400 tons of primary lime a day, were in operation. In addition, two separate hydrating plants operated.

In British Columbia, Ontario, Quebec and New Brunswick, captive secondary lime was reclaimed from waste carbonate sludges from the manufacture of pulp and paper in 13 plants. Statistics for this secondary output are not available.



Domestic Producers

New Brunswick

Bathurst Power and Paper Company Limited calcines limestone from Quebec for use in its pulp-and-paper mill. Snowflake Lime Limited operates a quarry and plant at Saint John for the production of quick and hydrated lime, mainly for the pulp-and-paper and building industries.

Quebec

At Shawinigan, Shawinigan Chemicals Limited calcines high-calcium limestone from near Bedford, mainly for use in the manufacture of calcium carbide and in the metallurgical industries.

At Wakefield, Aluminum Company of Canada Limited manufactures quick and hydrated lime from brucitic limestone for industry, agriculture and the building trade.

Dominion Lime Limited, Lime Ridge, produces lime from high-calcium limestone for use in the pulp-and-paper and building industries.

High-calcium lime is manufactured at Joliette and St. Marc des Carrières by Standard Lime Limited for use in the pulp-and-paper and building industries.

During 1958, four small lime plants supplied local markets.

Ontario

Brunner Mond Canada, Limited, calcines high-calcium limestone near Amherstburg for the manufacture of alkali.

Gypsum, Lime and Alabastine, Canada, Limited, produces high-calcium and dolomitic quick and hydrated lime from its plants at Beachville, Hespeler and Milton, mainly for industrial and building uses.

Cyanamid of Canada Limited produces high-calcium lime at Niagara Falls for use in the manufacture of calcium carbide. Another plant near Ingersoll supplies lime to the chemical industry.

Dominion Magnesium Limited calcines dolomite at Haleys for the production of magnesium.

Near Beachville, Chemical Lime Limited manufactures high-calcium lime mainly for fluxing in the metallurgical industry. Three new vertical kilns with the necessary facilities are being constructed at the plant. This addition, to come into production in 1959, will double plant capacity.

Near Guelph, dolomitic lime is produced for the building industry by Canadian Gypsum Company, Limited. This company is constructing two new vertical kilns.

The plant of Cobo Minerals Limited, destroyed by fire in 1957, was repaired and put into operation.

Five other lime plants were in operation during 1958.

Manitoba

The Winnipeg Supply and Fuel Company Limited makes high-calcium lime at Spearhill, mainly for use in pulp-and-paper mills and nonferrous smelters, and produces dolomitic lime at Stonewall, chiefly for pulp-and-paper mills and mason's lime.

The Manitoba Sugar Company Limited manufactures lime at its sugar refinery at Fort Garry.

Building Products and Coal Co. Ltd. produces dolomitic lime at Inwood, and Western Gypsum Products Limited hydrates purchased lime at Winnipeg.

Alberta

Summit Lime Works Limited and Loder's Lime Co. Ltd. manufacture high-calcium lime for various uses near Crowsnest Pass and at Kananaskis respectively.

Canada Sugar Factories Limited operates three kilns in conjunction with its sugar refineries at Raymond, Picture Butte and Taber.

British Columbia

High-calcium limestone is calcined at Blubber Bay, Texada Island and Vancouver by Gypsum, Lime and Alabastine, Canada, Limited.

Crown Zellerbach Canada Limited produces lime at Ocean Falls for its own use in the manufacture of pulp and paper.

Consumption and Uses

Lime has numerous uses and in most industries is consumed either as a raw material or indirectly. Because it costs little, is widely used and, in many cases, has no substitute, its future seems assured. As shown in the table on page 348, the consumers of lime fall into three main groups.

The largest group, which consumed more than 87 per cent of all types of lime used in Canada in 1958, comprises the chemical industry and other industrial users. No separate figures are available for the largest category consumed by this group, namely, captive-tonnage lime, which companies produce for their own use. In the table, this category is covered by 'other industries' and includes lime used in the manufacture of calcium carbide, alkali and magnesium. Other uses of lime are shown in the table in the order of the amounts consumed. Chemical and industrial processes require lime for neutralization, causticization, coagulation and precipitation.

Canada's uranium industry, which uses high-calcium lime mainly to neutralize waste sludges, was the second largest consumer of lime in 1958, following the 'other industries' category mentioned above.

In the pulp-and-paper industry, lime is used in the preparation of dissolving liquors for the sulphite, sulphate and soda processes and as a raw material in the manufacture of the bleaching agent, calcium hypochlorite.

Consumption of Lime
(producers' shipments by usage)

Uses	1958 Short Tons	1958 $	1957 Short Tons	1957 $
Chemical and other industrial				
Pulp and paper mills	183,650	2,458,932	200,162	2,635,663
Iron and steel plants	124,770	1,470,792	126,568	1,547,359
Nonferrous smelters	139,005	818,953	118,146	671,154
Uranium mills	284,486	3,437,226	75,577	926,140
Sugar refineries	36,335	433,181	31,363	403,489
Cyanide and flotation mills	9,767	141,992	17,997	222,205
Glass works	22,039	264,756	18,693	220,927
Sand-lime brick	12,215	142,796	9,960	117,393
Tanneries	7,523	94,866	7,269	89,355
Fertilizer plants	4,316	41,545	4,423	42,501
Insecticides, fungicides..	827	15,176	571	10,447
Other industries	573,716	6,467,074	578,918	6,383,229
Building-trade				
Mason's lime	95,562	1,522,567	93,528	1,399,039
Finishing lime	90,985	1,948,287	83,851	1,804,298
Agricultural...............	3,538	64,663	3,181	52,638
Other....................	7,688	143,017	8,410	152,777
Total	1,596,422	19,465,823	1,378,617	16,678,614

In steel plants, high-calcium lime is used extensively as a flux and desulphuring agent. In the manufacture of steel products it has many uses, including the neutralization of waste pickling liquors.

High-calcium lime is used mainly as a flux in the smelting and refining of nonferrous ores.

In the refining of beet sugar, high-calcium lime and the by-product carbon dioxide produce insoluble calcium sucrate, from which impurities are filtered.

Lime serves as a depressant in ore-flotation processes and for pH control in the recovery of minerals by the cyanidation process.

Dolomitic or high-calcium lime is one of the three principal raw materials used in the manufacture of glass.

Lime in one form or another is used in the manufacture of calcium, fertilizers, paint pigments, varnish and glue, and for other purposes including the treatment of sewage and municipal water.

High-calcium lime is a main raw material for the manufacture of such chemical compounds as calcium cyanamide, acetylene, soda ash, precipitated calcium carbonate, calcium chloride, calcium hydroxide, sodium bicarbonate, ethylene glycol and other organic and inorganic compounds.

Twelve per cent of the lime consumed in Canada in 1958 went to the building trade, which uses it as a constituent of plaster, stucco, mortar and sand-lime brick.

The agricultural industry employs lime for the control of soil acidity, as a source of calcium and magnesium, as a soil conditioner and in insecticides and fungicides.

Prices

Quicklime is marketed in Canada in bulk as lump, pebble and pulverized, or in bags as pulverized lime. Hydrated lime is sold in bulk or in bags as a fine granular product. Prices vary according to the type and form of product, the tonnage of sale and the location. During 1958 the average value of lime produced in Ontario was $12.19 a ton at the plants.

LIMESTONE

J.S. Ross

In industry, the term 'limestone' includes all rocks of sedimentary and metamorphic origin that are at least 50 per cent of calcite, dolomite or combinations of these two minerals. Varying amounts of magnesite and brucite may partly replace limestone to form such rocks as brucitic limestone and magnesitic dolomite. Marl is the unconsolidated form of limestone; marble, for the purpose of this review, is a recrystallized limestone. Limestone may vary in colour, texture, hardness and chemical composition depending on the type and amount of its impurities and its geological history.

In 1958 limestone was produced from some 450 quarries and in all provinces but Saskatchewan and Prince Edward Island. The production of limestone, marble and marl for all uses decreased 5 per cent owing to marked decreases in miscellaneous consumption in British Columbia, New Brunswick, Newfoundland and Ontario. By uses, large decreases occurred in concrete aggregate and railroad ballast.

International trade, although negligible, is increasing. Some stone is exported from British Columbia coastal ports to similar ports on the west coast of the United States for use in the manufacture of pulp and paper and as metallurgical flux. High-calcium limestone from Beachville and Picton, Ontario, is exported to the United States for use as flux and aggregate respectively. Minor imports of limestone enter Ontario and southern British Columbia for use as metallurgical flux.

During 1958, southwestern Ontario experienced an increase in the development of limestone deposits. For example, two new quarries and associated plants came into operation, one company commenced construction of a crushing and screening plant, and another substantially increased its operations. Apart from normal expansion programs and the opening of a few relatively small new plants, there was no noteworthy change in the industry in other parts of Canada.

Uses

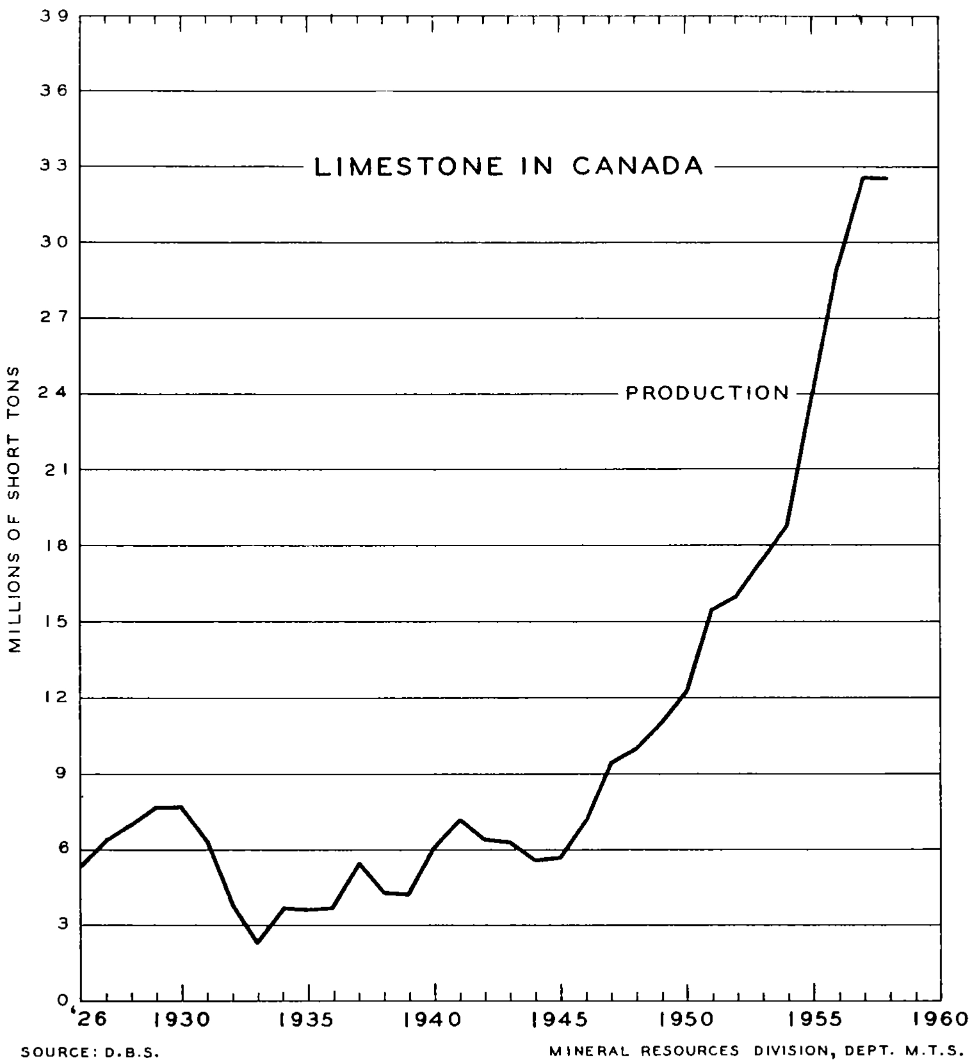
Because occurrences of the rock are common in the more populated areas of Canada, limestone is generally a low-priced commodity. It is used widely in the construction, the chemical and other industries. Except for

Limestone - Production and Consumption

	1958 Short Tons	1958 $	1957 Short Tons	1957 $
Production				
By province(1)				
Newfoundland	222,767	380,415	348,143	581,224
Nova Scotia	120,898	235,701	124,672	240,615
New Brunswick	199,511	503,278	497,911	793,349
Quebec	13,565,133	17,263,107	12,641,192	16,567,501
Ontario	15,178,350	18,844,057	16,632,732	20,046,509
Manitoba	540,703	983,463	391,796	829,618
Alberta	39,612	163,436	35,427	134,341
British Columbia	468,030	910,614	2,014,679	2,677,539
Total	30,335,004	39,284,071	32,686,552	41,870,696
By uses				
Structural(2)	89,477	2,421,309	86,086	2,409,157
Metallurgical	1,531,351	1,778,973	1,694,487	1,914,147
Glass-making	32,401	108,214	23,269	69,141
Sugar-refining	20,386	24,603	11,227	14,391
Pulp and paper	340,750	1,093,517	395,725	1,214,710
Other chemical uses	416,820	381,341	181,575	252,319
Pulverized for agricultural and fertilizer uses	696,437	1,790,169	610,398	1,471,841
Pulverized for other uses	174,756	699,408	99,487	494,839
Rubble and riprap	1,195,072	1,273,786	1,601,109	1,745,518
Concrete aggregate	6,137,598	7,466,637	9,338,334	11,886,706
Road metal	16,472,736	18,238,796	15,511,206	16,123,599
Railroad ballast	802,055	938,939	1,593,946	2,102,131
Other uses	2,425,165	3,068,379	1,539,703	2,172,197
Total	30,335,004	39,284,071	32,686,552	41,870,696
Consumption				
In the production of cement	8,473,596		8,741,863	
In the production of lime	2,831,886		2,562,740	
Miscellaneous	30,335,004		32,686,552	
Total	41,640,486		43,991,155	

(1) Does not include limestone produced for the lime and cement industries, but includes marl used for agricultural purposes.

(2) Includes building, monumental and ornamental stone, flagstone and curbstone.



dimension stone and rubble and riprap, Canadian limestone is consumed in sized, crushed and ground forms from approximately 16 inches to minus 325 mesh in size. The use of stone from a given location depends upon the distance to markets; the accessibility of the site; the colour, texture, hardness and chemical composition of the rock; the thickness and extent of the beds and formation; and other local conditions.

Canadian limestone is used mainly for construction purposes in road metal and concrete aggregate, for the production of cement and some lime, as rubble and riprap, railroad ballast, terrazzo, stucco and artificial stone, and as dimensional building and ornamental stone. The physical properties of limestone for construction purposes are its most important technical aspect except when it is used in the production of cement and lime.

High-calcium and dolomitic limestones are the main types consumed by the chemical industry. High-calcium limestones low in impurities have chemical qualities that make them important for this purpose. They are a source of the lime consumed by the chemical industry and are employed as fluxes in the smelting of ferrous and nonferrous ores. High-calcium limestone is consumed by the pulp-and-paper industry in the preparation of calcium-bisulphite dissolving liquor. It is also employed as a filler and whiting compound in the manufacture of such materials as rubber, paint and linoleum.

Dolomitic limestones containing low impurities are employed as fluxes in iron and steel production, in the production of lime mainly for construction purposes and in the manufacture of glass.

Ground limestone is used in agriculture to control soil acidity and supply calcium and magnesium. Increasing amounts of marl are also being used for this purpose in Quebec and British Columbia.

Aluminum Company of Canada Limited recovers magnesium from brucitic limestone quarried near Wakefield, Quebec. Dominion Magnesium Limited quarries dolomite for the production of magnesium near Haley Station, Ontario.

Magnesitic dolomite is mined by Canadian Refractories Limited at Kilmar, Quebec, for use in the production of basic refractory products. Steetly of Canada Limited dead-burns dolomite near Dundas, Ontario, for use as a refractory material in open-hearth furnaces.

Prices

Prices of limestone products vary according to the geographical location, the local supply and quantity of sale of a given product, and the type, quality and preparation of the stone. Transportation costs add greatly to the gross price of stone. Crushed and sized limestone for concrete aggregate may sell for $1.25 a ton or more at the plant.

LITHIUM MINERALS

J.E. Reeves

Quebec Lithium Corporation continued to be the only Canadian producer of lithium minerals, concentrating spodumene from very large pegmatitic deposits in Lacorne township, about 20 miles north of Val d'Or in western Quebec. Montgary Explorations Limited intends to produce limited amounts of lepidolite and pollucite (a cesium-aluminum silicate) from concentrations within its deposit in southeastern Manitoba, but plans for full-scale production must await an increase in demand for lithium and lithium compounds. Although world markets have expanded greatly in the last decade, their expansion has not nearly kept pace with the development of potential ore. All other properties, therefore, are now inactive.

Production and Trade

In 1958, Quebec Lithium Corporation shipped chemical-grade spodumene concentrate containing 3,853,322 pounds of lithia (lithium oxide or Li_2O), 25 per cent less than the 5,140,257 pounds produced in 1957. Virtually all production was sent to Lithium Corporation of America Inc., at Bessemer City, North Carolina, under a contract to supply concentrate at the rate of 165 tons a day with a minimum of 4.5 per cent lithia. This contract was replaced on January 1, 1959, by a new one for 17,000 short-ton units (1 unit = 20 pounds) of lithia a month and a total of 640,008 units.

The company decreased the milling rate somewhat during the year because an improvement in the grade of ore permitted a higher recovery; the average grade of the spodumene concentrate for 1958 was reported to have increased to 5.46 per cent lithia from 5.10 per cent in the previous year. A labour strike interrupted production during most of November.

Equipment has been installed for the production of a ceramic grade of spodumene concentrate containing less than 0.6 per cent Fe_2O_3, and a contract was signed on December 31 for shipments to the United States for use in glass-manufacturing.

The company also made initial shipments of by-product feldspar to the Montreal area.

During the year construction was started on a semicommercial pilot plant for producing lithium chemicals from spodumene concentrate. This plant is located at the mine site and is to have an initial capacity of 50 tons of spodumene concentrate a day. In the beginning it is planned to produce only lithium carbonate, but eventually to add other compounds. Output is expected to be about 12,000 pounds of lithium carbonate a day, and production should commence late in 1959.

Lithium-bearing Minerals

While lithium is not uncommon as a constituent of the earth's crust, commercial concentrations are limited mainly to pegmatite dykes in a few areas. Numerous minerals contain lithium, but only four have had any economic importance. In addition, zinnwaldite and lithiophilite occur as accessory lithium minerals. Generally the lithium has been replaced to some extent by other alkali metals and, in fact, the composition of these minerals is variable. In the following table, the lithium minerals appear in the order of their importance.

Mineral	Simplified Formula	Theoretical Li_2O Percentage	Actual Range Li_2O Percentage
Spodumene	$LiAlSi_2O_6$	8.03	4 to 8
Lepidolite	$KLi_2AlSi_4O_{10}F_2$	7.65	3 " 5
Amblygonite	$LiAlFPO_4$	10.10	8 " 9
Petalite	$LiAlSi_4O_{10}$	4.89	2 " 4
Zinnwaldite	$LiKFeAl_2F_2Si_3O_{10}$	3.40	2 " 3
Lithiophilite-triphylite	$Li(MnFe)PO_4$	9.52	2 " 6

Occurrences of Lithium Minerals in Canada

Quebec

Diamond-drilling on the property of Quebec Lithium Corporation has indicated one of the largest spodumene deposits in the world. The deposit consists of a number of large dykes and many associated smaller ones, constituting a family of parallel dykes which extends for several miles. The company has reported reserves in excess of 20 million tons containing 1.15 per cent lithia.

Other lithium-bearing dykes in the same general area are located in Lacorne, Figuery and Landrienne townships. In most of the occurrences spodumene is the only lithium mineral present, although lepidolite has been reported occurring in some of the smaller dykes and lithiophilite has also been recognized as a minor constituent in at least one dyke. These dykes are associated with the contact of a large granitic intrusive mass known as the Lacorne batholith. They occur both within the granitic rocks near the contact and in the enclosing metamorphic rocks. The spodumene has a uniform distribution in some of the larger dykes; in others it is locally segregated into zones and patches. Beryl and columbite-tantalite are among the accessory minerals.

Ontario

There are four districts in which large reserves of spodumene are indicated. The one that has received the most attention is in the Beardmore area near Lake Nipigon. Many occurrences of spodumene-bearing pegmatite have been discovered, and exploratory drilling by a number of companies has outlined in excess of an estimated 6 million tons of reserves running from 1.1 to 1.4 per cent lithia. The district is serviced by road and railway transportation and is close to boat transport on Lake Superior; hydro power facilities are also readily available. The other districts are near Root Lake, 50 miles north of Sioux Lookout, near Falcon Lake, 14 miles north of the Canadian National Railways between Nakina and Armstrong, and in Quetico Provincial Park, 90 miles southeast of Fort Frances. Less is known of these occurrences.

Manitoba

In southeastern Manitoba, numerous lithium-bearing dykes occur in the Winnipeg River-Cat Lake area. As elsewhere in Canada, the principal lithium mineral is spodumene. However, the lithium micas - lepidolite and zinnwaldite - occur, the former in some occurrences prominently, and also amblygonite and petalite. The property of Montgary Explorations Limited is on the north shore of Bernic Lake. The most recent estimate of reserves by the company is in excess of 8 million tons with a grade of more than 2 per cent lithia. In addition, a concentration of lepidolite is estimated at 200,000 tons, and a nearly pure concentration of the relatively rare mineral pollucite approximates 150,000 tons. This concentration of lepidolite and a reportedly substantial tonnage of amblygonite-bearing material are the only known nonspodumene lithium minerals with commercial potential.

On other properties near Bernic Lake and also northwest of Cat Lake substantial tonnages of spodumene-bearing pegmatite have been indicated by diamond-drilling.

Spodumene-bearing pegmatite dykes also occur near East Braintree, 84 miles east of Winnipeg, and in the Herb Lake area of northern Manitoba. The Herb Lake property has been drilled and indicated reserves in excess of 5 million tons containing 1.20 per cent lithia have been reported.

Northwest Territories

In the area lying northeast of Yellowknife for about 50 miles, and eastward along the north shore of Great Slave Lake as far as Hearne Channel, pegmatite dykes containing rare-element minerals are common. All the lithium minerals of commercial interest, as well as beryl and columbite-tantalite, have been reported as occurring in many of these dykes. Particularly, occurrences with a high content of spodumene have been reported in the areas of Redout Lake, Sproule Lake and Buckham Lake and to the north of Hearne Channel. Appreciable quantities of amblygonite have also been observed, in addition to minor occurrences of lithiophilite, lepidolite and petalite.

World Survey of Resources and Production

There are four principal producers of lithium chemicals, metal and alloys in the United States. Since production capacities can supply more than the present requirements, the major concern during 1958 was the development of markets. The chief domestic sources of raw material continued to be the large reserves of spodumene in North Carolina, to a lesser extent the Black Hills area of South Dakota, which has been a source of spodumene for many years, and the salt brine of Searles Lake, California, where dilithium sodium phosphate is obtained as a by-product of the production of potash and other chemicals. The main sources of imported raw materials are Canada and Southern Rhodesia. A chemical-processing plant in Texas continued to use Southern Rhodesian lepidolite as the raw material for the manufacture of lithium hydroxide.

The lithium industry in the United States is faced with several problems in addition to overcapacity. These include increased imports of relatively low-cost lithium compounds from Brazil, the large and increasing supply of lithium hydroxide which remains when the Atomic Energy Commission has extracted the lithium-6 isotope for its use, and the possibility that the Atomic Energy Commission will not renew contracts for lithium chemicals which expire in 1959 and 1960. While the long-range marketing forecasts remain encouraging, the immediate future is not encouraging.

Lithium-mineral production in Africa consists mainly of lepidolite and petalite and minor amounts of amblygonite. Very large reserves of lepidolite and petalite exist in Southern Rhodesia and Southwest Africa. During 1958, Southern Rhodesia, an important source, experienced a marked decrease in production, but African sources continued to supply the lithium-mineral requirements of England, France and Germany.

Many other countries contain lithium-mineral occurrences that have not yet been developed. Very large deposits of spodumene have been reported as occurring in the Belgian Congo, and Soviet geologists have reported large deposits containing lithium in the Kola peninsula.

Uses and Specifications

Lithium compounds find their most important applications in the ceramic industry and the manufacture of lubricating greases. A large proportion of lithium-mineral concentrates is converted chemically to lithium carbonate or hydroxide, the usual basic compounds used in industry. For chemical-processing in the United States, the only specification available is for the spodumene that Quebec Lithium Corporation is exporting. Four and a half per cent lithia is required as a minimum in the concentrate. However, practically all producers of lithium compounds either own or have a share in mining properties from which they obtain concentrates; standard specifications have, therefore, not been established and grades are a matter of individual negotiation.

Lithium greases, first evolved in 1943, came to play an important role in lubrication wherever operational extremes of temperature were experienced, as they maintain their lubricating qualities between -60°F and +320°F and, moreover, have excellent water-insolubility characteristics. In wartime, lithium greases were invaluable for aircraft engines. Since the war, their industrial use has grown rapidly, as their unique properties make possible the production of multipurpose greases, simplifying both manufacture and application. Late in the year it was reported that automobiles in the future may have teflon-fabric bearings in place of the conventional grease fittings, with a resulting decrease in automobile-grease consumption.

In ceramics, lithia serves primarily as a flux, permitting the development of low-temperature ceramic bodies with the attendant benefits of refractoriness, fuel economies and wider colour use. It also makes possible the production of glass transparent to ultraviolet light for use in germicidal lamps. Lithium compounds reduce the maturing temperature and increase the fluidity and gloss of glass, glazes and enamels, facilitate production of certain glasses of high electrical resistance and have many other desirable effects that render them of great benefit in the field of ceramics.

Other common applications include the use of lithium hydroxide as a constituent of the electrolyte in alkaline storage batteries; of lithium chloride and bromide in air-conditioning units and refrigeration systems; of lithium chloride or fluoride as a flux in the welding and brazing of aluminum; of lithium fluoride as the analyzing crystal in X-ray spectrographs; and of compounds in the control of reactions leading to the formation of alkyd resins for use in paints, and in the manufacture of dry-cell batteries which will function at extremely low temperatures where normal cells are inoperative.

Recently developed compounds include lithium perchlorate for use in conjunction with high-energy fuels, and the first of a new family of organo-lithium compounds to be used primarily as polymerization catalysts. Such markets still require considerable development.

Lithium as a metal has so far had limited application. Its principal use appears to be as a scavenger of impurities in refining nonferrous metals and as a grain-refining agent. Only very small amounts are added for these purposes. Lithium alloys of magnesium, aluminum, copper, lead and zinc are under development and have promise. The Aluminum Company of America has announced the development of a lithium-aluminum alloy which will maintain high strength up to 400°F.

The use of lithium in nuclear-energy production and as a source of fuel for rockets and guided missiles has received much publicity, and speculation as to its exact function has been widespread. Little information is available in either case, but from scientific publications it has become generally known that tritium, a reported constituent of the hydrogen bomb, is obtained by bombarding the lithium-6 isotope with neutrons. The association of lithium with solid fuels is in the form of lithium hydride. The chemical compound furnishes a readily available source of hydrogen, which is a high-energy fuel.

Consumption of lithium products in Canada is not large but has been increasing. All lithium compounds are imported from the United States. The major compound is lithium carbonate, but lesser amounts of lithium hydroxide, lithium hydroxide monohydrate and lithium stearate are also imported. In 1957 the value of these imports was approximately $56,000. In addition, sizable quantities of manufactured lithium greases are brought in from the United States.

Prices

Lithium concentrates are not traded in the open market and prices published in trade journals are therefore nominal. The one exception is the price of spodumene concentrate established in the contract between Quebec Lithium Corporation and Lithium Corporation of America Inc. - $11 per short-ton unit of lithia.

Approximate prices for lithium mineral concentrates are as follows:

Spodumene	$ 9.00 - $9.50 per unit Li_2O
Lepidolite (min. 3 1/2% Li_2O)	$ 6.00 - $7.00 " " "
Petalite (min. 3 1/2% Li_2O)	$ 6.00 - $7.00 " " "
Amblygonite (7% Li_2O)	$70.00 " short ton

Prices of lithium metal and lithium chemicals per pound,* as quoted in Engineering News of December 29, 1958, are:

Lithium metal, 99.5%	$9.00	-	$10.00
" bromide	$2.60		
" chloride	$1.45		
" carbonate	$0.67		
" hydroxide	$0.55		
" stearate	$0.47 1/2	-	$ 0.53 1/2
" fluoride	$2.17 1/2	-	$ 2.40
" citrate	$1.60		
" hydroxystearate	$0.70	-	$ 0.71
" salicylate	$1.60	-	$ 1.62

*For quantities normally involved in commercial transactions.

MAGNESITE AND BRUCITE

H.M. Woodrooffe

The mineral magnesite, magnesium salts in sea water and natural brines are the principal sources of magnesia for all its uses. In Canada, however, brucitic limestone and magnesitic dolomite are the only sources of magnesia now being worked. The value of production in 1958 declined by more than 16 per cent owing to a decrease in the demand for basic refractories resulting from labour disputes in the metallurgical industry.

Canada imports dead-burned magnesite from the United States and Yugoslavia for processing into basic refractories. Caustic calcined magnesia in several grades is also imported from the United States.

The Canadian magnesia-mineral industry is confined to two deposits in western Quebec near the Ottawa River. The product is used as a source of magnesium metal, in basic refractories and for other industrial and chemical requirements.

At Farm Point, near Wakefield, Quebec, 22 miles north of Ottawa, Aluminum Company of Canada Limited quarries a deposit of brucitic limestone. In this rock, in a matrix of calcite, spheroid granules of the hydroxide of magnesia (brucite) occur. During processing, the rock is crushed, sized and calcined to remove combined water and carbon dioxide and is separated into commercial forms of magnesia and lime. Some of the magnesia is shipped to the company's plant at Arvida, Quebec, for processing into magnesium chloride, from which magnesium metal is produced by an electrolytic process. Some of it is used in the manufacture of high-magnesia basic refractories and some is prepared in grades for agricultural, chemical and industrial application. In the recovery process, coproducts of hydrated lime and quicklime are made.

At Kilmar, in Argenteuil county, Quebec, about midway between Montreal and Ottawa, Canadian Refractories Limited, a subsidiary of Harbison-Walker Refractories Company, of Pittsburgh, Pennsylvania, is mining, by an underground method, a deposit of magnesitic dolomite that occurs in the Grenville series. The rock, an intimate mixture of magnesite and dolomite, is crushed and beneficiated in a sinkfloat plant to control impurities, these being silicate minerals. The beneficiated rock is calcined by dead-burning in a 245-foot rotary kiln to produce a clinker for basic-refractory manufacture. At Marelan, 10 miles south of Kilmar, the company operates a modern basic-brick-manufacturing plant. Products from both plants include basic brick in various sizes and shapes, high-temperature refractory cements,

Magnesite and Brucite - Production and Trade

	1958 Short Tons	1958 $	1957 Short Tons	1957 $
Production*				
Magnesite, dolomite and brucite		2,529,161		3,046,298
Imports				
Magnesite, dead-burned and sintered				
United States	6,990	689,119	5,203	446,910
Yugoslavia	6,909	369,443	4,933	262,787
Other countries	72	5,349	22	5,101
Total	13,971	1,063,911	10,158	714,798
Magnesite, caustic calcined				
United States	1,306	111,184	1,493	123,504
India	25	4,025	5	789
United Kingdom	24	1,511	21	3,529
Other countries	22	1,284	33	2,009
Total	1,377	118,004	1,552	129,831
Magnesite firebrick				
United States		277,990		404,580
United Kingdom		30,806		5,992
West Germany		19,031		20,357
Total		327,827		430,929
Magnesium carbonate and magnesium oxide				
United States	1,258	116,721	1,976	152,894
United Kingdom	462	63,686	476	67,213
Total	1,720	180,407	2,452	220,107
Magnesium salts or compounds				
United States	4,796	325,789	4,138	250,630
United Kingdom	133	41,336	148	92,410
Other countries	53	3,606	61	8,292
Total	4,982	370,731	4,347	351,332

(continued)

Magnesite and Brucite - Production and Trade (cont'd)

	1958		1957	
	Short Tons	$	Short Tons	$
Imports (cont'd)				
Magnesium sulphate or Epsom salts				
West Germany	1,403	27,034	1,524	27,935
United States	950	39,200	994	40,514
Other countries	100	4,975	40	2,846
Total	2,453	71,209	2,558	71,295
Magnesia pipe covering				
United States		70,560		74,916
United Kingdom		26,970		68,725
Total		97,530		143,641
Exports				
Dolomite and brucite				
United States		85,677		1,520

*Includes the value of brucite shipped, dead-burned magnesitic dolomite and a small quantity of serpentine.

ramming mixtures and other specialized refractory products. These products are prepared from dead-burned magnesitic dolomite and brucitic magnesia and other refractory raw materials.

Other occurrences of brucitic limestone in Canada have been discovered in the vicinity of Wakefield, Bryson and Lake St. John, Quebec; at Rutherglen, Ontario; and on West Redonda Island, British Columbia.

Magnesite and hydromagnesite deposits occur in British Columbia and Yukon Territory. Generally they are either not extensive or are remote from transportation and consequently have not been developed. The most important deposits occur in British Columbia, in the vicinity of Marysville, near Cranbrook. During 1958, development work was undertaken by a Canadian company interested in this material as a source of dead-burned magnesite.

Hydromagnesite deposits occur north of Clinton and near Atlin, both of which are also in British Columbia.

Uses

Magnesia is used principally in the manufacture of basic-type refractories for metallurgical furnaces. Although refractory-grade magnesia was formerly entirely supplied from natural magnesite, a large part of the world's supply of it is now obtained from sea water and salt brines. Magnesia is also used for the production of magnesium metal and in the preparation of magnesium-oxychloride and -oxysulphate cements.

Caustic calcined magnesite is prepared in several different grades for a number of chemical and industrial uses. It enters into the manufacture of rayon and is used as a catalyst and filler in the processing of synthetic rubber. Magnesia is consumed in the manufacture of one type of thermal steam-pipe insulation and is also used in fertilizers and welding-rod coatings, as insulant in heating elements, as a fine abrasive, in the manufacture of magnesium chemicals and pharmaceuticals, and in other ways.

Magnesia is now used by the pulp-and-paper industry in the preparation of magnesium-bisulphite dissolving liquor for the chemical treatment of wood pulp. Magnesia and sulphur are recovered in this process.

In Canada, magnesia is used to control acidity in the processing of uranium ores.

Prices

According to E & M J Metal and Mineral Markets, the United States prices of magnesite in carload lots, f.o.b. Chewelah, Washington, at the end of 1958 were:

Dead-burned grain, in bulk	\$46
Crude	\$27

MICA

J. E. Reeves

The Canadian mica-mining industry has experienced a general decline in production during the last few years. Competition from countries such as India has deprived the Canadian industry of much of the market formerly held in the United States.

Statistics show that, although production in 1958 was somewhat higher than in 1957, it was small compared with that of 1948. The value in 1958 declined because of a much larger proportion of lower-priced products.

Imports of unmanufactured mica increased twofold over those of 1957, although the value was slightly lower. This is due largely to a statistical change in the classification of imports of micaceous materials.

The exports of unmanufactured mica in 1958 declined by 17 per cent in volume and 42 per cent in value compared with those of the previous year. Japan, the main market for rough and trimmed phlogopite block and sheet, purchased considerably less than in 1957. The market for scrap mica did not change appreciably, and exports of dry-ground phlogopite, which had a relatively low unit value, increased by 225 per cent.

Producers

A number of small, scattered deposits in Quebec yielded about two thirds of the total production; all was phlogopite. These deposits are confined to the Gatineau-Lièvre area north of Ottawa in the townships of Hull, Templeton, Wakefield and Portland. Blackburn Brothers Limited mined sheet mica from a deposit near Cantley in Hull township and operated a dry-grinding mill near by. Feed for the mill was scrap phlogopite recovered from a property near Perkins and purchased from a number of individuals in Quebec and Ontario.

Production in Ontario was small. Some trimmed phlogopite sheet and scrap phlogopite originated in North Burgess township near Perth and in Bedford township north of Kingston, and a minor amount of trimmed muscovite came from the North Bay-Parry Sound area.

Some micaceous rock was mined near Albreda, in the east-central part of British Columbia, for grinding and use in the roofing industry.

(text continued on page 367)

Mica - Production, Trade and Consumption

	1958		1957	
	Pounds	$	Pounds	$
Production				
By shipments				
Trimmed	29,834	29,992	40,165	47,231
Sold for mechanical splittings	54,717	14,413	65,612	17,946
Splittings	-	-	16,385	3,568
Rough, mine-run or rifted	4,608	573	2,577	1,085
Ground or powdered	1,380,530	44,298	911,138	37,226
Scrap and unclassified	35,244	375	246,539	4,527
Total	1,504,933	89,651	1,282,416	111,583
By types				
Phlogopite (amber mica)	1,061,972	85,781	1,265,929	107,642
Other	442,961	3,870	16,487	3,941
Total	1,504,933	89,651	1,282,416	111,583
Imports				
Unmanufactured				
United States	687,800	50,149	67,200	34,895
India	335,900	164,097	419,400	195,274
Brazil	700	556	4,300	2,080
Other countries	23,300	2,634	11,000	1,755
Total	1,047,700	217,436	501,900	234,004
Manufactured				
United States		357,023		409,979
United Kingdom		25,363		27,338
Mexico		2,054		215
West Germany		56		1,250
Total		384,496		438,782
Exports				
Unmanufactured				
Rough				
Japan	-	-	87,500	28,666

(continued)

Mica – Production, Trade and Consumption (cont'd)

	1958		1957	
	Pounds	$	Pounds	$
Trimmed				
Japan	50,900	48,750	63,900	74,135
United States	200	850	900	1,980
Switzerland	-	-	900	2,363
Other countries	800	1,735	300	788
Total	51,900	51,335	66,000	79,266
Scrap				
United States	128,000	608	-	-
Japan	42,200	10,635	1,500	525
Belgium	-	-	183,200	5,878
Total	170,200	11,243	184,700	6,403
Ground				
United States	78,000	4,253	23,000	1,380
Venezuela	-	-	1,000	75
Total	78,000	4,253	24,000	1,455
Total unmanufactured	300,100	66,831	362,200	115,790
Manufactured				
Brazil		-		11,400

	1958	1957
Consumption (available data)		
Paints	1,912,073	2,196,612
Electrical apparatus	355,928	642,608
Rubber	634,021	574,706
Roofing	512,000	518,000
Paper	-	18,000
Nonmetallic mineral products	133,374	79,000
Total	3,547,396	4,028,926

Mica - Production, Trade and Consumption 1948-58
(pounds)

	Production(1)	Imports(2)	Exports(2)	Consumption(3)
1948	7,902,303		4,494,200	3,492,609
1949	3,490,550		1,314,200	4,599,627
1950	3,879,209		1,975,100	3,886,222
1951	4,961,508		2,432,800	4,124,876
1952	2,014,941		1,562,300	3,424,071
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

(1) Producers' shipments.
(2) Unmanufactured mica.
(3) Available data.

World Review

World trade in mica is substantial. It has been stimulated by conditions in the large consuming nations - either by a lack of mica resources or by the high cost of the hand labour on which the preparation of sheet mica for the market depends. High-quality ruby muscovite is readily available from India, and a large proportion of Canada's mica requirements, particularly splittings for use in the manufacture of built-up sheet, are filled from this source. Similarly, Madagascar supplies phlogopite of high quality.

Technology

Muscovite (potassium mica) of superior quality possesses the best dielectric properties of all types of mica and is used extensively for insulation at high frequencies and high voltage and in capacitors. Because of its high mechanical strength and transparency, it is also favoured for glazing.

Phlogopite (magnesium, or amber, mica) varies considerably in dielectric strength, hardness, structural strength and other properties; but its electrical properties make it useful as an insulator in a variety of electrical installations at normal industrial and domestic frequencies and voltages. Its high thermal resistance makes it applicable under high-temperature conditions - in heaters, toasters, flatirons, etc. - and its softness by comparison with muscovite makes it suitable in flush commutators, where copper and mica segments must wear at the same rate. In many applications, however, the use of phlogopite is declining in favour of muscovite.

Biotite (iron, or black, mica) has comparatively low dielectric strength and is somewhat brittle. It may find limited application as insulation in low-powered fixtures and appliances, although it is not currently in use in Canada.

Uses

Mica is marketed in three forms - natural sheet, splittings and ground mica.

Natural Sheet

Sheet mica is used chiefly for electrical insulation in a wide variety of electrical machines, instruments, lighting and power fixtures and industrial and household appliances; in electronic equipment such as radio, television and sound-recording equipment; as the dielectric in capacitors; and for glazing boiler gauges and furnace observation ports.

Sheet mica is sold commercially according to variety, size and quality and is selected by the manufacturer according to its intended application.

Splittings

Mica splittings are used in the manufacture of built-up sheet, in which the mica is bonded with natural or synthetic resins of suitable dielectric properties, baked and pressed into sheets of any required size. Either muscovite or phlogopite may be employed according to end use, the latter probably making up less than 10 per cent of the total consumed. Similarly, splittings are used in the manufacture of mica tape, cloth and paper and are cut or moulded into washers, tubes and many other forms.

Built-up mica sheet is used, within the limits of its dielectric characteristics, in place of natural sheet, particularly in cases where large size would make the use of natural sheet uneconomical.

Ground Mica

Mica may be ground wet or dry according to use.

Dry-ground mica is usually lower-grade, off-colour material - mainly muscovite or phlogopite - used principally in the roofing trade as a backing for asphalt tile and tar paper and for moulded high-frequency insulation, in which the mica is bonded with ceramic binders to form a compound that may be pressed into any desired shape. It is also used in protective coatings, to a limited extent in grease lubricants and as a dusting agent in the manufacture of rubber tires.

Wet-ground mica is prepared mainly from good-quality muscovite scrap, chiefly for the paint, plastic, rubber and wallpaper trades. White products are preferred. In paint, wet-ground mica serves as a pigment extender; in plastics, as a filler; in rubber, as a dusting agent and lubricant on tire walls; in hard rubber, as a filler. In wallpaper, it is used to produce decorative effects.

A new form of insulation is now being prepared in the United States from ground muscovite scrap treated by a chemical process. The resulting pulp is formed into a continuous sheet by methods similar to those used in the manufacture of paper.

Specifications

Natural Block Muscovite

Size and quality gradings for block muscovite in general use in Canada and the United States conform generally to those adopted by the American Society for Testing Materials (Designation D351-57T). This classification utilizes the area of minimum rectangle and the minimum dimension of one side for grading size, and the degree of staining by included impurities for grading visual quality.

Natural Phlogopite Sheet

In Canada, size gradings for phlogopite sheet generally follow those applying to muscovite but are expressed in terms of linear dimensions (inches), the following grades being in common use: 1 x 1 and 1 x 2, 2 x 3, 2 x 4, 3 x 5, 4 x 6, 5 x 8, and larger.

No formal quality-grading that applies specifically to phlogopite has been established, but the soft, light-coloured varieties are generally regarded as having the best electrical qualities. These grade down to the darker, more brittle varieties.

Ground Mica

Mica is ground to meet the user's requirements and, except for A.S.T.M. Designation D607-42, which specifies the requirements for mica pigment, there are no fixed specifications.

Dry-ground mica is sold for roofing purposes in sizes ranging from about 20-mesh to minus 200 mesh according to individual requirments.

Wet-ground mica, which has not been produced in Canada, is sold in the United States and Canada at minus 160 mesh for rubber and minus 200 mesh for paint and wallpaper, and there is a trend toward the use of finer grades. In general, wet-ground muscovite must be white or nearly so.

Since covering power is one of the dominant properties of finely divided mica, a well-delaminated product with a low bulk density is usually specified. For dry-ground roofing mica, a bulk density of about 17 pounds per cubic foot may be specified. A.S.T.M. Designation D607-42 specifies a maximum of 10 pounds per cubic foot for mica pigment.

Markets

The following Canadian companies buy mica:

All Grades

Walter C. Cross & Co., 209 Eddy St., Hull, Quebec.

Block and Sheet

Mica Company of Canada Ltd., 4 Lois St., Hull, Quebec.

Canadian Wilbur B. Driver Co. Limited, 85 King St. E., Toronto 1, Ontario.

Scrap

Blackburn Brothers Limited, 85 Sparks St., Ottawa, Ontario.

A list of mica buyers in the United States can be obtained from the United States Bureau of Mines, Washington 25, D.C.

Prices

Prices offered by Canadian purchasers for sheet phlogopite vary with the quality and with the degree of trimming and grading. In 1958, prices for well-graded good-quality sheet were approximately as follows:

Size (inches)	Value ($ per lb)
1 x 1	0.30 to 0.70
1 x 2	0.50 " 0.80
1 x 3	0.75 " 0.85
2 x 3	1.30 " 1.40
2 x 4	1.60 " 1.70
3 x 5	2.15 " 2.50
4 x 6	2.50 " 2.75
5 x 8	3.00 " 3.50

Clean scrap phlogopite sold for as much as $25 a ton delivered at the plant.

Prices in the United States for muscovite, according to E & M J Metal and Mineral Markets of December 4, 1958, were as follows:

Clear sheet, North Carolina district

Size (inches)	Value ($ per lb)
1 1/2 x 2	0.70 to 1.10
2 x 2	1.10 " 1.60
2 x 3	1.60 " 2.00
3 x 3	1.80 " 2.30
3 x 4	2.00 " 2.60
3 x 5	2.60 " 3.00
4 x 6	2.75 " 4.00
6 x 8	4.00 " 8.00

Punch mica, per lb	$ 0.07 to $ 0.12
Wet-ground mica, per short ton	$140.00 " $155.00
Dry-ground mica, per short ton	$ 30.00 " $ 55.00
Scrap mica, per short ton	$ 20.00 " $ 30.00

The raw oxide is recovered from two deposits nearby in Champlain county, calcined to remove moisture and organic matter and to develop the desired colour. The calcine is ground in buhrstone mills and is air-classified. Part of the product is exported to the United States in unground form. Uncalcined oxide is also prepared for the market by washing, drying and grinding.

In former years, other occurrences of ochres were worked in Champlain county, Quebec, and Colchester county, Nova Scotia, and near New Westminster, British Columbia.

Pigment-grade ochre has been reported from Haliburton county, Ontario, from north of Lake Winnipegosis, Manitoba, and in Saskatchewan and British Columbia.

Uses and Specifications

Iron-oxide pigments are widely used in paints, wood and paper stains, oilcloth, linoleum, shade cloth, concrete and mortar, roofing granules, plaster, rubber, plastic, imitation leather, mastic tile and many other pigmental materials.

Permanence of colour has been one of the reasons for the wide use of iron-oxide pigments in outside paints to protect large surfaces, such as those of barns, railway buildings and rolling stock. These pigments have proven useful in protecting metal and are used in metal-priming and ship-bottom paints.

Natural iron oxide as a paint pigment should be virtually free of grit (particles above 325-mesh) and water-soluble salts. Pigments of this type are resistant to alkali and consequently are used in colouring portland cement, mortars and artificial stone.

Other iron-oxide materials that are not of pigment grade are mined, air-dried and used to extract hydrogen sulphide and other undesirable constituents from manufactured gas. A similar use is found in some of the older types of refineries, where natural gas is cleaned by being passed through columns filled with wood chips coated with iron oxides.

Certain grades of iron oxide are processed by grinding and sizing into jeweller's rouge for metal- and glass-polishing. Other grades (e.g., sienna and umbers) are used principally in the preparation of stains for treating wood and paper.

A number of standard tests have been developed with the object of eliminating the human factor in assessing pigments, but they have not been altogether successful. In the final analysis, the appraisal of a pigment is a matter of experience. The most important properties are mass colour, tinting strength, particle size, oil absorption, opacity and hiding power, and chemical composition. Mass colour and tinting strength have to do with the comparison of colour with a standard and refer to colour, respectively, when it is rubbed out with a specified amount of oil and when it is diluted with standard amounts of zinc-oxide oil paste. The physical properties are more important than the chemical composition.

The specifications for air-dried oxide to be used in gas purification are not rigid with respect to iron content, grain size or silica content, but the proportion of clay must be kept to a minimum because it tends to pack and clog the purification chambers.

Prices

No published quotations for Canadian ochres are available. The prices quoted by E & M J Metal and Mineral Markets at the end of 1958 for Georgia ochres were \$26 to \$32 a ton bagged, f.o.b. mines.

Other Pigments

Canada has one of the world's largest producers of synthetic iron-oxide pigments. It is at New Toronto, Ontario, and is operated by Northern Pigment Co., Limited.

Canadian Titanium Pigments Limited, at Varennes, Quebec, produces titanium-dioxide pigment from titania slag produced at the Sorel smelter of Quebec Iron and Titanium Corporation.

Whiting Substitute

In industry the term 'whiting' is often applied to a fine white powder of calcium carbonate derived from chalk, marl, limestone or marble or from a precipitate in a chemical process. More specifically, true whiting is prepared by grinding chalk to a suitable particle size. Chalk is a white, friable, fine-grained type of limestone composed of the residue of microscopic marine organisms. 'Whiting substitute' is a term applied to a white powder prepared by fine-grinding marble or limestone. In Canada this material is sometimes termed domestic whiting or marble flour. Marl, when of suitable colour and free of organic impurities, is an acceptable source of whiting substitute, but there has been no production in Canada from marl for several years.

During 1958, 11,900 tons of whiting substitute valued at \$143,977 were produced in Canada. Most of the production was derived from a deposit of white marble near Bedford, Missisquoi county, Quebec. A small output was also reported from British Columbia.

No true whiting is produced in Canada. Canadian requirements are met by imports from the United States, the United Kingdom and France.

Use

True whiting originating in England is referred to commercially as a paris white, gilders' whiting, or ground cliffstone.

Whiting - Production, Imports and Consumption

	1958		1957	
	Short Tons	$	Short Tons	$
Production				
Stone processed for whiting ...	11,900	143,977	21,527	209,091
Imports				
Whiting, gilders' whiting and paris white				
United States	4,830	219,604	4,642	208,398
United Kingdom	3,603	56,999	3,078	49,565
France	2,688	17,867	2,124	12,362
Total	11,121	294,470	9,844	270,325
	1957		1956	
Consumption*				
Ground chalk, whiting and whiting substitute				
Explosives	371		341	
Medicinals and pharmaceuticals	75		240	
Paints and varnishes	12,736		14,108	
Soaps	41		41	
Toilet preparations	15		14	
Electrical apparatus	519		547	
Clay products	25(e)		26	
Linoleum and oilcloth	7,300(e)		7,223	
Rubber goods	8,327		9,502	
Tanneries	234		242	
Gypsum products	73		260	
Adhesives	115		124	
Asbestos products	60(e)		57	
Pulp and paper	421		466	
Miscellaneous chemicals	1,000(e)		1,015	
Starch and glucose	5(e)		4	
Miscellaneous	36		31	
Total	31,353		34,241	

* Includes some ground limestone.
(e) Estimated.

Whiting - Production, Imports and Consumption, 1948-58
(short tons)

	Production	Imports	Consumption
1948	17,992	17,120	24,085
1949	15,657	19,361	24,238
1950	17,603	21,336	26,110
1951	18,380	20,565	25,866
1952	17,527	11,986	25,554
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	31,353
1958	11,900	11,121	

Whiting is an important raw material in the manufacturing processes of a number of industries. True whiting, which improves opacity, and whiting substitute are used in formulating cold-water paints. In this application whiteness, fine-particle size and freedom from grit are the major characteristics.

In the manufacture of oil paint, both types of whiting are used as extender pigments. Bulk density, colour, oil-absorption, fineness and chemical composition are among the important characteristics for this use. Whiting is also the principal ingredient in putty.

Whiting is used in large quantities as a filler in rubber products, chemical composition being extremely important in this application. Some whitings are chemically treated to improve dispersibility in the rubber mix. Whiting is used as a filler in linoleum, oilcloth, the moulding of plastics, polishes, paper and cleaning compounds. In these uses colour, particle size and shape, and absence of grit are generally of primary importance.

True whiting is used by the ceramic industry in glazing and in the manufacture of whiteware.

Other Mineral Fillers

In various industrial processes in Canada, a number of other non-metallic mineral fillers are used to impart the desired properties to the product. These include pulverized limestone, china clay, diatomite, barite, nepheline syenite, feldspar, talc and soapstone. Information on these minerals will be found in the appropriate reviews in this series. All the foregoing except china clay and diatomite are produced in Canada.

NEPHELINE SYENITE

J. E. Reeves

The upward trend in the production of nepheline syenite continued during 1958, but at a much lower rate than in any other year since 1952. Shipments in 1958 exceeded those in 1957 by less than 1 per cent. The value of shipments in 1958 decreased by about 5 per cent from that of the previous year, mainly because of a relatively larger proportion of the less expensive glass-grade product and a slight decrease in its price. In addition, there was less manufacturing of many whiteware and other ceramic products, in which other grades are used. The volume and value of exports were lower in 1958 than in 1957, the greater decrease in value being due to the aforementioned reasons.

Producers

All production since 1942 has come from the extensive deposit at Blue Mountain in Methuen township, Peterborough county, southeastern Ontario. This deposit is relatively uniform chemically and contains large reserves. American Nepheline Limited continued to operate a 600-ton mill at Nephton in the southwestern part of the deposit and supplied this mill from a nearby quarry. International Minerals & Chemical Corporation (Canada) Limited operated both a 300-ton milling plant and a quarry at the northeastern end of Blue Mountain.

Other Canadian Occurrences

Nepheline-bearing rocks are not uncommon in many countries, and in Canada there are several known occurrences of nepheline syenite. Apart from the one at Blue Mountain, deposits occur in Ontario near Bancroft in Hastings county, near Gooderham in Haliburton county, in Bigwood township in the French River area of the Georgian Bay district, and at Port Coldwell in the Thunder Bay district. Each of these areas has received some consideration as a source of marketable nepheline syenite, and prior to 1942 minor, intermittent production came from some of the deposits near Bancroft and Gooderham. In Quebec, nepheline syenite occurs in the Labelle-L'Annonciation and other areas, and in British Columbia, in the Ice River district near Field.

Nepheline Syenite - Production, Exports and Consumption

	1958		1957	
	Short Tons	$	Short Tons	$
Production (shipments)	201,306	2,613,446	200,016	2,754,060
Exports, crude and processed material				
United States	152,862	1,977,523	156,379	2,096,587
United Kingdom	4,084	64,274	2,553	42,622
Puerto Rico	1,650	30,105	949	15,405
Other countries	1,485	26,519	4,461	81,229
Total	160,081	2,098,421	164,342	2,235,843

	(short tons) 1958	1957	1956
Consumption (domestic) (available data)			
Glass	19,279	15,806	16,330
Stone products (mineral wool etc.)	4,886	5,227	6,679
Clay products etc.	2,579	2,345	2,008
Total	26,744	23,378	25,017

Foreign Occurrences

Several occurrences of nepheline syenite are known to exist in the United States, particularly in New Jersey and Arkansas. It has not been possible, however, to reduce the iron content of these rocks sufficiently for the production of ceramic raw materials. The deposits near Little Rock, Arkansas, have been used for many years as a source of material for roofing granules.

Deposits occur also in Norway, India, and Korea. The nepheline syenite of India has been considered for use in glass-manufacturing in that country, but there has been no production. A deposit in the northern part of Norway, between Alta and Hammerfest, has been reported as suitable for commercial development.

Russia is the only other producer of a ceramic raw material containing abundant nepheline. A few miles from the city of Kirovsk in the Kola peninsula, a huge deposit of an apatite-nepheline rock is being mined on a large scale for apatite, with nepheline as a by-product. Part of this nepheline product is now being used as a source of aluminum. Recently it was announced that vast resources having a very high nepheline content have been discovered in the area to the west of Lake Baikal in eastern Siberia.

Prices

Prices of nepheline syenite, per short ton, in bags, by carload lot, f.o.b. works, according to Canadian Chemical Processing of January 1959, are:

Glass grade	$15.00
Finely ground grades	$21.50 to $28.00
By-product grade	$12.00

It is customary, however, where possible, to ship in bulk so as to benefit by the attendant cost advantage.

PHOSPHATE

J. E. Reeves

Canadian requirements in phosphatic raw materials are imported; no significant production of phosphate has taken place in Canada for many years. A number of attempts have been made in recent years to develop properties containing deposits of apatite, which is essentially calcium phosphate, but none have attained production.

In 1958, the imports of phosphate rock amounted to 744,164 short tons, or nearly 3 per cent more than those of 1957. The value of these imports increased by 16 per cent, partly because of increases in shipping costs. Consuming industries in eastern Canada import from Florida, and those in western Canada from the western United States. The Consolidated Mining and Smelting Company of Canada Limited operates mines near Garrison, Montana, through a subsidiary, Montana Phosphate Products Company, and ships sedimentary phosphate rock to fertilizer plants at Trail and Kimberley, British Columbia.

Canada trades considerably with other countries, chiefly with the United States, in phosphate fertilizers. In 1958, its imports of this commodity amounted to 221,030 short tons worth more than $5 1/2 million, or about 4 per cent more than in the previous year. Most of this was ordinary superphosphate with a P_2O_5 content in the order of 20 per cent. Exports of phosphate fertilizers were valued at $12,370,470, or slightly less than in 1957. About 80 per cent was shipped to the United States.

An active industry maintained by Canada produces phosphoric acid and phosphorous compounds. Electric Reduction Company of Canada, Limited, is planning construction of a new plant at Port Maitland, Ontario, which is to begin production in 1960.

Occurrences and Production

Almost all the phosphate mined in Canada has consisted of the mineral apatite. An apatite-mining industry flourished from 1878 to 1892 and then declined sharply as the large sedimentary deposits in Florida were developed. A peak was reached in 1890, when more than 31,000 tons were produced, but since 1894 production has seldom exceeded 1,000 tons. The last shipment was made in 1951.

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Phosphate - Trade and Consumption

	1958		1957	
	Short Tons	$	Short Tons	$
Imports				
Phosphate rock				
United States.........	740,822	6,672,681	722,215	5,840,223
Belgium	3,342	181,562	1,005	57,561
Total................	744,164	6,854,243	723,220	5,897,784
Phosphate fertilizers				
Triple superphosphate				
United States.........	44,248	2,019,957	45,380	2,004,031
Superphosphate not otherwise provided				
United States.........	168,459	3,211,138	163,746	3,131,318
Netherlands..........	4,998	80,981	-	-
Total................	173,457	3,292,119	163,746	3,131,318
Phosphate fertilizer not otherwise provided				
United States.........	3,325	235,208	2,574	190,687
Belgium	-	-	256	14,784
Total................	3,325	235,208	2,830	205,471
Total, phosphate fertilizers	221,030	5,547,284	211,956	5,340,820
Phosphoric acid and phosphorous compounds.	4,576	938,567	4,729	884,492
Exports				
Phosphate fertilizers				
United States.........		9,907,128		10,725,533
Colombia		1,257,452		317,681
Korea		500,361		797,276
Philippines...........		397,600		631,853
Hawaii		142,381		272,980
Other countries.......		165,548		249,481
Total................		12,370,470		12,994,804

Phosphate - Trade and Consumption (cont'd)

	1958		1957	
	Short Tons	$	Short Tons	$
Consumption of phosphate rock (available data)				
Fertilizers.........	583,584		584,216	
Chemicals	115,556		114,265	
Stock and poultry feed.............	29,766		24,234	
Total	728,906		722,715	

Phosphate Rock - Production, Imports and Consumption 1948-58
(short tons)

	Production	Imports	Consumption
1948	-	482,008	410,069
1949	20	620,808	429,528
1950	129	491,026	488,237
1951	6	499,711	519,143
1952	-	470,913	511,757
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

Apatite is commonly found, together with phlogopite, in association with pyroxenites in southeastern Ontario and southwestern Quebec. Quebec has contributed almost 90 per cent of the nearly 350,000 tons of apatite produced in Canada since 1870, when production was first reported. Most of Quebec's production came from deposits in Buckingham and Portland townships in the Lièvre River valley, and from Templeton and other adjacent townships to the west. In Ontario, mines in North Burgess, Loughborough and Bedford townships, in the area between Perth and Kingston, were the main producers.

Apatite is also relatively abundant in some of the alkaline rock complexes that occur in parts of Ontario and Quebec. Of particular note is the Nemegos area, about 150 miles northwest of Sudbury in northern Ontario, where extensive zones contain about 20 per cent apatite.

Some sedimentary phosphate rock occurs between Banff, Alberta, and the Crowsnest-Fernie area of southeastern British Columbia. From 1927 to 1934, The Consolidated Mining and Smelting Company investigated deposits, especially near Crowsnest, as a source of raw material for fertilizer, but these proved to be of low grade and only about 4,000 tons were shipped.

World Production

Most of the world supply of phosphate rock comes from sedimentary deposits of marine origin, frequently referred to as phosphorites. Deposits of apatite are being mined, notably in Russia, where the apatite-nepheline deposits provide a substantial proportion of phosphate production.

World production in 1958 was in the order of 35 million long tons. The United States was the largest producer, the estimated output for this period being 14,879,000 long tons. Florida supplies about 73 per cent of United States production. Other producing areas are North Africa, particularly Morocco and Tunisia; Russia; Makatea, Nauru and Ocean Island in the Pacific; Christmas Island and other Asian sources; and Peru, Brazil, Chile and Venezuela. There is considerable world trade.

Technology

Phosphorus is an essential constituent in plant and animal life. Phosphate rock is the source of phosphorus in the manufacture of fertilizers. Ordinary superphosphate, containing 16 to 20 per cent P_2O_5, is made by treating phosphate rock with sulphuric acid, rendering it largely water- and citrate-soluble. Triple superphosphate is produced by acidulating the phosphate rock with phosphoric acid. It contains 42 to 50 per cent P_2O_5 and is more important where high transportation costs are concerned. These fertilizers can be applied directly to the soil; or they can be used in the manufacture of mixed fertilizers, which also contain certain proportions of nitrogen and potash. Ammonium phosphate is manufactured by adding ammonia to phosphoric acid. This is generally wet-process phosphoric acid produced by a method similar to that used in making superphosphate. In the United States, wet-process phosphoric acid is now being used to manufacture liquid fertilizers, consumption of which is still relatively small but is increasing rapidly.

A high-purity elemental phosphorus is obtained by fusing mixtures of phosphate rock, silica and coke in electric furnaces. From this, phosphoric acid and numerous compounds of phosphorus are produced.

Because of its open texture, sedimentary phosphate rock is more amenable to acid treatment than compact, crystalline apatite, but Canadian apatite would be acceptable for furnace treatment. Because Canadian apatite has a higher P_2O_5 content per unit than sedimentary phosphate, it permits the use of smaller feed and lower temperatures and reduces slag. However, the very low price of imported phosphate rock and the lack, over the past years, of large, dependable sources of supply have resulted in little recent consumption of apatite in Canada. Electric Reduction Company of Canada, Limited, at Buckingham, Quebec, continued to purchase small amounts until about seven years ago, but is currently not interested unless it can be assured of sizable shipments at a price competitive with that of Florida phosphate rock.

Uses and Specifications

Much phosphate rock is used for the manufacture of fertilizers or, to a much lesser extent, for direct application as a fertilizer to the soil. Smaller amounts are used for making phosphorus and phosphorous chemicals and compounds, and as a feed supplement for livestock and poultry.

Consumption in Canada in 1957 was more than 30 per cent higher than in 1956. Approximately 80 per cent of this was used by manufacturers of fertilizers; consumption for this use was 40 per cent above that of 1956. Use in the manufacture of phosphorus and phosphorous chemicals and compounds also increased but by a much smaller amount.

Phosphorus and its compounds are consumed widely by many industries. The largest single application is in the manufacture of domestic and industrial detergents, in which several compounds are used. The food-processing industry uses considerable amounts as a leavening agent in baking powders, prepared cake mixes, etc., and in food preservatives. Phosphorus and its compounds are used also in water-conditioning, plastic- and paper-manufacturing, the synthesis of organic phosphates, metal treatment and the manufacture of flotation and other chemical reagents, and in paints, pharmaceutical preparations, stock-feed supplements, munitions and fireworks, and many other products.

Chemical analyses of phosphate rock are reported in terms of the P_2O_5 content or as tricalcium phosphate, $Ca_3(PO_4)_2$. The latter is commonly referred to as bone phosphate of lime and is signified by the initials B. P. L. The relationship is: 1.0 B. P. L. = 0.458 P_2O_5.

For electric-furnace use, phosphate rock should contain a minimum of about 70 per cent B. P. L. and a maximum of 1 per cent Fe_2O_3, and should be as coarse as possible to facilitate the furnace treatment. For fertilizers, it should contain about 74 to 75 per cent B. P. L. Particle size does not matter because it must be ground fine before further treatment.

Prices and Tariffs

According to E & M J Metal and Mineral Markets of December 4, 1958, the United States prices of Florida land-pebble phosphate rock per long ton, f.o.b. mine or mill, were as follows:

% B. P. L.	$
77 to 76	7.00
75 to 74	6.00
72 to 70	5.00
70 to 68	4.35
68 to 66	3.95

Phosphate rock enters Canada duty-free.

POTASH

C.M. Bartley

Potash was first produced in Canada during the second half of 1958 - at the property of Potash Company of America, Ltd., just east of Saskatoon. The operation is significant both as the start of a new Canadian industry and as the successful conclusion of a difficult and expensive mining development.

Potash minerals were first noted in Saskatchewan in 1943, in the drill cores from oil-well holes. Numerous subsequent discoveries aroused interest, and in 1948 a Canadian company started development of a property near Unity, Saskatchewan. United States potash companies became interested in 1947, and by 1952 several were exploring and acquiring property.

Potash Company of America, Ltd., started shaft-sinking and plant construction in February 1956 and reached production late in 1958. Another company commenced sinking and plant construction in June 1957 and is now well advanced toward production. Many other companies representing United States, European and Canadian interests are conducting exploration.

The supply of potash was plentiful during 1958. World demand, however, is steadily increasing, and more Canadian mines will be brought into production as the output from the Carlsbad area of New Mexico diminishes. The great size and unusually high grade of Canadian potash deposits assure their development, although shaft-sinking and underground problems and the high cost of bringing the deposits into production will probably make expansion slow.

Deposits

The potash deposits are found in the upper part of a vast salt bed that occurs at depth in central Alberta, southern Saskatchewan and southwestern Manitoba and extends southward into the United States. The beds dip flatly to the southwest, and would outcrop in northern Saskatchewan if the shallowest parts had not been leached out. The shallowest deposits found in place to date are at depths ranging from 2,800 feet near the Saskatchewan-Manitoba boundary east of Esterhazy to 3,335 feet near Saskatoon and 3,400 feet near Unity. To date, deposits of economic interest have been found only in Saskatchewan and in a small area in Manitoba along the Saskatchewan boundary. Potash minerals, mainly sylvite (KCl) and carnallite ($KCl.MgCl_2.6H_2O$), occur in three zones that are fairly distinct and continuous but vary in thickness and grade at different locations. The ore reserves indicated by drilling are enormous, being in excess of 6,000 million tons averaging 25 per cent K_2O* by conservative estimate.

Potash Operations in Canada

While only one company, Potash Company of America, Ltd., has reached production, 10 other companies hold land rights for potash, several have carried out extensive drilling and geological studies, and two have sunk shafts part way to the potash horizon. At the end of 1958, the 11 companies held almost 1,750,000 acres for potash developments under permit, withdrawal, reservation and lease.

Potash Company of America, Ltd.

The property of Potash Company of America, Ltd., is located at Patience Lake some 14 miles east of Saskatoon. The company holds 12,576 acres under lease and 87,300 acres under reservation. The 16-foot-diameter, concrete-lined circular shaft was sunk through artificially frozen ground in order to control underground water flows. The potash horizon was reached at 3,335 feet in June 1958, and underground development began while mill and surface facilities were being completed. Production started in November 1958, and the first shipment of potash mined and refined in Canada was made early in 1959.

Actual production of potash during 1958 was limited to development ore as new mining machines and equipment were installed and drifts were driven east and west from the shaft in the ore zone. Continuous mining machines, operated by electric power and similar in design to those used in coal mines, excavate the ore without drilling and blasting. The machines feed ore to conveyor belts, which transport it to storage bins and a loading pocket at the shaft. Ore is hoisted in 10-ton skips, which load and dump automatically. At surface, the ore is moved by conveyors from storage bins to the crushing and grinding plant and then into the mill for recovery of the potash and elimination of halite, clay and other undesirable material. The finished product, in three different grades, is stored in large warehouses that have a total capacity of some 200,000 tons.

The plant of Potash Company of America, Ltd., is designed to process up to 4,000 tons of ore a day averaging a grade of 25 per cent K_2O or better. Annual production of processed potash is expected to be 600,000 tons or approximately 360,000 tons in terms of K_2O.

*This is potash, or oxide of potassium, which is not a natural compound. The term 'potash' is generally applied to various compounds of potassium used in agriculture and industry and serves as a basis of comparison for all potash minerals and artificial salts.

International Minerals & Chemical Corporation

This company, which mines potash in the Carlsbad area of New Mexico, holds 91,945 acres under permit near Esterhazy in southeastern Saskatchewan. After preliminary exploration, the company started to sink a shaft and build a processing plant in June 1957. Shaft-sinking procedure was unusual in that after about 300 feet of overburden and shale had been frozen, the opening was excavated to 1,200 feet by a mechanical shaft-mucking machine without further freezing, and fewer than 50 cases of explosives were used. Below 1,200 feet a horizon of shales and fine sand with water under high pressure presented a problem. An attempt was made to seal off this formation by drilling a ring of holes and pumping in a chemical sealant. This method was only partially successful and has been abandoned in favour of the more expensive and slower but more certain freezing procedure. Surface-plant construction is proceeding on schedule, and production is expected to start about March 1961.

Potash bodies in the Esterhazy area are of excellent grade and in most places are overlain by rock salt, which provides a satisfactory roof for mining operations. Such factors may be of considerable importance, both in the safety of the operations and in the amount of ore that can be recovered.

The plant of International Minerals & Chemical Corporation is designed to process up to 720,000 tons a year, and future expansion is planned.

Continental Potash Corporation Limited

This Canadian company with 95,200 acres under permit northwest of Unity was the first to attempt potash production. Under its former name, Western Potash Corporation Limited, it attempted to recover potash through drill holes by brining methods. This procedure was not successful and the company later sank a 12-foot-diameter shaft to 1,675 feet. Company officers report that the shaft was to provide access to the potash zone and that recovery would be by controlled solution and pumping to surface. Work was stopped in the summer of 1958 while negotiations were being carried on for funds to complete the project.

General Petroleums of Canada Limited

With 54,720 acres under permit near Nokomis, southwest of Quill Lakes, this company conducted potash brining tests through a drill hole during 1958. The operation is considered experimental and is not intended for production. No results have been released, but the company reports that satisfactory progress has been made and that the economics of operation and brine-processing are being studied.

Potash Imports

	1958		1957	
	Short Tons	$	Short Tons	$
For fertilizer				
Muriate of potash				
United States	78,791	1,650,329	76,250	1,684,938
France	24,934	676,037	24,236	747,123
West Germany	21,465	597,340	36,159	974,114
Russia	6,050	164,174	-	-
Israel	65	1,834	-	-
Total	131,305	3,089,714	136,645	3,406,175
Sulphate of potash				
United States	9,033	319,242	11,114	362,731
France	4,581	170,281	6,433	242,431
West Germany	1,925	66,704	175	5,175
Total	15,539	556,227	17,722	610,337
Sulphate of potash magnesia				
United States	2,728	50,393	2,156	28,721
West Germany	400	10,725	1,300	38,302
Total	3,128	61,118	3,456	67,023
Total, potash fertilizers	149,972	3,707,059	157,823	4,083,535
Potash chemicals and compounds				
Potash and pearl ash	365	62,075	294	49,679
Potash, bichromate, crude	137	44,877	157	51,702
Potash caustic	4,419	459,775	3,651	349,807
Potash chlorate, ground	41	12,251	71	19,273
Potash, red or yellow prussiate	12	7,169	13	9,353
Potash nitrate or saltpetre	680	81,757	523	57,105
Cream of tartar in crystals	149	75,825	138	70,785
Potassium cyanide	67	45,750	140	92,635
Potash compounds, not otherwise provided	3,301	769,240	3,040	763,342
Total, potash chemicals and compounds	9,171	1,558,719	8,027	1,463,681

Other Companies

Two other companies, which have conducted geological studies and drilled numerous holes to test for potash, state that they are prepared to develop potash mines and build processing plants but that they are still engaged in preliminary work to determine the most efficient procedures and equipment. This group includes United States Borax and Chemical Corporation, with 108,203 acres under permit, and Alwinsal Potash of Canada Limited, representing West German and French interests, with 97,440 acres under permit and 196,000 acres under withdrawal.

In addition, several other companies have conducted varying amounts of exploration but have not yet announced their intentions. This group includes: Southwest Potash Corporation and Canadian AMCO Limited, both subsidiaries of American Metal Climax Inc.; Commonwealth Potash and Chemicals Limited; Duval Sulphur and Potash Company; and National Potash Company.

Late in 1958 a Canadian company, S.A.M. Explorations Ltd., with 31,040 tons under withdrawal in Saskatchewan and Manitoba, was negotiating public financing to continue development. This is one of the few active companies not controlled by or associated with large United States or European organizations.

Production and Trade

World production of potash as K_2O equivalent increased at a uniform rate from 6,500,000 tons in 1953 to 8,800,000 tons in 1958. In the latter year, the United States and West Germany each produced more than 2 million tons, and East Germany, France, and Russia each produced between 1 million and 2 million tons.

In North America, the deposits at Carlsbad, New Mexico, supply most of the demand, but some European potash is imported along the east coast. Between 1953 and 1957 imports to North American countries increased from 148,000 tons to 235,000 tons.

Canadian imports of potash for fertilizer in 1958 totalled 149,972 short tons valued at $3,707,059, and for chemicals 9,171 short tons valued at $1,558,719. Imports were mostly from the United States, but amounts were also received from France, West Germany, Russia and Israel.

Technology

Like coal, most potash is produced from underground bedded deposits by mining. Such ores are concentrated and refined by gravity and flotation methods. Smaller amounts of potash are recovered by hot-solution crystallization methods from concentrated-brine solutions in saline lakes and, to a lesser extent, from brine wells. Hot-solution procedures are expensive and difficult but generally produce a high-purity product that can be used directly in potash chemicals. Solution methods are used by American Potash and Chemical Corporation at Searles Lake, California, and by an Israeli company on the shore of the Dead Sea.

Foreign Occurrences

Substantial quantities of potash are produced in several countries, and the discovery of new deposits or efforts to reactivate known occurrences have been reported recently. Since the Canadian market for potash is very small in relation to the production expected, a large proportion will have to be exported in competition with foreign sources.

The United States is the largest producer of potash. Mines in the Carlsbad area of New Mexico produced more than 2,260,000 tons of K_2O in 1957. Substantial tonnages are also produced in West and East Germany, France, and Russia. Smaller amounts are recovered in Spain, Israel, Chile and Japan.

In addition to the potash deposits being operated, others have been found at depth in Yorkshire, England, and a discovery in Denmark is to be tested by core-drilling. Newly discovered deposits of kainite ($MgSO_4.KCl:3H_2O$) in Sicily are being developed by the Montecatini organization.

In the United States, a potash discovery has been reported in the Lisbon Valley, Utah, at a depth of 2,000 feet. This occurrence is about 20 miles from an earlier discovery made by Delhi-Taylor Oil Corporation. Both are reported to be of large tonnage and good grade.

None of the foreign deposits can be compared to those in Canada, either in quality or in indicated reserves, but because of more favourable mining conditions and/or low labour costs, many can compete effectively for world markets and, in some cases, for North American markets. An important factor in potash world trade is the fact that the Saskatchewan deposits, like those in New Mexico, are located in the interior of the continent and must be transported great distances by rail.

The grade of potash being mined in the United States was less than 18 per cent K_2O in 1957. French potash ore is reported to be about 20 per cent K_2O and German potash is believed to average about 15 per cent K_2O. The deposits in Sicily are reported to contain 200 million tons of ore averaging 12 per cent K_2O.

In 1952 the Paley Report in the United States estimated world potash reserves as ranging from 500 million tons of K_2O, considering 20 per cent K_2O ores, to 3,250 million tons K_2O, considering 10 per cent K_2O ores. Estimates of Canadian potash reserves on a conservative basis are 6,400 million tons of recoverable K_2O equivalent in ores averaging 25 per cent K_2O or better. The significance of these deposits on future world production and trade is therefore apparent.

Uses and Specifications

Approximately 95 per cent of the potash consumed is used in agriculture - usually in mixed fertilizers. Such fertilizers are combinations of nitrogen, phosphate and potash with various fillers, and the percentages of the main ingredients, which are always listed alphabetically, are shown by three numbers, for example, 7-7-7. Most fertilizer potash is consumed as potassium chloride of various concentrations, but some crops and some soils require other forms such as potassium sulphate.

The need for chemical fertilizers is increasing as populations grow and living standards rise in the less developed countries. This is particularly true at present, when the economics of agriculture demand larger yields from smaller acreage.

Small amounts of potash are used in the manufacture of potash chemicals for industrial and consumer use. For chemical use, the concentrate supplied by mining companies is refined to high purity and made into potassium hydroxide, chlorate, carbonate, nitrate and other compounds. These are used in the manufacture of soap, glass, textiles, matches, explosives and a variety of consumer products and fine chemicals.

Potash for the manufacture of fertilizer is usually a 96-98 per cent concentrate of potassium chloride. It is marketed in several grain sizes to meet customer requirements. For this material, physical specifications of size and uniformity are important. A concentrate of greater than 99-per-cent purity is produced for chemical purposes by removal of such impurities as iron and magnesium.

Prices

The Oil, Paint and Drug Reporter for December 29, 1958, quoted the prices for agricultural potash as follows:

	*	**
Potassium agricultural muriate		
Standard		
Bulk, carload, works, unit-ton	$ 0.32	$ 0.34
Bagged, 60% min. K_2O, same basis, ton	$24.10	$25.30
Granular		
Bulk, carload, works, unit-ton	$ 0.32 1/2	$ 0.34 1/2
Bagged, 60% min. K_2O, same basis, ton	$24.40	$25.60
Potassium sulphate, agricultural, bulk, carload, works, unit-ton	$ 0.64 1/2	$ 0.66 1/2

*Inside prices apply to material contracted for prior to July 1, 1958.
**Outside prices apply to material contracted for after July 1, 1958, but for delivery during the current month.

Roofing Granules - Consumption and Imports*

	1958		1957	
	Short Tons	$	Short Tons	$
Consumption				
By kind				
Naturally coloured	26,812	546,245	19,931	406,402
Artificially coloured......	114,250	3,941,788	90,612	2,999,253
Not classified	674	21,605	-	-
Total	141,736	4,509,638	110,543	3,405,655
By colour				
Black and grey-black.....	39,700	883,500	30,152	686,173
Green	34,063	1,157,605	25,887	865,489
Red	15,518	458,757	15,575	452,325
Blue	9,224	376,766	8,612	341,738
White	23,655	995,412	14,367	585,823
Grey	8,569	253,191	8,700	216,391
Buff	1,407	51,127	937	33,446
Brown and tan	6,709	216,273	4,366	138,669
Coral, cream and yellow..	2,217	95,402	1,947	85,601
Not classified	674	21,605	-	-
Total	141,736	4,509,638	110,543	3,405,655
Imports				
United States				
Naturally coloured	23,757	499,349	17,392	366,705
Artifically coloured	77,145	2,800,512	60,241	2,138,201
Total	100,902	3,299,861	77,633	2,504,906

*Compiled from figures supplied to the Mines Branch by producers and consumers.

Roofing-granule Plants in Canada

Ontario

Building Products Limited is the principal producer of roofing granules in Canada. Granules from natural slate and igneous rocks are quarried and manufactured in the vicinity of Havelock and Madoc, Ontario. Igneous rocks processed for granule manufacture are fine-grained, dark-coloured basalt and fine-grained, pink-coloured rhyolite. Base granules are artificially coloured in the company's plant at Havelock by the sodium-silicate process. Building Products Limited supplies consumers of roofing granules across Canada as well as their own roofing- and siding-manufacturing plants in Montreal, Hamilton, Winnipeg and Edmonton.

Roofing and Siding Plants in Canada

Granule-coated roofing and siding were manufactured during 1958 by eight companies in 17 plants across Canada as follows:

Company	Location
Barrett Company, Limited (The)	Montreal, Quebec Vancouver, British Columbia St. Boniface, Manitoba
Bishop Asphalt Papers Limited*	Portneuf Station, Quebec
Building Products Limited	Montreal, Quebec Hamilton, Ontario Winnipeg, Manitoba Edmonton, Alberta
Canadian Gypsum Company, Limited	Mount Dennis, Ontario
Canadian Johns-Manville Company Limited	Asbestos, Quebec
IKO Asphalt Roofing Products Limited	Calgary, Alberta
Murray-Brantford Limited**	
Brantford Roofing Company Limited	Brantford, Ontario Saint John, New Brunswick Lachine, Quebec
Canada Roof Products, Limited	Vancouver, British Columbia
Philip Carey Company, Limited (The)	Lennoxville, Quebec
Sidney Roofing and Paper Company Limited	Victoria, British Columbia Lloydminster, Alberta

Granule Specifications

Granules vary in quality on the basis of the physical nature of the rock from which they are made. A rock suitable for use as a natural granule might be lacking in durability if processed for artificially coloured granules.

*This company, which operated only for part of 1958, has changed ownership and its plant will no longer be used for the manufacture of roofing and siding.

**On January 1, 1959, Alexander Murray and Company, Limited, Brantford Roofing Company Limited and Canada Roof Products, Limited, were consolidated as Murray-Brantford Limited.

The following includes all the physical characteristics required in a rock that is to be processed for roofing granules.

Opacity - Granule opacity prevents the sun's ultraviolet rays from penetrating to the asphalt. Such rays, if allowed to penetrate, will eventually dry out the tar and cause cracking. If granules are low in opacity, the black tar background has a tendency to darken the colour of the imbedded granules.

Toughness - During processing, granules are subjected to rough handling and must be capable of being worked with a minimum of dust and fracturing.

Porosity - Low porosity prevents excessive water penetration and subsequent blistering by the heat of the sun. The lower the porosity, the greater the resistance to extreme changes in weather.

Adhesion - The adherence of a rock granule to the asphalt-impregnated felt base is essential. Failure to meet this requirement greatly reduces the usefulness of the product.

Constancy in Physical Properties - For the stability of the final product, a granule rock source should be uniform in colour and in physical and chemical properties, particularly if the granules are artificially coloured.

Size - Sieve analysis of granular mineral surfacing of three commercial gradings, as supplied to manufacturers of asphalt roofing and shingles by manufacturers of granular mineral surfacing, is specified by Designation D 1001-51 of the American Society for Testing Materials. These gradings are as follows:

No. 9 Grading - maximum percentage of sample between sieve sizes No. 6 and No. 20.

No. 11 Grading - maximum percentage of sample between sieve sizes No. 10 and No. 28.

No. 12 Grading - maximum percentage of sample between sieve sizes No. 10 and No. 35.

Finer grades are also specified for use in undercoating, surfacing, and weighting for added bulk and strength. Suitable mixtures of coarse and fine grains are necessary to obtain complete coverage.

Shape - An angular-shaped particle, not too nearly equidimensional nor too elongate, is most adaptable for optimum coverage and maximum cementing contact on the tar surface.

High Temperature Resistance - Granules should be able to withstand heat and take on and retain colour in colouring processes.

Colouring Processes and Reproducibility of Colour

Granules are artificially coloured by various methods. The two most widely used are the sodium-silicate and phosphoric-acid processes. The value in marketing granules lies in the reproducibility of granule tint from one batch to the next. Great difficulty is experienced in colouring granules, as the slightest change in processing conditions or in the base material causes changes in the tint of the final product. To a degree, this difficulty has been minimized by the blending of several off-tint granules, which has resulted in a more easily duplicable product.

Canadian Prices

Compared with the prices of 1957, those paid in 1958 for roofing granules, c.i.f. consumers' plants, were higher in almost all colour groups. There were two exceptions: black, despite a 31.7-per-cent increase in volume, was down $2.82 a ton; and the coral-cream-yellow group, although its volume was almost 14 per cent higher, was lower by 94 cents a ton. The gains marked up on other coloured granules varied from a few cents to $1.30 a ton.

The average prices of coloured granules per short ton in 1958, with 1957 figures in brackets, were: red, $29.56 ($29.03); green, $33.98 ($33.48); black, $22.25 ($25.07); blue, $40.85 ($39.68); white, $42.08 ($40.78); grey, $29.55 ($28.66); buff, $36.33 ($35.68); brown and tan, $32.24 ($31.76); and coral, cream and yellow, $43.03 ($43.97). Cost to the consumer depends on the type of granule, the colour, the distance from the producing plant and whether the granules are naturally or artificially coloured.

Imported natural granules, c.i.f. Canadian roofing plants, dropped to an average of $21.02 a short ton in 1958 from the 1957 average of $21.08. The average price, per short ton, of all granules increased to $31.82 in 1958 from the 1957 average of $30.81.

SALT

R.K. Collings

Common salt is a chemical compound composed of two elements, sodium and chlorine. Large quantities of salt occur in solution in the oceans of the world, as brine on many of the continents and as bedded deposits of rock salt.

In Canada, salt is recovered from underground deposits by standard brining and evaporation techniques at plants in Nova Scotia, Ontario, Manitoba, Saskatchewan and Alberta. Salt-mining operations are carried on at present at two locations only - at Malagash, Nova Scotia, and Ojibway, Ontario. However, two new salt mines are now nearing the production stage. The shaft and surface buildings for the plant of Sifto Salt Limited at Goderich are now practically complete, and production of rock salt is scheduled to begin early in September 1959. A 45-foot section of salt is to be mined at a depth of 1,750 feet. Malagash Salt Company Limited is continuing shaft-sinking operations at Pugwash, Nova Scotia, to salt beds 600 feet below the surface. The shaft is now well below the 400-foot level.

Canadian production of salt in 1958 rose 34 per cent over that of the previous year to 2,375,192 short tons. This increase was due almost entirely to the production of brine for export by Canadian Brine Company at Sandwich, Ontario. This operation, initiated early in the year, is expected to account for the export of well over 500,000 tons of salt annually. Exports of salt other than that contained in brine amounted to 406,707 short tons in 1958. Most of this amount was rock salt for consumption in the United States.

Imports of salt for use by fisheries, for ice and dust control on highways and for use in the manufacture of chemicals amounted to 340,887 short tons in 1958.

Producers*

Ontario

Ontario accounted for almost 90 per cent of Canada's production in 1958. The entire production was from salt beds located 800 to 1,800 feet below the surface in the area between Amherstburg and Goderich in the south-western section of the province.

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*See map on page 407.

Salt – Production and Trade

	1958		1957	
	Short Tons	$	Short Tons	$
Production (shipments)				
By type				
Fine vacuum salt.....	438,394	8,700,562	422,977	8,132,732
Mined rock salt......	787,032	4,910,675	786,975	4,766,127
Salt recovered in chemical operations..	17,733	59,293	17,211	64,549
Salt content of brines used and shipped	1,132,033	1,319,012	544,396	1,026,295
Total	2,375,192	14,989,542	1,771,559	13,989,703
By province				
Ontario	2,126,483	10,204,472	1,538,805	9,478,587
Nova Scotia..........	125,872	2,026,551	122,763	1,900,538
Alberta	55,766	983,640	46,935	1,038,346
Saskatchewan........	46,511	1,157,729	43,684	1,069,201
Manitoba............	20,560	617,150	19,372	503,031
Total	2,375,192	14,989,542	1,771,559	13,989,703
Imports (by type)				
Table				
United States	41	34,342	82	34,842
United Kingdom	–	–	15	1,446
Total	41	34,342	97	36,288
For fisheries				
Bahamas............	25,259	101,959	14,379	65,792
Spain	24,923	110,530	51,331	190,629
Jamaica.............	5,223	26,720	3,072	10,056
United States	1,550	7,750	8	234
United Kingdom	22	415	–	–
Other countries......	–	–	11,388	41,370
Total	56,977	247,374	80,178	308,081
Other, in bulk				
United States	223,789	897,688	248,116	970,817
Mexico	43,635	48,471	11,148	11,883
Bahamas............	–	–	10,417	40,414
Total	267,424	946,159	269,681	1,023,114
Other, in bags, barrels and other covering				
United States.........	14,704	237,861	16,276	249,868
United Kingdom.......	1,741	37,262	1,251	31,866
Total	16,445	275,123	17,527	281,734
Total imports	340,887	1,502,998	367,483	1,649,217

Salt - Production and Trade (cont'd)

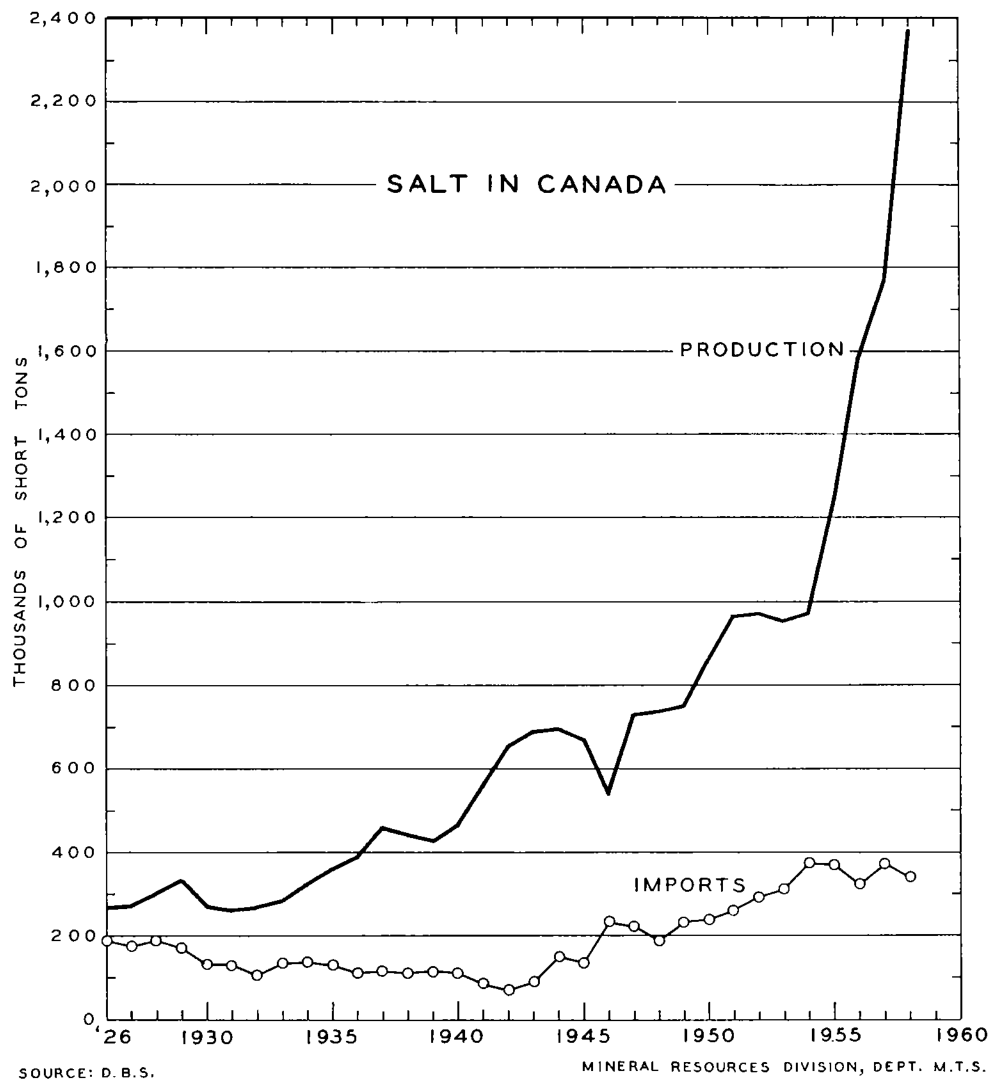
	1958		1957	
	Short Tons	$	Short Tons	$
Exports				
United States........	406,563*	2,910,426*	457,713	3,234,474
Bermuda...........	141	6,617	139	5,543
Other countries.....	3	226	36	1,102
Total..............	406,707	2,917,269	457,888	3,241,119

*These figures do not include the salt content or value of brine exported to the United States. The quantity and value relating to brine were included under another classification in Trade of Canada statistics in 1958.

Salt - Production and Trade, 1948-58
(short tons)

	Production(1)	Imports	Exports
1948	741,261	186,071	5,630
1949	749,015	236,688	3,474
1950	858,896	238,239	4,100
1951	964,525	258,822	4,561
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	406,707(2)

(1) Producers' shipments.
(2) This figure does not include the salt content of brine exported to the United States. The quantity and value relating to brine were included under another classification in Trade of Canada statistics in 1958.



Fine salt, obtained by vacuum-pan evaporation of brine from local wells, is produced by The Canadian Salt Company Limited, at Sandwich, and by Sifto Salt Limited, a subsidiary of Dominion Tar and Chemical Company, Limited, at Goderich and Sarnia. The Canadian Salt Company Limited also operates a fusion plant at Sandwich. Fine salt from the evaporator plant is fused, cooled, crushed and sized to produce coarse salt for special purposes.

Coarse rock salt is produced at Ojibway, near Windsor, by The Canadian Rock Salt Company Limited, a subsidiary of The Canadian Salt Company Limited. This salt is mined by standard room-and-pillar methods from a 27-foot seam located at a depth of 1,000 feet.

Brine from company-owned wells is used by Dow Chemical of Canada Limited to produce caustic soda, chlorine and related chemicals at Sarnia. At Amherstburg, Brunner Mond Canada, Limited, produces industrial salt, soda ash, calcium chloride and other chemicals, using brine from local wells.

Canadian Brine Company, a subsidiary of The Canadian Salt Company Limited, supplies brine from wells at Sandwich, Ontario, to a chemical plant in Detroit. The brine is pumped to Detroit through pipelines running under the Detroit River.

Warwick Salt and Chemicals Limited has resumed operations at Watford,producing coarse evaporation salt for use in agriculture, ice control and water-softening and for salting hides.

Nova Scotia

Fine salt is produced by Sifto Salt Limited at a plant at Nappan near Amherst. Brine for this operation is obtained from salt beds 1,100 to 1,800 feet below the surface.

Malagash Salt Company Limited, a subsidiary of The Canadian Salt Company Limited, operates a rock-salt mine at Malagash. The salt is crushed and screened to give a coarse product for use in ice and dust control on highways and for the removal of ice from railway tracks. Small amounts of salt from Malagash are used locally for curing hay and as a fish preservative.

Prairie Provinces

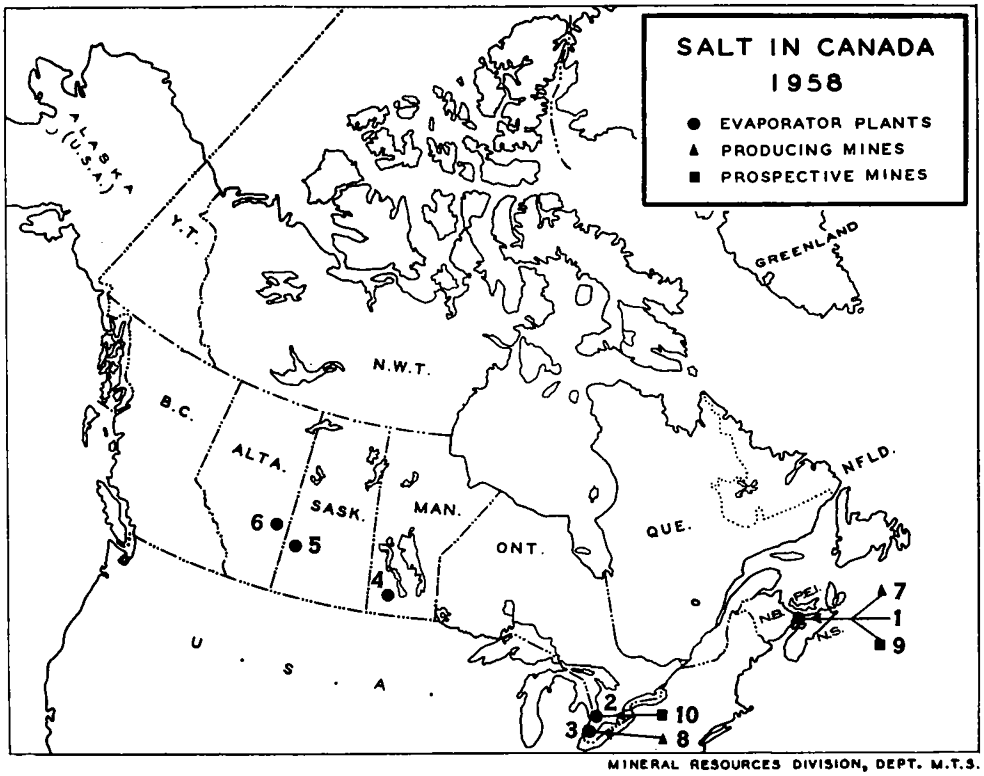
Fine salt, obtained by vacuum-pan evaporation of brine from salt beds 1,000 to 3,500 feet below the surface, is produced by The Canadian Salt Company Limited at Neepawa, Manitoba, and Lindbergh, Alberta, and by Sifto Salt Limited at Unity, Saskatchewan. Part of the Lindbergh output is fused, crushed and screened to give a coarse salt for various uses.

Western Chemicals Limited, of Calgary, Alberta, uses brine obtained from salt beds 3,600 feet below the surface to produce caustic soda, chlorine and hydrochloric acid at its chemical plant 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 southwesterly-dipping basin that extends from northeastern Alberta southeasterly through central Saskatchewan and thence into southwestern



Evaporator Plants

1. Sifto Salt Ltd. (Nappan)
2. Sifto Salt Ltd. (Goderich and Sarnia)
   Warwick Salt and Chemicals Limited (Watford)
3. Canadian Salt Co. Ltd., The (Sandwich)
   Brunner Mond Canada, Ltd. (Amherstburg)
4. Canadian Salt Co. Ltd., The (Neepawa)
5. Sifto Salt Ltd. (Unity)
6. Canadian Salt Co. Ltd., The (Lindbergh)

Producing Mines

7. Malagash Salt Co. Ltd. (Malagash)
8. Canadian Rock Salt Co. Ltd., The (Ojibway)

Prospective Mines

9. Malagash Salt Co. Ltd. (Pugwash)
10. Sifto Salt Ltd. (Goderich)
    Midrim Mining Corp. Ltd. (Strathroy)

Manitoba. These beds vary from less than 400 feet below the surface in northern Alberta to 6,000 feet or more in southern Saskatchewan.

Uses

Brine is used extensively in the chemical industry for the manufacture of chlorine, hydrochloric acid, caustic soda and related chemicals. Fine salt produced by vacuum-pan evaporation of brine is also used in the chemical industry and for dairy, household and food purposes.

The coarser grades of salt are used in the curing of fish, for ice and dust control on highways, in dairying, for the regeneration of zeolites in water-softening, as refrigerants and for other puroses. Coarse salt is obtained by the use of open-pan evaporators, by the pressing or fusion of fine salt into blocks or pellets which are then crushed and screened, and by the mining, crushing and screening of rock salt. Coarse salt produced by the open-pan evaporation of brine or by the fusion of fine salt is pure but expensive, and hence is used only where purity is essential, as in the curing of fish or in the dairy industry. Mined rock salt is used extensively for the control of ice and dust conditions on highways and the removal of ice from railways. Rock salt, dissolved in water to form brine, is also used in the chemical-manufacturing industry.

Consumption of Salt in Specified Canadian Industries, 1957*

(short tons)

Industry	Quantity Used
Chemical	
Brine (salt content) and dry salt	815,659
Slaughtering and meat-packing	52,000(e)
Pulp and paper mills	45,483
Miscellaneous food preparations	38,078
Fish-processing	23,578
Stock and poultry feed, prepared	22,662
Leather tanneries	7,064
Miscellaneous manufacturing	5,497
Other industries	671,133**

* Later figures not available.

** Apparent consumption (1957) less amount used by specified industries. Includes coarse rock salt for winter maintenance of roads and railways, refrigeration, chemical use, etc., as well as fine salt.

(e) Estimated.

Tariffs

Canada

	British Preferential	Most Favoured Nation	General
Fishery salt	free	free	free
Bulk salt	"	3¢ per 100 lb	5¢ per 100 lb
Salt in bags, barrels, etc.	"	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 sand, gravel and crushed stone produced in Canada during 1958 amounted to 190,367,674 short tons valued at $135,908,873. It was lower by 2,644,172 tons and $644,814 than the record high of 1957.

Crushed stone, representing 18.2 per cent of this output, decreased by 6.2 per cent to 34,724,813 tons, with a drop in value of $4,004,503. The demand for specific types of material in the crushed-stone field shifted during 1958. The amount required for use in the construction of streets and highways, which was 47 per cent of the total consumed in 1957, increased in 1958 to 56 per cent. There was less demand for concrete aggregate and for rubble and riprap, production decreasing 26.3 and 37.4 per cent, respectively.

The production of natural sand and gravel was 155,642,861 tons valued at $93,970,461, compared with the record output of 1957, which was 156,001,776 tons valued at $90,610,772.

Imports and Exports

Virtually all the aggregate imported in 1958, amounting to 1,063,473 short tons valued at $1,412,540, came from the United States. Imports in 1958 were 307,100 short tons less than in 1957. The cost also decreased by $307,100. A very small amount of stone was received from the United Kingdom and Italy. Crushed stone made up 78 per cent of all the stone imported.

Canada exported 581,467 short tons of stone valued at $683,687, principally to the United States. This was a 39.5-per-cent increase over the 1957 volume exported but only a slight increase in value, the 1957 exports being worth $676,319. Sand and gravel made up more than 60 per cent of the aggregate shipped from Canada.

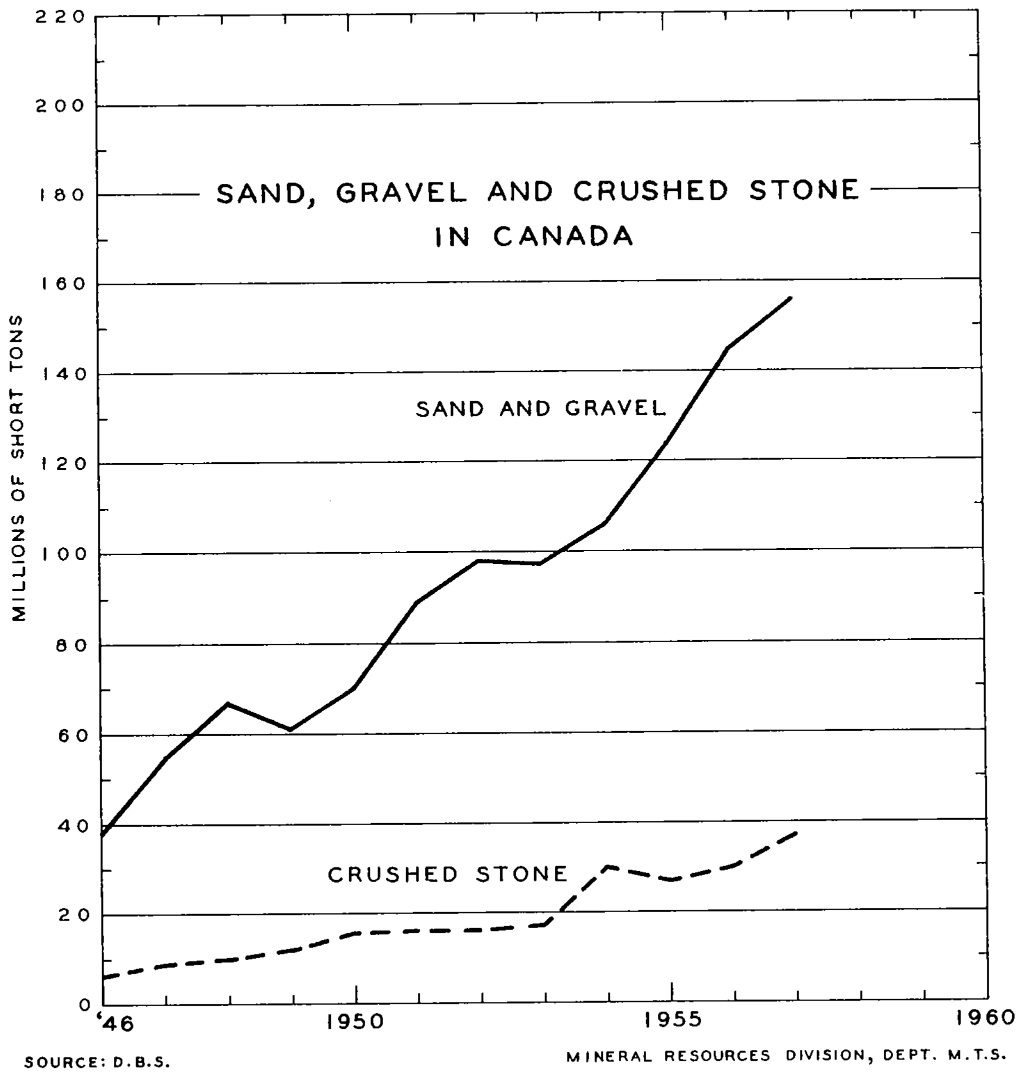
Consumption of Aggregate

Large quantities of aggregate were consumed during the construction of the St. Lawrence Seaway, which was completed in 1958. Because of the increased volume of shipping that its construction has brought to Canada, crushed stone will be in demand for several years to supply the need for harbour and dock installations and terminal storage facilities.

(text continued on page 412)

PRODUCTION OF SAND, GRAVEL AND CRUSHED STONE

	SAND AND GRAVEL				CRUSHED STONE				TOTAL PRODUCTION SAND, GRAVEL AND CRUSHED STONE			
	1958		1957		1958		1957		1958		1957	
By province	Short Tons	$	Short Tons	$	Short Tons	$	Short Tons	$	Short Tons	$	Short Tons	$
Newfoundland	3,924,080	1,456,379	2,707,869	1,659,293	59,867	156,335	351	1,650	3,983,947	1,612,714	2,708,220	1,660,943
Nova Scotia	2,332,909	2,372,419	1,932,125	1,875,222	335,575	563,814	338,681	716,167	2,668,484	2,936,233	2,270,806	2,591,389
New Brunswick	4,015,976	1,750,657	7,341,578	3,676,312	2,026,865	1,464,367	1,224,662	1,194,047	6,042,841	3,215,024	8,566,240	4,870,359
Quebec	38,375,529	19,010,360	40,252,310	20,384,952	16,263,456	20,415,088	15,441,898	19,336,844	54,638,985	39,425,448	55,694,208	39,721,796
Ontario	65,465,401	39,455,397	63,599,656	35,913,363	14,096,699	17,047,756	15,622,241	18,428,375	79,562,100	56,503,153	79,221,897	54,341,738
Manitoba	9,985,838	5,962,166	6,545,619	3,365,132	170,291	154,448	415,441	414,458	10,156,129	6,116,614	6,961,060	3,779,590
Saskatchewan	5,358,702	2,821,487	6,480,617	3,080,662	-	-	-	-	5,358,702	2,821,487	6,480,617	3,080,662
Alberta	13,225,048	12,714,750	11,801,271	9,981,206	52,504	84,926	45,331	257,353	13,277,552	12,799,676	11,846,602	10,238,559
British Columbia	12,959,378	8,426,846	15,340,731	10,674,630	1,719,556	2,051,678	3,921,465	5,594,021	14,678,934	10,478,524	19,262,196	16,268,651
Total	155,642,861	93,970,461	156.001,776	90,610,772	34,724,813	41,938,412	37,010,070	45,942,915	190,367,674	135,908,873	193,011,846	136,553,687
By type												
Sand												
Building concrete	13,232,445	11,902,625	14,173,048	9,673,088								
Sand and gravel												
Concrete: road-building	106,229,805	55,362,687	108,654,941	56,593,792								
Railroad ballast	8,373,117	3,624,978	7,687,770	3,057,655								
Crushed gravel	27,807,494	23,080,171	25,486,017	21,286,237								
Crushed stone												
Concrete aggregate					8,364,487	12,493,684	11,355,030	15,761,075				
Railroad ballast					1,496,352	1,633,114	1,672,185	2,136,969				
Road metal					19,290,774	21,240,892	17,489,156	18,525,532				
Rubble and riprap					2,479,319	2,597,157	3,958,004	5,831,052				
Terrazzo, stucco and artificial stone					45,303	511,432	41,350	445,878				
Other uses					3,048,578	3,462,133	2,494,345	3,242,409				
Total	155,642,861	93,970,461	156,001,776	90,610,772	34,724,813	41,938,412	37,010,070	45,942,915				



Many multimillion-dollar contracts in varying stages of construction during 1958 were carried over into 1959. These, together with new construction proposed for 1959, required large quantities of aggregate. Large airport terminals and airfield runways are being constructed or modernized for heavier jet-aircraft operations. The needs of defence construction have increased the contracts passing through the Department of National Defence in 1959 to twice their 1958 volume. Housing-construction units mushroomed in all cities across Canada, all provinces benefiting by this residential boom. In 1958, a year of recovery from the recession of 1956-57, residential building was far ahead of other categories of construction.

Road and airdrome construction, a major industry requiring vast quantities of aggregate, was second only to defence construction in the 1958 budget. The amount allowed for this construction was $711,854,000 in 1958 and an estimated $789 million in 1959. The cost, borne by municipal, provincial and federal governments, covered the construction and repair of town and city streets, secondary and provincial highways and main arterial highways. The federal government increased its share in the Trans-Canada Highway by voting an extra $100 million during 1958, thus raising its contribution to the project to $350 million. At the end of 1957, 39 per cent of this road had been completed to Trans-Canada Highway specifications; at the end of 1958, 47 per cent had been so completed. During 1958 the federal government initiated the 'roads to resources' program, a plan designed to further the development of remote mineral areas by the construction of access roads. Additional roads are being constructed in the Northwest Territories and Yukon Territory in conjunction with the development of such townsites as Frobisher Bay and Inuvik.

Improving Aggregate Plants

Many plants operate close to marginal limits. The 1- or 2-cent-a-ton saving gained by employing some measure of beneficiation is often the difference between economic and noneconomic operation. Beneficiation, however, is only one of many methods of increasing profits. Savings are being realized in many plants by redesigning quarrying, milling and/or transportation methods.

Many companies are raising their profits by replacing numerous small machines employed in drilling and transportation with larger, heavy-duty machines. Not only are fewer machines required, but saving in manpower and increased productivity soon pay off the investment.

Small sand and gravel deposits have been economically worked by using a portable crushing and screening plant. This plant is equipped with a feeder scalper and primary jaw and secondary roll crushers. The advantage of using this unit is that it follows the shovel into a deposit and is easily transported for any distance to new deposits.

Increased production is obtained by the replacement of antiquated equipment with new or improved machinery and by improvements in processing methods. Many bottlenecks that slow down production are quickly eliminated simply by adding an extra secondary crusher or by altering a feed rate. Surge bins leading to vibratory feeders assure a constant supply of material to crushers and conveyors. Rapid mixing and transportation of graded aggregates is made possible by feeding from surge piles located above underground conveyors. Large quantities of material can be handled by a few men.

SILICA

R. K. Collings

Silica is the common name for silicon dioxide, a compound occurring in the free state chiefly as quartz. Quartz is widespread in Canada. It occurs in many forms, but only those in which the silica content is high - namely vein quartz, silica sand, sandstone and quartzite - are used in industry. Most of the silica produced in Canada is used domestically as a fluxing agent in metallurgical industries. Smaller amounts are used in the manufacture of ferrosilicon alloys, glass, silicon carbide and silica brick, as an ingredient in portland cement, and for foundry purposes, etc. Part of the Canadian production of lump silica is exported to the United States for use in the manufacture of ferrosilicon alloys.

Canada's requirements of high-purity silica sand for the manufacture of glass, silicon carbide and silica chemicals, and for other purposes are supplied, for the most part, by imports from the United States. However, high-purity sand is now being supplied in increasing amounts to the Canadian market by producers at Lachine and St. Canut, Quebec, and Selkirk, Manitoba.

The production of silica minerals in Canada in 1958 was 1,453,656 short tons. This represented a decrease of 32 per cent from that of 1957 due partly to reduced demand for silica for use as smelter flux and partly to a reduction of the amount required by ferrosilicon producers. Smelter flux requirements were down because of a three-month strike by employees of The International Nickel Company of Canada, Limited. Production curtailments within the steel industry resulted in reduced demand for ferrosilicon, which in turn resulted in a slackening of the demand for silica for use in ferrosilicon manufacture. Exports of quartzite, which reached 232,299 short tons in 1957, amounted to only 17,074 short tons in 1958. Imports of silica sand for use in the manufacture of glass, silicon carbide, etc., totalled 603,343 short tons in 1958, or 19 per cent less than in the previous year.

(text continued on page 418)

Silica - Production and Trade

	1958		1957	
	Short Tons	$	Short Tons	$
Production(1)				
Quartz and silica sand				
By province				
Ontario	922,599	666,275	1,591,091	1,428,400
Quebec	268,676	1,412,802	284,403	1,321,830
Saskatchewan	187,360	134,899	168,051	84,026
British Columbia	67,146	286,438	95,701	350,930
Manitoba	7,875	37,736		
Total	1,453,656	2,538,150	2,139,246	3,185,186
By use				
Ferrosilicon			387,759	1,133,766
Foundry			6,280	68,646
Flux			1,638,599	1,133,732
Glass, silicon-carbide, flour and other industrial uses			106,608	849,042
Total	1,453,656	2,538,150	2,139,246	3,185,186
	Thousands of Bricks		Thousands of Bricks	
Silica brick	2,815	472,346	4,308	655,903
	Short Tons		Short Tons	
Imports				
Silica sand for glass and carborundum manufacture and for use in steel foundries, filtration plants and sand-blasting				
United States	603,287	2,113,949	743,820	2,351,770
Norway	56	606	-	-
Belgium	-	-	1,047	55,863
Total	603,343	2,114,555	744,867	2,407,633
Quartz				
Silex or crystallized quartz, ground or unground(2)	12,024	150,960	13,718	186,882
Piezoelectric quartz(3)	2.6	60,710	6.1	176,572
Total	12,026.6	211,670	13,724.1	363,454

Silica - Production and Trade (cont'd)

	1958		1957	
	Short Tons	$	Short Tons	$
Imports (cont'd)				
Flint and ground flint stones				
United States	346	12,687	393	14,235
France	104	4,171	55	1,503
Denmark...............	72	2,937	80	1,894
Belgium	20	2,772	-	-
Total	542	22,567	528	17,632
Firebrick containing not less than 90% silica				
United States		1,207,828		2,929,205
West Germany		39,505		21,303
Total		1,247,333		2,950,508
Exports				
Quartzite				
United States	17,074	72,797	232,299	790,728

(1) Producers' shipments, including crude and crushed quartz, crushed sandstone and quartzite, and natural silica sands.
(2) Mostly from the United States.
(3) Mostly from Brazil.

Available Statistics on the Consumption of Silica by Specified Industries, 1957

(short tons)

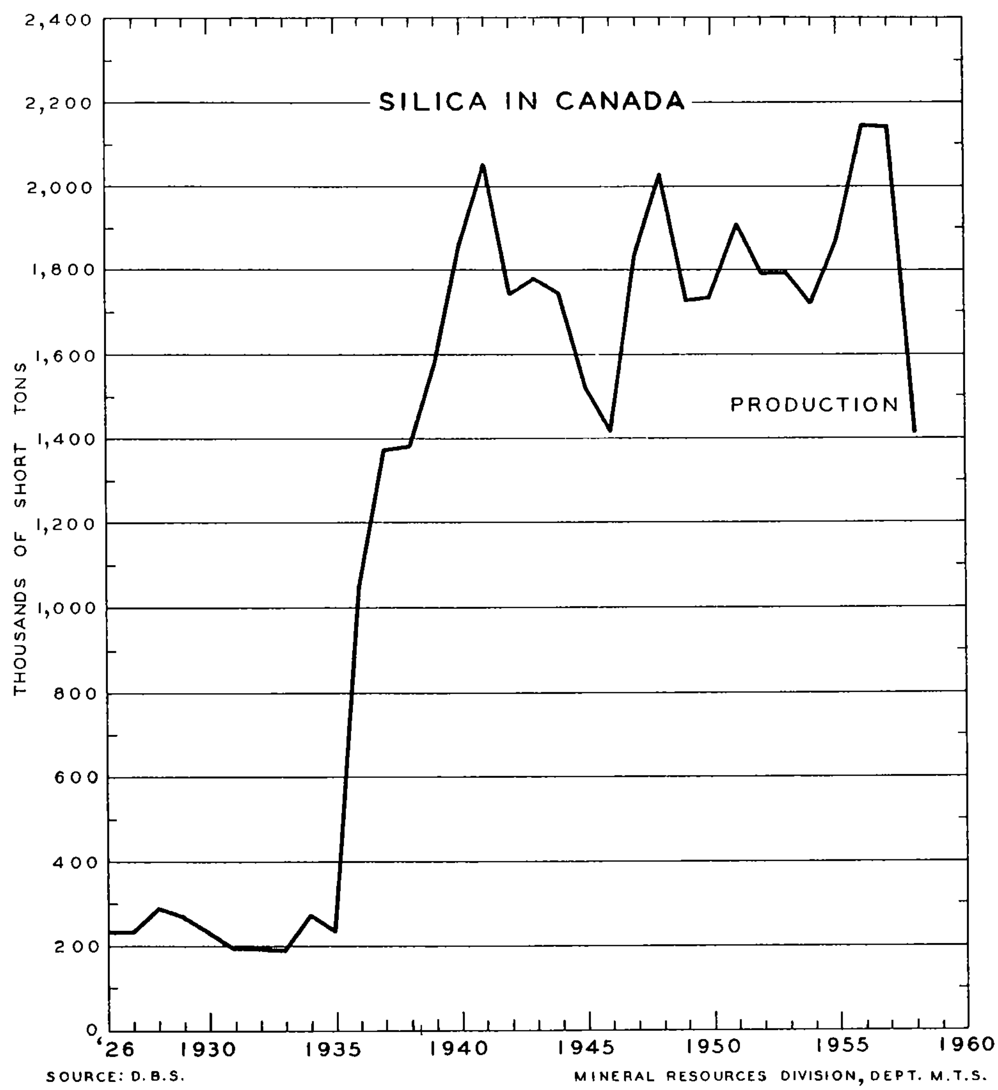
Industry	Consumption
Smelter-flux	1,626,900*
Glass-manufacturing..........................	268,300
Foundry-sand	170,100
Ferrosilicon	141,100
Artificial-abrasives	125,500
Cement-manufacturing	89,800
Chemical	26,800
Soap-and-cleanser............................	12,300
Clay-products	7,100

*Includes low-grade sand and gravel as well as crushed quartz.

Silica - Production and Trade, 1948-58

	Production		Imports				Exports
	Quartz and Silica Sand (short tons)	Silica Brick (thousands of bricks)	Silica Sand	Silex or Crystallized Quartz	Ground Flint Stone	Ganister	Quartzite (short tons)
			(short tons)				
1948	2,017,262	3,464	584,019	17,474	739	230	228,100
1949	1,722,476	3,663	511,116	22,966	602	176	144,302
1950	1,730,695	3,126	573,362	24,757	939	128	195,430
1951	1,904,885	3,510	692,937	30,398	1,231	144	281,379
1952	1,783,081	3,544	642,880	26,174	481	260	193,955
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

*Not now available separately. Included with miscellaneous stone imports from January 1, 1958.



Producers

Nova Scotia

Dominion Steel and Coal Corporation, Limited, quarries quartzite as required at Chegoggin Point, Yarmouth county. Rock from this deposit is used in the manufacture of silica brick at Sydney.

Quebec

Electro Metallurgical Company, Division of Union Carbide Canada Limited, quarries sandstone at Melocheville, Beauharnois county, for the manufacture of ferrosilicon at Beauharnois. The fines produced during crushing and screening are sized and used in foundry work, in cement manufacture and as a metallurgical flux.

Dominion Silica Corporation Limited quarries quartzite at St. Donat, Montcalm county, for use in the manufacture of silica sand and flour at Lachine. The production from the Lachine plant is used in the manufacture of glass and artificial abrasives and for other products requiring high-quality silica.

Radius Exploration Limited, of Montreal, operates a sandstone quarry near Ste. Clothilde, Chateauguay county, for the production of various grit sizes for the poultry industry. Silica from this deposit is also sold for concrete-block and cement-brick manufacture.

Canadian Silica Corporation Limited, with head offices in Toronto, produces silica sand and flour at a silica-milling plant at St. Canut. The silica sand is used in the manufacture of glass, silicon carbide and cement and for foundry purposes. The flour is used by steel foundries as a filler in asbestos-cement products and as an abrasive ingredient in various cleansers.

Ontario

Canadian Silica Corporation Limited and Electro Metallurgical Company operate quarries in the quartzite formations occurring along the northwest shores of Georgian Bay. Canadian Silica has quarries at Sheguiandah on Manitoulin Island; Electro Metallurgical Company's quarries are at Killarney on the mainland. A large portion of the production from these deposits is exported to the United States; the remainder is used domestically for the manufacture of ferrosilicon. A small percentage of the production from Sheguiandah is used for the production of silica flour at Whitby, Ontario.

Algoma Steel Corporation, Limited, quarries quartzite from a deposit at Bellevue, north of Sault Ste. Marie, for the manufacture of silica brick for furnace linings.

Manitoba

Selkirk Silica Co. Ltd., of Winnipeg, obtains sand from a deposit on Black Island, Lake Winnipeg. It is shipped to Selkirk, where it is washed, sized, dried, and sold for glass manufacture, foundry purposes and other miscellaneous uses.

Other Areas

Silica for metallurgical flux is obtained near Noranda, Buckingham and Howick, Quebec; Sudbury, Ontario; Flin Flon, Manitoba; and Trail, British Columbia.

Large deposits of sand, sandstone and quartzite exist in all provinces, but most are too impure or too far from markets to warrant development.

Specifications and Uses

Lump Silica

Silica Flux

Quartz, quartzite and, in some cases, sandstone and sand are used as fluxes in smelting base-metal ores low in silica. The composition of the flux and the amount of silica used depend upon the composition of the ore, but the silica content should be as high as possible. In small amounts, impurities such as iron and alumina are not objectionable. Silica used for flux is generally -1, +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 at least 98 per cent, that of iron and alumina less than 1 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 as they cause deterioration and disintegration of the manufactured product. The silica used is generally -6, + 1 inch in size.

Silica Brick

Quartz and quartzite, crushed to pass an 8-mesh screen, are used in the manufacture of silica brick for high-temperature refractory furnace linings. The silica content of the quartz used should be at least 97 per cent. The iron and alumina content should be less than 1 per cent each and that of other impurities, such as lime and magnesia, should be low.

Other Uses

Lump quartz and quartzite, shaped to proper size, 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 0.04 per cent. The content of other impurities such as alumina, lime and magnesia should be low. Uniformity of grain size is important; glass sand should be between 20-mesh and 100-mesh size with a minimum of coarse or fines.

Silicon Carbide

Sand used for silicon-carbide manufacture should have a silica content of at least 99 per cent. The iron and alumina content 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 in size.

Hydraulic Fracturing

Silica sand is used in the hydraulic fracturing of oil-bearing formations. The amount used in this operation varies greatly, generally from 5,000 to 15,000 pounds per treatment. The sand 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 must be closely controlled 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 to grain size are used extensively in the foundry industry for moulding. Silica 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 sand with a rounded grain is preferred for the foundry industry.

Sodium Silicate and Other Chemicals

Sand used in the manufacture of sodium silicate and other chemicals should be very pure. It should contain more than 99 per cent silica, less than 0.5 per cent alumina, less than 0.1 per cent lime and magnesia combined and less than 0.04 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 an abrasive grit in sand-blasting operations and for the manufacture of sandpaper. Various grades of closely sized sand are used in water-treatment plants as filtering media. Silica sand is 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 for paint and as an abrasive ingredient in soaps and scouring powders.

Quartz Crystals

Quartz crystals possessing the necessary piezoelectric properties are used in radio-frequency-control apparatus, radar and other electronic devices. Crystals used for this purpose must be water-clear, perfectly transparent and free of all visible impurities or flaws. The individual crystals should weigh 100 grams or more and measure at least 2 inches in length and 1 inch or more in diameter.

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 $8 to $10 a ton.

Tariffs

Canada

Sand and ganister	free
Silex, or crystallized quartz, ground or unground	"

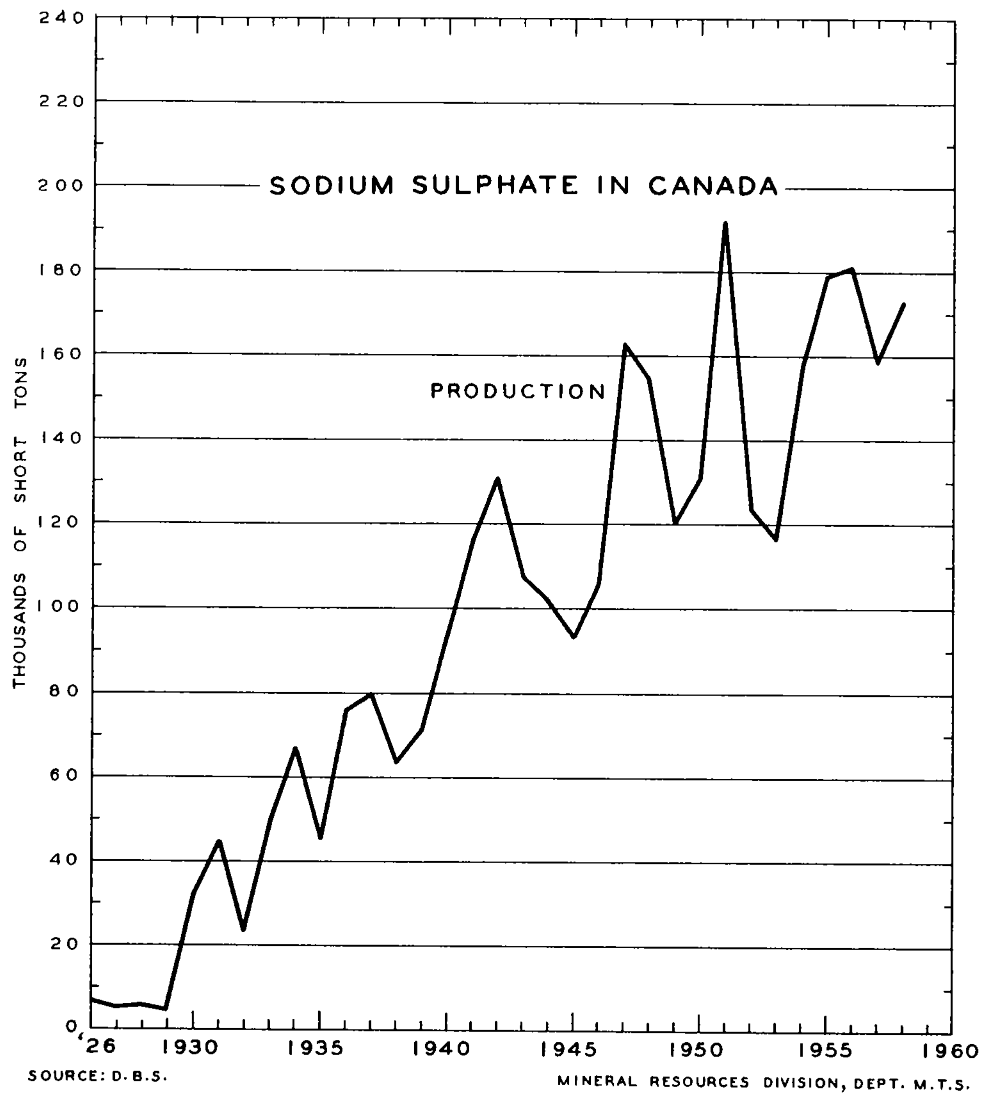
United States

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

SODIUM SULPHATE

C.M. Bartley

In 1958, as previously, Canada's production of sodium sulphate was derived largely from natural occurrences in Saskatchewan. Production increased about 10 per cent - from the 157,800 short tons of 1957 to 173,217 short tons valued at $2,862,915.



Sodium Sulphate - Production, Trade and Consumption

	1958		1957	
	Short Tons	$	Short Tons	$
Production (shipments)...	173,217	2,862,915	157,800	2,568,728
Imports				
Crude sodium sulphate or salt cake				
United States	16,663	293,597	18,907	336,960
United Kingdom........	9,150	184,618	9,181	174,497
Total	25,813	478,215	28,088	511,457
Glauber's salt				
West Germany.........	765	19,240	516	13,558
United States	450	19,298	993	36,530
United Kingdom........	2	254	3	365
Switzerland	-	-	500 lb	74
Total	1,217	38,792	1,512	50,527
Exports				
Crude sodium sulphate				
United States	39,763	645,670	37,023	593,390
	1957		1956	
Consumption				
Pulp and paper	160,042		156,698	
Glass, including glass wool..................	2,111		2,922	
Medicinals.............	67		54	
Soaps	1,252		1,335	
Stone products	271		264	
Total	163,743		161,273	

Production and Trade

Despite the gains in production and sales, the trend of rising transportation costs is a serious problem for producers in Saskatchewan. In addition, while it is too soon to see the effect of the St. Lawrence Seaway on trade in sodium sulphate, Canadian producers fear that the Seaway may allow foreign imports to get a foothold in the market served by Saskatchewan. To offset foreign competition, the industry is trying to improve the quality of its product and the efficiency of its recovery operations.

Sodium Sulphate - Production, Trade and Consumption - 1948-58

	Production(1)	Imports		Exports(2)	Consumption
		Salt Cake	Glauber's Salt		
1948	153,698	12,394	1,472	29,612	128,926
1949	120,259	4,294	1,996	21,090	106,257
1950	130,730	15,705	2,256	28,375	115,937
1951	192,371	19,432	3,234	63,179	144,144
1952	122,590	19,576	4,577	27,144	116,786
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	

(1) Producers' shipments of crude sodium sulphate.
(2) Exports to United States from 1948 to 1954 inclusive taken from United States import statistics.

Imports in 1958 were lower than in 1957. Exports increased from the 37,023 short tons of 1957 to 39,763 short tons.

A minor amount of by-product sodium sulphate is produced in Canada, but it has little influence on the market.

Producing Companies

The same four Saskatchewan companies again produced and marketed sodium sulphate in 1958. The combined capacity of the processing plants, more than 300,000 tons a year, is adequate to all foreseeable demand.

Saskatchewan Minerals, Sodium Sulphate Division, has a plant on Chaplin Lake about 50 miles west of Moose Jaw. In operation since 1947, it has been active in efforts to improve processing efficiency. Dams have been used to divide the lake into sections so that closer control may be maintained over the concentration of the brine. A long ditch line has been dug to insure a supply of water for the lake in very dry weather. These steps have reduced dependence on natural climatic conditions and provide better control over the natural evaporation process in the lake.

In the plant itself, the use of natural gas rather than fuel oil has provided the most important single improvement in operating efficiency. The use of stainless-steel equipment has contributed to greater efficiency in operation and more uniformity of grade.

Ormiston Mining and Smelting Co. Ltd. has been operating near Ormiston on Horseshoe Lake since 1950, but recovery of sodium sulphate from the lake has been continuous since 1930. Between 1930 and 1950, The International Nickel Company of Canada, Limited, used sodium sulphate from this source in the smelting of copper-nickel ores. Since 1950 the plant has been owned by a group of paper companies and operated for their own needs.

Production is carried on both by solution methods and by the mining of raw salt from the lake bottom. Since natural gas is not yet available, local low-grade coal is used for dehydration.

Midwest Chemicals Limited, which has a plant near Palo on Whiteshore Lake, operated normally during 1958. It had been using one submerged combustion unit and three rotary driers, but during the year a second submerged combustion unit was installed. These units have almost doubled the capacity of the plant.

Sybouts Sodium Sulphate Company Limited has a plant on East Coteau Lake* about 9 miles south of Gladmar near the International Boundary. Operations were first started at the lake about 1932. The present company erected a rotary kiln plant in 1941 and expanded it in 1947.

Saturated brine is pumped to a reservoir and the crystallized salt is harvested in the fall. Two coal-fired rotary kilns are used for drying. Natural gas is not yet available in the area, but the possibility of using butane from the Steelman oil field has been considered.

Other Occurrences

Explorative work on the numerous deposits in Saskatchewan has shown that large reserves of sodium sulphate are available. More than 20 lake deposits contain at least 500,000 tons each and 11 are estimated to contain from 100,000 to 500,000 tons each. The reserves in Saskatchewan have been estimated to total more than 200 million tons.

Sodium sulphate occurrences similar to those in Saskatchewan have been found in Alberta and British Columbia. Production totalling 200 tons has been credited to Alberta. There is no record of production from British Columbia.

Drilling in New Brunswick has indicated a deposit of glauberite, the double sulphate of sodium and calcium, at depths of about 1,300 feet.

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*Formerly Sybouts East Lake.

Foreign Competition

Foreign competition from Europe and the United States is becoming of considerable concern to sodium-sulphate producers in western Canada. The foreign material is a by-product of other industrial processes and as such is low in cost. In addition, the largest markets for sodium sulphate are the kraft-pulp mills of eastern Canada and the Great Lakes area. European sodium sulphate can be delivered to east coast points by low-cost ocean freight. Many of the kraft-paper mills in the St. Lawrence and Great Lakes area are closer to United States sources of by-product sodium sulphate than to the Saskatchewan producers. In past years, imports of United States salt cake into eastern Canada were more than balanced by exports of Canadian salt cake to the central United States. Present trends in transportation costs and increased foreign competition make this balance difficult to maintain.

Technology

The recovery of sodium sulphate from occurrences in western Canada consists in mining the salt from a lake bottom or obtaining it by the controlled precipitation of a saturated brine. This raw material, mirabilite or Glauber's salt ($Na_2SO_4 \cdot 10H_2O$), is then dehydrated to drive off the water of crystallization, and the end product is anhydrous sodium sulphate, known to the trade as salt cake.

Since production began, there have been numerous changes in technology. Dams and ditches are used to keep brine in the lakes at the best levels. New materials, such as stainless steel, and new fuels, such as natural gas, have been found to increase efficiency in processing plants and have been adopted wherever possible. Improvements have been made in some of the processes. In some plants new processes, such as submerged combustion, have been adopted, with considerable improvement in efficiency.

Initially the larger markets did not demand a high-purity product and simple processes were adequate. In recent years, increasing competition from foreign suppliers, rising marketing costs in Canada, and the demand of the main consumers for relatively lower quantities and higher specifications have forced Canadian producers to investigate every possible means of reducing cost and increasing efficiency. The two main approaches to date have been the control of the concentration of brine in the lakes and the use of natural gas rather than local coal or fuel oils. These changes have improved the efficiency and lessened the cost of some of the present operations without basically altering them.

Research is also being carried on for the purpose of developing new methods of processing, making higher-grade products and producing other materials, such as sodium carbonate, in addition to sodium sulphate.

Uses

More than 95 per cent of the sodium sulphate produced in Canada in 1958 was consumed by the kraft-paper industries in Canada and the United States. Increased efficiency and waste-recovery efforts in the paper mills are gradually reducing the amount of sodium sulphate consumed per ton of paper produced, but the amount of sodium sulphate used is still rising with the increase in the production of kraft paper.

Sodium sulphate is also used in tanning and the manufacture of glass, heavy chemicals, detergents, dyes, and feed supplements for cattle.

Prices

Canada

Canadian prices for sodium sulphate are determined by contract between producers and consumers and depend on purity, tonnage and the term of the contract.

Canadian Chemical Processing of January 1, 1959, quotes the price of sodium sulphate in salt-cake form, bulk, carload, works, as $17 a ton.

United States

According to Oil, Paint and Drug Reporter of December 29, 1958, United States prices of sodium sulphate were as follows:

Anhydrous, technical-grade, bags, car lots, per short ton	$54
Detergent, per short ton	
Rayon-grade bags, car lots	$36
Bulk, car lots	$32
Crystallized, per lb	17 1/2¢ to 18¢

Tariffs

Canada

	British Preferential	Most Favoured Nation	General
Sodium sulphate, crude or salt cake, per lb	1/5¢	1/5¢	3/5¢

United States

Sodium sulphate, crude, or crude salt cake	free
Sodium sulphate, crystallized (Glauber's salt), per long ton	$1

BUILDING AND ORNAMENTAL STONE

F.E. Hanes

The value of production in 1958 was a record $7,471,126, compared with the previous high of $7,424,172, established in 1957. This increase was accompanied, however, by a 1-per-cent decrease in volume, the output being 172,764 short tons, compared with 174,502 in 1957.

Distribution

The six principal provinces actively engaged in the production of building and ornamental stone in Canada are Ontario, Quebec, Manitoba, New Brunswick, British Columbia and Nova Scotia.

Alberta produces a small quantity of construction stone. Newfoundland has widespread occurrences of rock suitable for use as dimension stone but, owing to its isolated position, cannot compete in Canadian or other markets. Saskatchewan and Prince Edward Island have no economic production.

Imports

The value of imported stone for building, ornamental and monumental use remained virtually unchanged in 1958. Imports in 1958 were valued at $2,613,596, approximately 35 per cent of the total value of Canadian-produced stone. Marble is the most valuable stone imported, and granite and limestone make up the remainder. Much stone is imported in sawn or unwrought blocks. About 20 per cent enters as manufactured products.

Exports

The value of Canada's exports of building, ornamental and monumental stone decreased in 1958 to $174,101 from the 1957 value of $177,913. The United States was Canada's principal market, absorbing 93 per cent of the stone exported. Jamaica bought most of the remainder. Seventy per cent of the exports were shipped in unwrought slabs and blocks composed essentially of granite and marble.

PRODUCTION OF BUILDING AND ORNAMENTAL STONE, 1958

	GRANITE		LIMESTONE		MARBLE		SANDSTONE		SLATE AND SHALE		TOTAL	
	S. Tons	$	S. Tons	$	S. Tons	$	S. Tons	$	S. Tons	$	S. Tons	$
Building stone												
Rough	10,733	205,430	49,091	519,870	8	222	21,554	465,779	-	-	81,386	1,191,301
Dressed	26,884	2,967,288	35,902	1,865,802	300	24,000	757	65,843	-	-	63,843	4,922,933
Total	37,617	3,172,718	84,993	2,385,672	308	24,222	22,311	531,622	-	-	145,229	6,114,234
Monumental and ornamental												
Rough	8,597	257,634	-	-	8	272	-	-	-	-	8,605	257,906
Dressed	7,542	966,626	-	-	-	-	-	-	-	-	7,542	966,626
Total	16,139	1,224,260	-	-	8	272	-	-	-	-	16,147	1,224,532
Flagstone	414	5,175	4,168	11,143	-	-	6,281	80,721	454	32,395	11,317	129,434
Curbstone	70	2,912	-	-	-	-	-	-	-	-	70	2,912
Paving blocks	1	14	-	-	-	-	-	-	-	-	1	14
Total	485	8,101	4,168	11,148	-	-	6,281	80,721	454	32,395	11,388	132,360
Grand total	54,241	4,405,079	89,161	2,396,815	316	24,494	28,592	612,343	454	32,395	172,764	7,471,126

PRODUCTION OF BUILDING AND ORNAMENTAL STONE, 1957

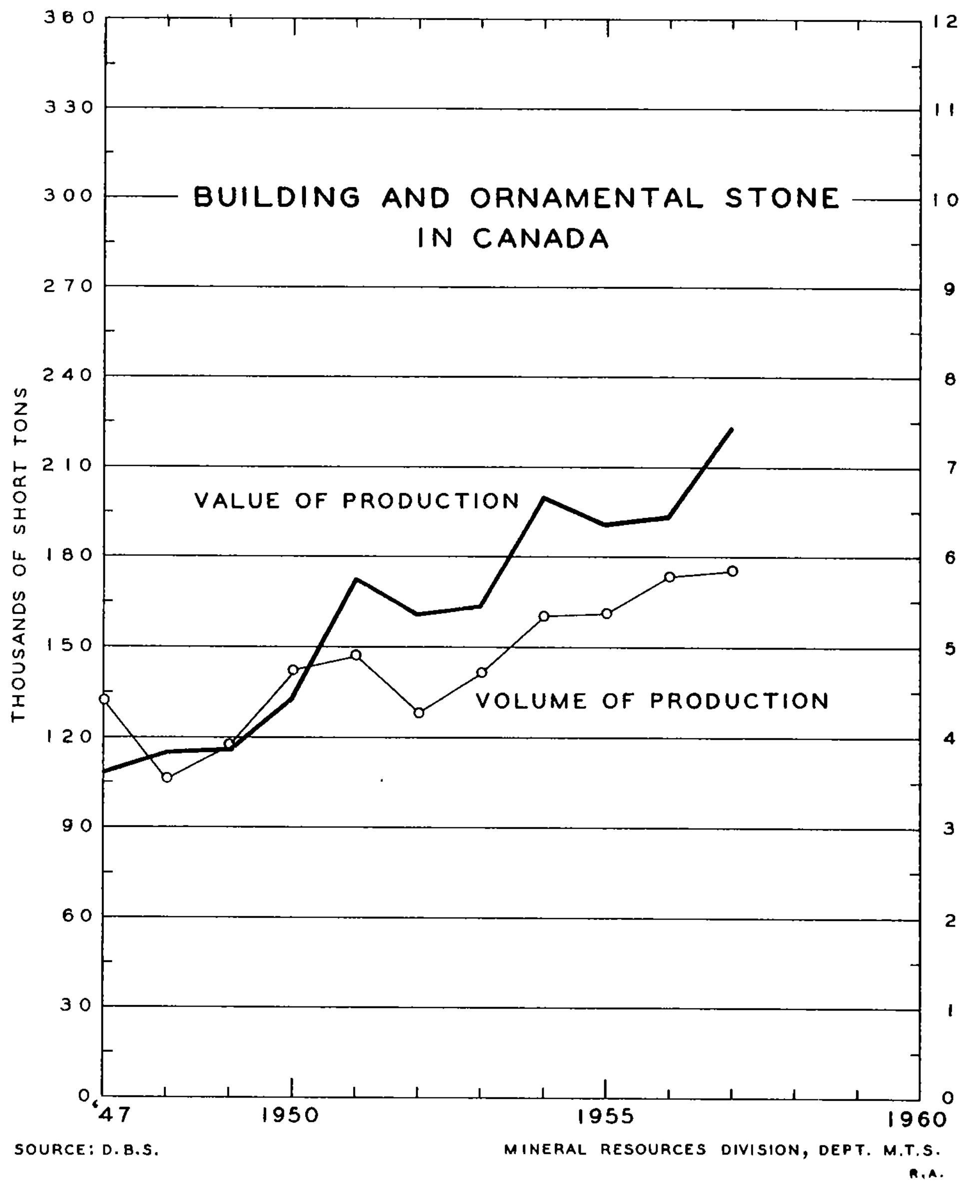
	GRANITE		LIMESTONE		MARBLE		SANDSTONE		SLATE AND SHALE		TOTAL	
	S. Tons	$	S. Tons	$	S. Tons	$	S. Tons	$	S. Tons	$	S. Tons	$
Building stone												
Rough	7,754	134,458	45,851	531,672	-	-	11,570	127,932	-	-	65,175	794,062
Dressed	26,719	3,031,850	37,095	1,834,753	6	476	870	75,908	-	-	64,690	4,942,987
Total	34,473	3,166,308	82,946	2,366,425	6	476	12,440	203,840	-	-	129,865	5,737,049
Monumental and ornamental												
Rough	8,791	241,783	3	6	-	-	394	3,940	-	-	9,188	245,729
Dressed	7,547	970,381	-	-	310	25,394	-	-	-	-	7,857	995,775
Total	16,338	1,212,164	3	6	310	25,394	394	3,940	-	-	17,045	1,241,504
Flagstone	580	5,675	2,821	16,856	-	-	23,630	398,485	429	18,685	27,460	439,701
Curbstone	-	-	-	-	-	-	112	5,618	-	-	112	5,618
Paving blocks	20	300	-	-	-	-	-	-	-	-	20	300
Total	600	5,975	2,821	16,856	-	-	23,742	404,103	429	18,685	27,592	445,619
Grand total	51,411	4,384,447	85,770	2,383,287	316	25,870	36,576	611,883	429	18,685	174,502	7,424,172

PRODUCTION OF BUILDING AND ORNAMENTAL STONE, BY PROVINCE, 1958

	GRANITE		LIMESTONE		MARBLE		SANDSTONE		SLATE AND SHALE		TOTAL	
	S. Tons	$	S. Tons	$	S. Tons	$	S. Tons	$	S. Tons	$	S. Tons	$
Nova Scotia	1,332	179,805	-	-	-	-	1,497	33,343	-	-	2,829	213,148
New Brunswick	2,210	98,728	882	2,646	-	-	370	42,300	-	-	3,462	143,674
Quebec	46,632	4,022,740	20,381	1,115,338	316	24,494	451	1,446	-	-	67,780	5,164,018
Ontario	2,277	72,306	59,511	818,578	-	-	26,211	534,908	-	-	87,999	1,425,792
Manitoba	-	-	8,387	460,253	-	-	-	-	-	-	8,387	460,253
Alberta	-	-	-	-	-	-	63	346	103	2,560	166	2,906
British Columbia	1,790	31,500	-	-	-	-	-	-	351	29,835	2,141	61,335
Total	54,241	4,405,079	89,161	2,396,815	316	24,494	28,392	612,343	454	32,395	172,764	7,471,126

IMPORTS AND EXPORTS OF BUILDING, ORNAMENTAL AND MONUMENTAL STONE

	1958		1957	
	Quantity	$	Quantity	$
Imports				
Granite				
Rough, not hammered or chiselled		386,050		299,681
Sawn		81,109		107,923
Manufactures		277,412		349,932
Total		744,571		757,536
Marble				
Rough, not hammered or chiselled		51,438		79,092
Sawn or sand-rubbed, not polished		653,660		600,753
Not further manufactured than sawn for the manufacture of tombstones		40,688		38,511
Ornamental or decorative		170,628		255,228
All other marble manufactures		164,349		92,524
Total		1,080,763		1,066,108
Slate				
Roofing (squares)	783	22,461	1,475	32,766
Manufactures		105,316		42,157
Total		127,777		74,923
Building stone other than marble and granite (short tons)	31,161	660,485	36,029	720,185
Total, building, ornamental and monumental stone		2,613,596		2,618,752
Exports				
Granite and marble, unwrought (short tons)	6,827	108,049	7,081	126,694
Freestone, limestone and other building stone, unwrought (short tons)	391	14,042	585	21,622
Stone of all kinds, dressed		52,010		29,597
Total		174,101		177,913



BUILDING AND ORNAMENTAL STONE IN CANADA
VALUE OF PRODUCTION
VOLUME OF PRODUCTION
THOUSANDS OF SHORT TONS
MILLIONS OF DOLLARS
360
330
300
270
240
210
180
150
120
90
60
30
0
12
11
10
9
8
7
6
5
4
3
2
1
0
'47
1950
1955
1960
SOURCE: D.B.S.
MINERAL RESOURCES DIVISION, DEPT. M.T.S.
R.A.

General Requirements

In prospecting for raw materials, the first requirement is that blocks of sufficient size be obtainable. In sedimentary rocks (limestone, sandstone and marble), the beds must be thick, i.e., at least 18 inches for marble and 2 feet for building stone, and be free from structural defects so as to allow the removal of sound durable blocks 5 feet or more in length. In granites, the spacing of joints is likely to be critical, and here again other planes of weakness or disfiguring features must be widely enough spaced to obtain the required size of mill block.

For building purposes all types of stone must have an even texture, be of uniform composition and have a pleasing and lasting colour. Iron is at all times an objectionable constituent because it may cause undesirable stains. For massive structures a coarse-textured stone may be used with pleasing effect, although the finer-textured stones are also used. Building stone must be durable to withstand weathering - particularly the freezing and thawing conditions of Canadian climates. This is particularly true of the more porous limestones and sandstones.

For ornamental stone used in polished form in base courses of buildings, pillars and monuments, specifications as to texture, colour and freedom from flaws are more rigid. All cracks, knots, hair lines and iron spots should be absent. The stone must be capable of taking and retaining a high polish, and there must be a good contrast between the polished and hammered or sand-blasted surfaces.

Building and Ornamental Stones, by Types

Granite*

Vast resources of granite suitable for building and monumental stone are produced in many areas in Canada. These granites, composed of many different igneous-rock types and available in a wide variety of colours and textures, are successfully competing with imported stones. Deposits of other equally fine stones located in remote areas cannot be produced economically.

The 1958 value of Canadian granite production remained about the same, increasing slightly less than half of 1 per cent over that of 1957. The 5.5-per-cent increase in volume accompanying this levelling-off in value is in sharp contrast to the record increase of 40 per cent in value for 1957 compared with 1956. The significant increase during the latter period was due partly to an increase in the volume of stone quarried and, more specifically, to an appreciable increase in the volume of dressed-stone products, which command the highest value.

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*The term 'granite' used in the stone industry applies to practically all rocks of igneous origin. The term 'black granite' is used to describe dark-coloured rocks of igneous origin, such as anorthosites, essexites, diabases, etc.

Nova Scotia

Grey granites are quarried and dressed in the Middleton-Nictaux and Shelburne areas. A small amount of black diorite is also quarried in the Shelburne area. Sporadic quarrying for medium- to coarse-grained, grey granite is carried on in the Halifax area. A large percentage of the Nova Scotian stone is used for monumental products.

New Brunswick

A coarse-grained, grey-brown granite is produced from the 'ledge' east of St. Stephen. A light-pink, medium-grained granite is quarried in the Antinouri Lake district, and grey, pink-grey and blue-grey granites ranging from fine to medium grain are quarried in the Hampstead (Spoon Island) district. No activity in the coarse-grained St. George red-, Bocabec black- or Bathurst pink-brown-grey-granite quarries was reported during the year.

Quebec

Quebec is the leading granite-producing province. Many quarries and dressing plants are located south of the St. Lawrence River. Most of the stone quarried in this area is fine- to medium-grained, grey granite. Quarries are located in the Stanstead, Stanhope, Scotstown, St. Samuel-St. Sebastien and St. Gerard areas. These granites are suitable for use either as building or as monumental stone. Dark grey-blue essexite, both fine- and medium-grained, is quarried on Mount St. Gregoire, and a coarse-grained, dark-green nordmarkite is quarried in the Lake Megantic mountain area. A fine-grained, green granite is also produced in the St. Gerard area.

Numerous quarries north of the St. Lawrence River produce a variety of coloured granites. Black anorthosite and red and brown granites are produced in the Lake St. John region; blue-grey, rose-grey, deeper pink-grey and a black-and-white gneissic granite are produced in the Rivière-à-Pierre district; a pink granite comes from the Guenette area; pink-red granite is produced in the St. Alban area; a banded gneiss comes from the St. Raymond area; brown-red to green-brown granites with darker varieties are quarried in the Grenville area; and pink and black granites are sporadically quarried in the Rouyn area.

Ontario

Production of granite in Ontario is limited to a few widely separated localities. Rough building and monumental stone is produced from a pink granite in the Vermilion Bay area of the Kenora region. A grey granite with pink-blue colouring is found in the Parry Sound area, and red, coarse-grained granite is produced in the Lyndhurst area. There is sporadic quarrying in a black-granite deposit in River Valley. Both pink stone and black stone are being investigated in the Kapuskasing area.

British Columbia

Practically all stone used for building purposes on the west coast is quarried on Nelson and Haddington islands. Light-grey and blue-grey, even-grained granites are produced on Nelson Island. Both are suitable for building and monumental stone. A fine-grained, bluish-grey and buff andesite deposit on Haddington Island supplies a popular stone used for building construction on the west coast.

Limestone

Canadian limestones suitable for building and ornamental use are recognized for their qualities of hardness, texture and colour. Limestone, is more readily worked than granite and is produced in many dimensional forms with many different types of surfaces. Both large and small forms are dressed to rectangular and curved shapes for use as wall facings, sills, lintels, blocks, columns, etc. The stone is often carved in ornate designs and is occasionally used as monumental stone. Various finishes are obtained by the use of hammering and pebbling tools, rock-face effects by chiselling and smoother finishes by sawing, hone-polishing and buffing. Most Canadian limestones can be polished successfully, and particularly pleasing effects are obtained on surfaces containing fossil outlines.

Quebec

A fine-quality building stone is quarried in the St-Marc-des-Carrières area, where several companies have quarries and dressing plants. The stone, a brownish-grey, fine- to medium-grained, fossiliferous, high-calcium limestone, is used extensively for building construction. Several companies produce limestone for use as building stone in the Montreal area, particularly on the island north of the city.

Ontario

A large quantity of limestone is produced from the Lockport formation in the Queenston area for building stone. It is a silver-grey to variegated buff-and-grey, fine- to medium-grained, dolomitic limestone. Large blocks of light-buff and grey limestone are produced in the Wiarton area.

Manitoba

Quarries operating in the Tyndall area, a few miles north of Winnipeg, are producing a popular and distinctive mottled, buff-brown to brown-grey, dolomitic limestone. Both rough- and sawn-surfaced limestones have been used effectively in building construction in Ontario and western Canada.

New Brunswick

A small amount of rough building stone is quarried in the Saint John area.

Sandstone

Much of the sandstone used as building stone in the past few years has been produced in two areas. Many small quarry operators depleted their suitable stone or found it difficult to operate in the competitive field of precast units and simulated-stone products. The smaller operators still active in the industry buy most of their stone from the larger quarry operator and supplement it with small, sporadic production from their own quarries.

One of the two larger quarries can produce massive blocks suitable for any dimension. The other, while specializing in a stone that is suitable for splitting into slabs for use as flagstone and ashlar units, is capable of producing a larger block.

Nova Scotia

Virtually all the sandstone produced comes from the Wallace area. This drab, olive-to-buff, massive-textured stone is suitable for ornamental dressing. It is effectively used in many fine buildings throughout eastern Canada. A small amount of fine-grained, dark-brown sandstone is produced in the Antigonish area.

Ontario

Numerous quarries are located along the length of the Caledon Hills in the Georgetown-Orangeville area, where outcrops of fine-grained, flat-lying beds of the Medina formation are being worked. A medium-grained, buff to cream-coloured stone of the Nepean formation is quarried at Bell's Corners, near Ottawa. Highly coloured, medium-grained, banded and mottled sandstone is produced from deposits north of Kingston.

New Brunswick

A fine- to medium-grained, olive-green sandstone is produced in the Shediac area.

Quebec

A small quantity of rough and dressed, grey sandstone is quarried in the Montebello area.

Marble

Quebec was the only province producing marble block suitable for use as building, ornamental or monumental stone. Many marble quarries in Ontario that were active years ago are now producing crushed-marble chips for terrazzo and artificial-stone manufacture.

Quebec

Black, white-green and grey varieties of marble block are produced near Philipsburg, and white-grey stone is quarried in the western part of the Stukely area.

SULPHUR

C. M. Bartley

Although the only native sulphur discovered in Canada consists of minor amounts in oil-well cores and small occurrences associated with gypsum in the Arctic Islands, Canada in 1958 ranked third in production, second in consumption, and first in per capita consumption of world sulphur. Until recent years Canadian sulphur was produced entirely from base-metal sulphides, but since 1952 there has been a growing production from natural gas. Because of technical advances, the discovery of very large amounts of 'sour' gas in western Canada, and some gradual changes in the economics of world-sulphur production and trade, Canada is expected to become one of the major sulphur producers.

At present world sulphur is plentiful, and the large volumes becoming available in Alberta may not find markets until transportation rates are stabilized on a large-tonnage basis and marketing problems are solved.

The production of sulphur and sulphur compounds from by-product pyrite and pyrrhotite and from smelter and oil-refinery gases continued, with some adjustment in production rates to meet changing conditions. At one plant in Ontario, elemental sulphur was obtained by the electrolysis of nickel-sulphide matte, and it has been reported that a similar unit is planned for a plant in Manitoba. At Copper Cliff, a pilot-plant test was conducted with the object of producing elemental sulphur from roaster gases.

Both capacity and the actual production of elemental sulphur from natural gas increased substantially in western Canada during 1958: seven plants were in operation, two were under construction and several more were being planned. Temporary transportation and marketing difficulties kept shipments down; for this reason the year's official production figures, which are based on shipments, are low. Exploration drilling continued, and indicated reserves of gas and sulphur - particularly in the Foothills region of Alberta and British Columbia - have now increased to volumes which are attracting international attention.

The interest in sulphur and the technological advances of recent years are reflected in the production figures. In 1951 Canada produced about 372,000 short tons of sulphur equivalent, all of it from pyrite or smelter gas. In 1958, 847,859 short tons of sulphur were produced in various forms, and of this amount 94,377 tons were elemental sulphur produced in five provinces by four processes.

(text continued on page 443)

Sulphur - Production and Trade

	1958		1957	
	Short Tons	$	Short Tons	$
Production[1]				
Pyrite and pyrrhotite				
Gross weight	1,191,731	4,248,668	1,166,416	4,808,228
Sulphur content	512,427		515,096	
Sulphur in smelter gases[2].	241,055	2,361,252	235,123	2,322,067
Elemental sulphur[3]	94,377	1,872,832	100,706	
Total sulphur	847,959		850,925	
Imports				
Brimstone				
United States	374,201	8,296,929	416,930	9,752,368
Mexico..................	1,130	27,262	-	-
Total....................	375,331	8,324,191	416,930	9,752,368
Exports				
Pyrite				
United States		1,203,705		1,200,454
United Kingdom		359,510		761,127
Netherlands		316,036		849,524
Taiwan..................		-		41,648
Total....................		1,879,251		2,852,753
Other sulphur				
Alaska	5,040	108,600	7,224	170,925
United States	2,299	52,766	4,956	117,244
India....................	269	9,600	184	4,873
Total....................	7,608	170,966	12,364	293,042

(1) Producers' shipments of by-product pyrite and pyrrhotite from the processing of metallic-sulphide ores. Included are quantities used by companies to produce sulphur dioxide and quantities used to produce iron sinter.

(2) Includes sulphur in acid made from roasting zinc-sulphide concentrates at Arvida, Quebec.

(3) 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.

Sulphur - Production, Trade and Consumption, 1948-58
(short tons)

	Production				Imports	Exports		Consumption
	In Pyrites Shipped (1)	In Smelter Gases (2)	Elemental Sulphur (3)	Total	Brimstone	In Pyrite (4)	Other Sulphur (5)	Elemental Sulphur (6)
1948	87,126	142,337	-	229,463	354,622	50,243	-	328,143
1949	117,581	144,290	-	261,871	280,557	90,553	-	328,302
1950	150,487	150,685	-	301,172	390,333	111,652	65	372,347
1951	215,363	156,427	-	371,790	395,928	178,039	44	415,335
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

(1) Sulphur content of pyrite and pyrrhotite shipped by producers. Figures for 1952-55 include sulphur content of acid made by roasting zinc-sulphide concentrate at Arvida, Quebec.

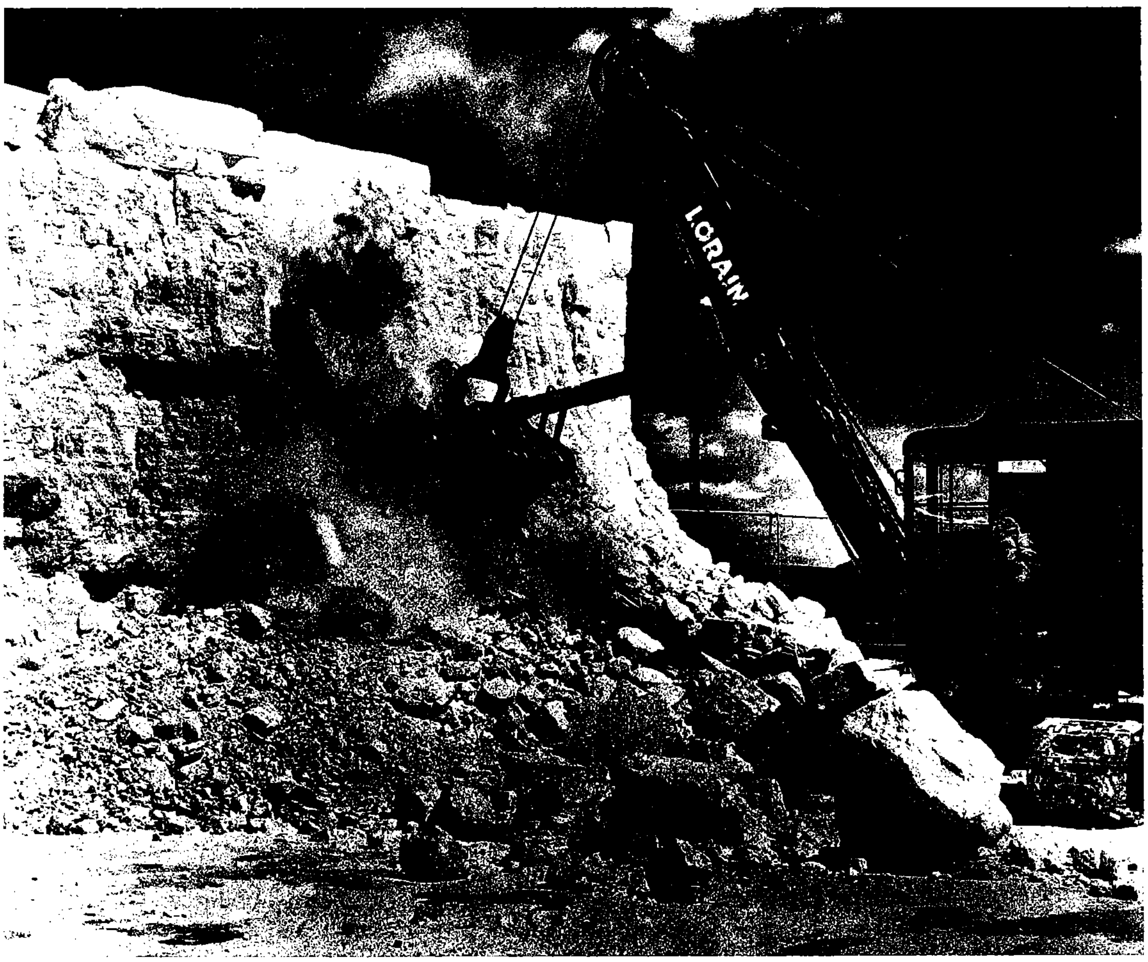
(2) Sulphur in liquid sulphur dioxide and sulphuric acid from the smelting of metal-sulphide ores. Figures for 1956 and years following include sulphur in acid made from roasting zinc-sulphide concentrate at Arvida.

(3) Elemental sulphur produced from natural gas: 1952 to 1956, production; from 1957 on, sales. Figures from 1957 include some elemental sulphur derived from treatment of nickel-copper sulphide matte at Port Colborne, Ontario.

(4) Exports of pyrite, sulphur content. Quantities for 1955 and years following not available; values only published.

(5) Exports of sulphur produced from natural gas and other sources.

(6) Consumption of elemental sulphur by industries. Coverage is incomplete.



Courtesy of Shell Oil Company of Canada Limited
Shell Oil 2867

Removing sulphur from the stockpile at the Jumping Pound gas-processing and sulphur-manufacturing plant.

Production and Trade

In Canada sulphur is produced in large and ever-increasing volume from various sources by several methods and in several forms. The rapid increases in the production of elemental sulphur from sour gas in western Canada have attracted much attention in the last few years, but sulphur in other forms has been produced in Canada for the past 90 years.

Canadian pyrite was first used to produce sulphuric acid in 1869, in a small plant at Brockville, Ontario. The pyrite industry expanded until after World War I but declined when United States Frasch sulphur gained control of the market. The sulphur shortage during the Korean War (1951-52) revived interest in pyrite, and production from this source increased for a few years. The high purity, low cost and large volume of Frasch sulphur, however, have made it the dominant factor in the sulphur industry, although pyrite has been produced and used in a few operations where favourable location or cost made it competitive with elemental sulphur.

While United States Frasch sulphur remains by far the largest source, sulphur from other countries and some other sources has been offering the traditional producers serious competition during the past few years. (In these cases the ability to compete is based on low costs, or favourable location with respect to markets.) Pyrite has been able to compete with United States Frasch sulphur in certain areas and, similarly, Mexican Frasch sulphur and sulphur recovered from sour natural gas in France and Canada can compete successfully in some areas. The new, low-cost sources have added to the volume of sulphur available and, in the competition for markets, have depressed the price.

The new sources are low in cost because they are by-products, because they are found in low-wage countries or because their operating conditions are more favourable than the Frasch operation in the United States. Most future Canadian sulphur production will be derived from the processing of western Canada's sour natural gas, very large reserves of which have been found. Since the contained sulphur and the liquid-petroleum fractions must be removed before the gas is distributed as fuel, the cost of producing them can be charged, in large measure, to the production of gas. The new sources have neither the volume nor the low cost necessary for control of the sulphur market, but in some areas they will displace the traditional suppliers.

Production and trade in sulphur are now adjusting to pressures from new sources. As the sulphur industry regains stability, Canada and other new producers will be relatively more important as sources of supply.

Pyrite and Pyrrhotite

Concentrates of pyrite and pyrrhotite, for many years the chief source of sulphur in Canada, are produced at numerous base-metal-mining plants from British Columbia to Quebec and could be produced in New Brunswick and

Consumption of Elemental Sulphur
(short tons)

	1958	1957
Pulp and paper	273,861	284,561
Heavy chemicals	229,170	189,911
Rubber goods	2,424	2,687
Medicinal uses	21	43
Adhesives	61	77
Starch	450	43
Fruit and vegetable preparations	3	6
Sugar-refining	135	144
Petroleum-refining	225	225
Steel and iron	58	83
Explosives	5,374	3,161
Miscellaneous chemicals	3,265	-
Total	515,047	480,941

Sulphur from Natural Gas

It has long been known that hydrogen sulphide (H_2S) occurs in natural gas and that various sulphur compounds occur in petroleum. Such gases and oils were not desirable as fuels, since hydrogen sulphide is poisonous and the sulphur compounds are corrosive. The sour gases were avoided if possible. When they were used, the hydrogen sulphide was flared off to the atmosphere before the gas was distributed to users as fuel. Elemental sulphur was first recovered from natural gas in the United States in 1944. The main purpose was to remove a toxic compound from the fuel. It is only in recent years that natural gas has become an important source of sulphur.

The position of sulphur in Canada has become considerably more significant in the past two years as a result of major wet- and sour-gas discoveries, particularly in the Foothills region of Alberta and British Columbia. Gas fields vary widely both in indicated reserves and in their content of H_2S and liquid petroleums, but it has been estimated that natural gas reserves are of the order of 27 trillion* cubic feet, of which about 40 per cent is sour gas containing about 82 million tons of sulphur. Very large amounts of gas have been found and are being used in the United States, but these are largely 'sweet' gases, do not contain appreciable amounts of sulphur and are not in competition for sulphur markets.

*Trillion = 1 million million.

In general, both natural gas and sulphur are at present essential to Canadian industry: demands for power and fuel are increasing, and large amounts of sulphur are being imported. The availability of gas and sulphur does not mean, however, that they will be produced immediately. The production of sulphur is directly proportional to the amount of gas that can be processed and sold. The Canadian demand for natural gas is not yet large enough to result in the production of large tonnages of sulphur (at the estimated factor of 5 long tons of sulphur per million cubic feet of field gas); but, as Canadian consumption increases and gas is exported on a large scale to the northern and western United States as planned, sulphur production will increase substantially. It is expected that, in addition to small local markets in western Canada, Canadian sulphur will find markets in the northern and northwestern United States and eastern Canada and by overseas export from the west coast.

Producing Companies

During 1958 elemental sulphur was produced from natural gas at five plants in Alberta, one in British Columbia and one in Saskatchewan. The total capacity of these plants is 1,200 tons a day, but some did not operate until the year was well begun and all operated below their maximum. The production figures consequently showed little change from those of 1957.

Recovery of Sulphur at Oil Refineries

Laurentide Chemicals and Sulphur Ltd., at Montreal East, recovers elemental sulphur from several oil-refinery waste gases. The hydrogen-sulphide content of source gases varies from 2 to 12 per cent. The 23,000 tons of sulphur produced by this company in 1958 came from foreign crude oils and therefore are not included in the production table.

A $2 million hydro treater has been installed at the Montreal East refinery of Texaco Canada Limited to remove from 2 to 15 tons of sulphur a day from distillate. The sulphur will be marketed by Laurentide Chemicals and Sulphur Ltd.

World Review

Frasch sulphur operations in the United States and Mexico still supply the bulk of the world's sulphur needs and will continue to do so for some time. From these operations the United States still provides most of the global supply, but the United Stated share of world production is shrinking. Sulphur recovered from new Frasch operations in Mexico, from natural gas in western Canada and France and other sources, and at oil refineries throughout the world appears to be fully competitive and is capturing some markets.

Sulphur Plants

Company	Location	Approximate Percentage H_2S	Capacity in Short Tons per Day 1958	Total Planned
Producing				
British American Oil Company Limited, The	Pincher Creek, Alta.	9	675	900
Jefferson Lake Petro-chemical	Fort St. John, B. C.	3	300	425
Shell Oil Company of Canada Limited	Jumping Pound, Alta.	3	80	80
Royalite Oil Company Limited	Turner Valley, Alta.	4	30	30
Imperial Oil Limited	Redwater, Alta.	3 to 6	10	10
British American Oil Company Limited, The	Nevis, Alta.	?	100	100
Steelman Gas Limited	Steelman, Sask.	1	7	7
			1,202	1,552
Under construction				
Texas Gulf Sulphur Company	Okotoks, Alta.	33		370
Canadian Fina Oil Co. Limited	Windfall, Alta.	18		100
				470
Proposed for construction when natural-gas exports are approved				
Jefferson Lake Petro-chemicals of Canada Ltd.	East Calgary, Alta.	35		890
Jefferson Lake Petro-chemicals of Canada Ltd.	Savanna Creek, Alta.	14		350
Standard Oil of California	Homeglen-Rimbey, Alta.	?		190
Standard Oil of California or British American (?)	Dick Lake, Alta.	1		150
Standard Oil of California	Nevis, Alta.	?		65
Not known at present	Berland River, Alta.	16		500
Shell Oil Company of Canada Limited	Waterton Park, Alta.	?		-
				2,145

During the sulphur shortage of 1951-53, there was active exploration for new deposits of Frasch sulphur, and considerable research and development were carried out on the production of sulphur from natural gases, oils and sulphides. All these efforts were more or less successful. As demand returned to normal after the Korean War, and output from Frasch suppliers and the new sources of recovered sulphur increased, supply came into balance with demand and then continued to rise at a faster rate than world sulphur consumption. As a result, world sulphur supplies are ample and aggressive competition from some of the new sources has forced sulphur prices down to low levels.

The new sources are competitive for various reasons. Unlike the more expensive offshore mines being developed in the United States, Mexican Frasch operations are land-based. In addition, Mexican labour costs are much lower than those in the United States. Sulphur produced from sour natural gases in France and Canada is a by-product of the fuel values in the gas and can therefore be assigned a very low production cost. Although the effective world price of sulphur is controlled not by the cheapest production but by the source which can satisfy the final demand, sulphur markets are regional to the extent that freight costs are an inescapable part of what the consumer must pay. This is illustrated by the fact that sulphur recovered from the Lacq natural-gas field in France has a profit margin in European markets equivalent to the transportation cost from North America to Europe, which is estimated to be \$5 to \$8 a ton.

In Mexico sulphur domes discovered in 1952 are now producing up to 1,200,000 long tons a year, and this output is being marketed in competition with United States Frasch production.

The Lacq area of France first produced sulphur from sour gas in 1957, and in 1958 some 350,000 tons were recovered. Production from this source is expected to reach 1,400,000 tons by 1960 and to capture almost all the European market. In 1958 western Europe consumed about 1,600,000 tons of sulphur. The pyrite-sulphur industry in Europe is efficient and strong, and since the iron and base metals being recovered find ready markets, it is probable that this industry will retain many of its markets and that Lacq sulphur will displace the sulphur now imported from North America.

Increasing amounts of sulphur are being recovered from refinery-waste products throughout the world. Although individual production is usually small, the total is reaching significant proportions, particularly in the United States and western Europe.

While the immediate outlook for sulphur is clouded by overproduction, depressed prices and changes in trade patterns, the long-term outlook shows consistent expansion in demand. Sulphur-industry spokesmen estimate that world consumption, which amounted to 15 million tons in 1957, will reach 24 million tons by 1967. Their forecast is based on the fact that, over the past 50 years, the production and consumption of sulphur have increased uniformly at a rate of about 5 per cent per annum. An abrupt upswing in the demand for sulphuric acid for uranium-processing and an expected major rise in its use for fertilizer production will result in further increases.

Sulphuric Acid

The production of sulphuric acid increased during 1958 to 1,495,000 short tons. From 1957 to 1958, owing to interruptions in Canadian production caused by a strike, imports increased from 1,046 to 39,345 short tons. Exports, at 23,252 tons, were 6,300 tons lower than in 1957.

In Canada the largest consumers of sulphuric acid are the fertilizer and uranium industries. At the end of 1958, the uranium industry in Ontario was using about 1,500 tons of sulphuric acid a day.

Sulphuric Acid - Production, Trade and Apparent Consumption
(short tons of 100% acid)

	Production	Imports	Exports	Apparent Consumption
1948	679,448	59	29,478	650,029
1949	707,717	24	17,336	690,405
1950	756,110	332	44,417	712,025
1951	820,867	1,162	57,000	765,029
1952	816,270	85	33,135	783,220
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

Consumption of Sulphuric Acid*
(short tons of 100% acid)

	1957	1956
Fertilizers	668,900	563,400
Acids, alkalis and salts	177,900	188,700
Nonferrous smelters and refiners	29,300	25,600
Coke and gas	28,000	35,600
Petroleum-refining	11,100	11,000
Leather-tanning	2,100	2,300
Iron and steel	31,900	39,000
Electrical apparatus	8,400	6,800
Plastics	16,600	17,000
Soap and washing compounds	13,700	12,200
Sugar-refining	300	300
Pulp and paper	12,400	9,000
Vegetable oils	100	100
Adhesives	900	400
Miscellaneous	85,500	83,400
Total	1,087,100	994,800

*Available data.

Uses

Sulphur is consumed in some form and at some stage in the manufacture of almost everything that is used in an industrial country and is one of the commodities essential to industrial growth. It is usually consumed in sulphuric acid, but in Canada large amounts are used in other forms by the pulp-and-paper industry. Other important consumers are the fertilizer, chemical, uranium and steel industries.

Prices

The Oil, Paint and Drug Reporter of December 29, 1958, quotes the following United States prices per long ton:

Crude, domestic, bright, bulk f.o.b. mines	$23.50
United States and Canada, f.o.b. vessels, Gulf ports	$25.00
Domestic, dark	$ 1.00 lower
Crude, bulk, imported Mexican, filtered, f.o.b. vessels, Coatzacoalcos	$24.00
Pyrite, Canadian, 48-50% sulphur, f.o.b. mines	$ 5.00 to $6.00

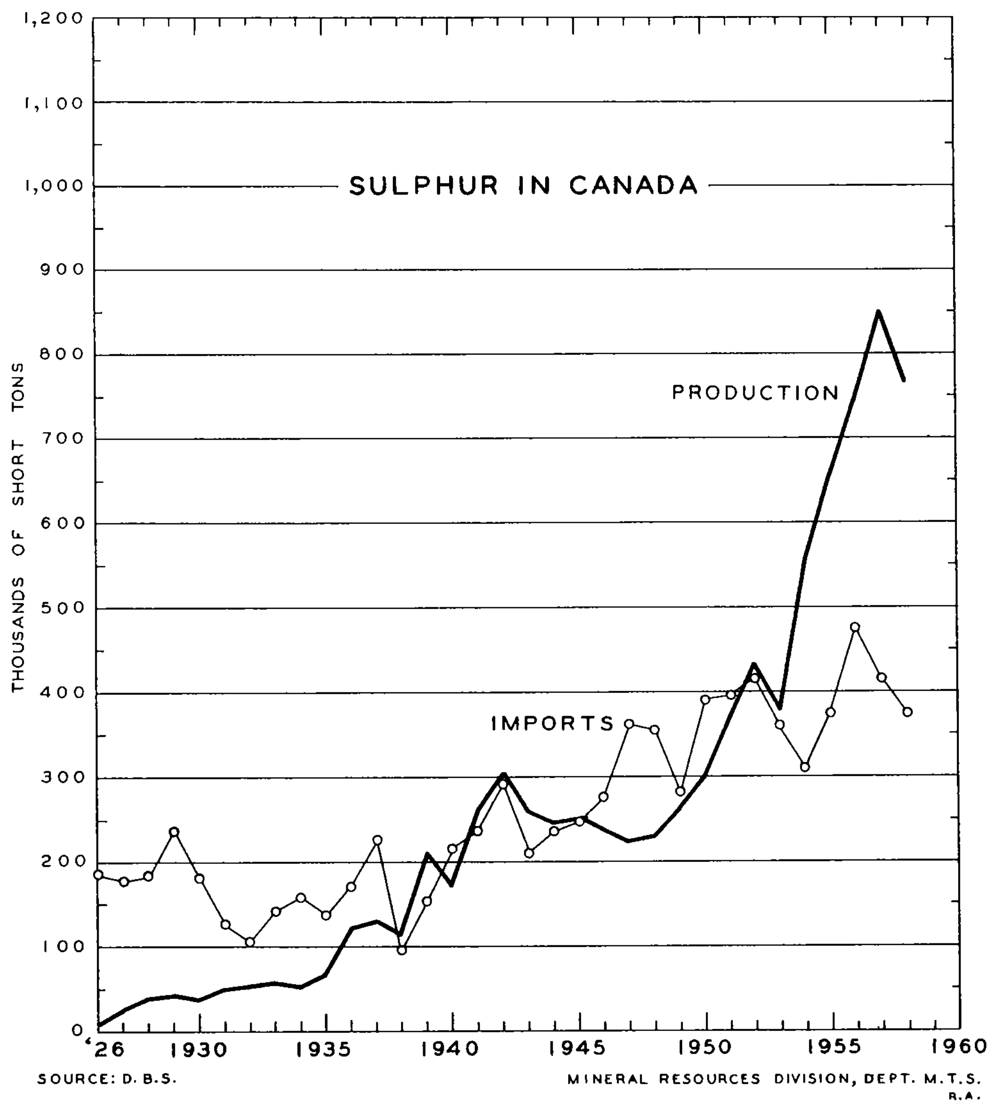
Tariffs

Canada

Sulphur	free

United States

Sulphur and sulphur ore including pyrite containing more than 25% sulphur	"


SULPHUR IN CANADA
1,200
1,100
1,000
900
800
700
600
500
400
300
200
100
0
THOUSANDS OF SHORT TONS
PRODUCTION
IMPORTS
'26
1930
1935
1940
1945
1950
1955
1960
SOURCE: D.B.S.
MINERAL RESOURCES DIVISION, DEPT. M.T.S.
R.A.

TALC AND SOAPSTONE; PYROPHYLLITE

J.E. Reeves

The production of talc, soapstone and pyrophyllite in 1958 was slightly higher in both volume and value. The output of pyrophyllite in Newfoundland increased considerably, and shipments of talc and soapstone from Quebec were about 8 per cent higher, but shipments of Ontario talc declined.

Most of Canada's requirements in higher-quality grades of ground talc at relatively high unit prices - for consumption by the paint, ceramic, cosmetic and pharmaceutical industries - are imported. In 1958, the import volume, the highest on record, was 11 per cent higher than in the previous year. The United States, which is the main source of these grades, accounted for the whole increase. The relatively small amount of prime-quality talc from Italy is preferred for many cosmetic and pharmaceutical preparations.

Exports of talc in 1958 decreased for the third consecutive year. There has been a general decline since 1941, when almost 20,000 tons were exported.

Producing Companies

Quebec

Baker Talc Limited, 215 St. James Street West, Montreal, operates the Van Reet mine near the town of South Bolton in Brome county and produces several lower-priced grades of ground talc at a mill near Highwater, about 10 miles to the south. A program, started in 1956, to enlarge and improve the mill was continued in 1958. Included in this was the installation of bulk-loading facilities for roofing-grade talc.

Broughton Soapstone and Quarry Company Limited produces some lower-priced grades of ground talc, metalworkers' crayons of soapstone, and a small quantity of refractory soapstone blocks at a mill and plant near Broughton Station in Beauce county. Talc was mined from a deposit about 6 miles northwest of the mill, and soapstone was quarried from a deposit less than 2 miles southwest of it.

Production, Trade and Consumption

	1958		1957	
	Short Tons	$	Short Tons	$
Production (shipments)				
Quebec[1]	19,226	194,074	17,803	220,330
Ontario[2]	8,725	125,511	11,236	160,015
Newfoundland[3]	7,454	109,551	5,686	47,328
Total	35,405	429,136	34,725	427,673
Imports[4]				
United States	15,179	525,533	13,228	462,709
Italy	1,414	59,133	1,699	72,372
France	-	-	22	1,108
Total	16,593	584,666	14,949	536,189
Exports[5]				
United States	1,771	22,366	2,243	28,381
Ecuador	62	807	92	1,224
Nicaragua	50	625	18	243
Other countries	48	915	-	-
Total	1,931	24,713	2,353	29,848

	1958	1957
Consumption[6] (available data)		
Roofing	10,540	9,564
Paints	8,638	6,914
Ceramic products	5,384	5,247
Paper	254	1,064
Rubber	1,879	2,047
Toilet preparations	1,582	1,607
Pharmaceutical preparations	376	393
Soaps and cleaning preparations	119	109
Electrical apparatus	204	104
Polishes and dressings	45	44
Miscellaneous chemicals (including insecticides)	4,216	3,092
Total	33,237	30,185

(1) Ground talc, soapstone blocks and crayons.
(2) Ground talc.
(3) Pyrophyllite.
(4) Ground talc.
(5) Excluding pyrophyllite.
(6) Ground talc.

Talc and Soapstone - Production, Trade and Consumption, 1948-58

(short tons)

	Production*	Imports	Exports	Consumption
1948	28,780	7,798	5,052	26,782
1949	26,922	7,269	4,222	29,747
1950	32,604	8,974	4,467	32,778
1951	24,846	9,283	3,743	29,306
1952	25,032	8,749	3,435	30,696
1953	27,408	11,867	2,937	31,850
1954	28,143	12,392	3,609	33,073
1955	27,160	11,382	4,428	31,357
1956	27,947	16,268	2,613	31,479
1957	29,039	14,949	2,353	30,185
1958	27,951	16,593	1,931	33,237

*Producers' shipments (including minor amounts of pyrophyllite shipped prior to 1956).

Ontario

Canada Talc Industries Limited, at Madoc, Hastings county, operates the Conley and Henderson mines and produces a variety of grades of ground talc. The latter mine yields an especially high-grade white product. Development of a new level at the Conley mine was begun in 1958.

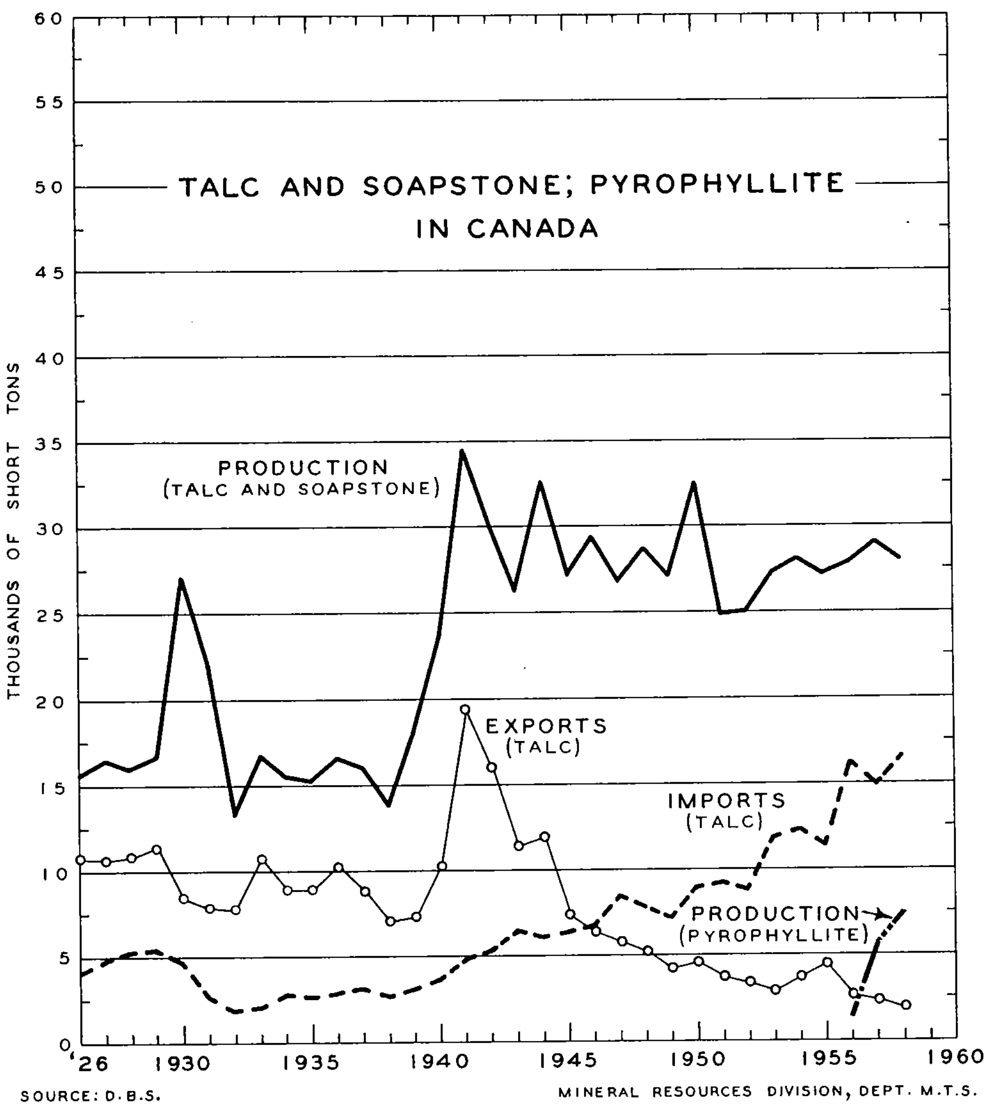
Newfoundland

Newfoundland Minerals Limited, Box 2043, St. John's, commenced operations in June 1956 and has continued development of the pyrophyllite deposits near Manuels, about 12 miles southwest of St. John's. In 1958 it began to install a new crushing and screening plant with a capacity of up to 300 tons a day. All production is exported to the parent company in the United States.

Occurrences

Talc and soapstone occur in many localities in Quebec, Ontario and British Columbia.

There are several other deposits of talc in the vicinity of the Van Reet mine in southern Quebec, a number of which were mined extensively for feed for the mill at Highwater before the Van Reet mine became the sole source. In the Thetford Mines area there are numerous deposits from which soapstone was quarried when blocks of it were much more widely used as refractory material.



Deposits of talc occur in many places in southeastern Ontario, and soapstone is not uncommon in the Kenora district. Refractory soapstone blocks were produced in Ontario on a limited basis many years ago, and minor amounts of talc have been obtained from several places, but for a considerable period production in this province has been confined to Madoc.

Many deposits of talc are known to occur in British Columbia and there has been a little mining there, but the smallness of the markets in the West has not encouraged the development of a talc-mining industry.

Pyrophyllite occurs in Newfoundland near Manuels and in British Columbia near Princeton and Semlin in the south-central part of the province and at Kyuquot Sound in the northwestern part of Vancouver Island. The deposits in Newfoundland appear to be the largest and have received intermittent attention for many years.

Technology

The mineral talc is a hydrous magnesium silicate, but most commercial talcs contain an appreciable amount of other minerals including serpentine, chlorite, magnesite, tremolite and dolomite. The extent to which these associated minerals should be restricted depends on the particular use. The talc deposits in southern Quebec resulted from the alteration of serpentine rock, contain some unaltered serpentine and iron-bearing minerals such as chlorite, have a variable carbonate content and yield ground products which are somewhat off-colour. These products are used where colour specifications are not exacting. The Madoc deposits represent altered white dolomite and consist principally of various proportions of talc, tremolite and dolomite. They are low in iron and yield ground products of prime white colour, but because of a variable carbonate content the products are limited somewhat in their range of uses.

Soapstone is essentially a massive, relatively impure talcose rock, from which blocks and crayons can be readily sawn. Some ground soapstone is also used, particularly as a low-carbonate material.

Pyrophyllite is physically very similar to talc but contains aluminum instead of magnesium. It also is an alteration product, but it has been derived from siliceous rocks and is often accompanied by sericite and quartz. The colour is entirely acceptable, but the impurities must be limited as in the case of talc.

Uses and Specifications

The roofing, paint, ceramic, insecticide, asphalt-pipeline-enamel and rubber industries account for much of Canada's consumption of ground talc. In 1957 there was a notable increase in the amount used in the manufacture of paper.

High-quality talcs are used as fillers in the paint, ceramic and paper industries. Colour, particle shape, packing index and oil absorption are the principal factors in paint use. The ceramic trade demands prime white colour, and the paper industry talc of high brightness, high retention in the pulp, low abrasiveness and freedom from chemically active substances. Talc of high purity is demanded for the cosmetic and pharmaceutical trades.

Lower-grade talc is used as a dusting agent for asphalt roofing, a diluent for some dry insecticides, a filler and dusting agent in rubber products, and a polishing agent for wire nails, rice, peanuts and other commodities.

Neither the colour nor the presence of the usual impurities is of importance. For asphalt enamels the colour is not significant, but a low carbonate content is of first importance because the enamel must be inert to soil acids.

Because of its peculiar physical characteristics there are a number of miscellaneous uses for talc, including its use in cleaners, plaster, polishes, plastics, foundry facings, linoleum and oilcloth, oil-absorbent preparations and textiles.

Massive, compact, relatively pure talc, often referred to as steatite, is used in making ceramic electrical insulators.

Grinding specifications for most uses vary from 95 per cent to 99.8 per cent minus 325 mesh, the trend being toward still finer grinds for some uses. The paint industry demands at least 99.8 per cent minus 325 mesh and in some cases 99.99 per cent minus 325 mesh. For rubber, ceramics, insecticides and pipeline enamels 95 per cent minus 325 mesh is the usual minimum. In the wall-tile industry 90 per cent minus 325 mesh is usually 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 is still used in the manufacture of metalworkers' crayons and for artistic carvings.

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 ware. It must be essentially minus 325 mesh and contain a minimum of quartz and sericite.

Prices

Prices vary considerably according to quality, colour, loss on ignition and fineness of grind.

United States prices of ground talc per short ton, carload lots, f.o.b. works, containers included unless otherwise specified, as quoted in E & M J Metal and Mineral Markets on December 4, 1958, were:

New Jersey		
	Mineral pulp, ground	\$10.50 to \$12.50, bags extra
Vermont		
	100% through 200-mesh, extra white, bulk basis	\$12.50
	99 1/2% through 200-mesh, medium white	\$11.50 to \$12.50
	Packed in paper bags	\$ 1.75 extra

Virginia

	200-mesh	\$10.00 to \$12.00
	325-mesh	\$12.00 " \$14.00
	Crude	\$ 5.50

Georgia

	Packed in paper bags	
	98% through 200-mesh, grey	\$10.50 to \$11.00
	White	\$12.50 " \$15.00

COAL AND COKE

COAL

E. Swartzman

The continuing and increasing competition from oil and gas and the general recession of 1958 resulted in further contraction of the Canadian coal industry. Production, at 11,687,110 tons,* was 11.4 per cent lower than in 1957 and 39.0 per cent below the 19,139,112-ton record of 1950. Production in 1958 was the lowest since 1912.

Of the total, Nova Scotia contributed 45 per cent, Alberta 22, Saskatchewan 19, British Columbia and Yukon Territory together more than 7 and New Brunswick just under 7. Every province showed a decrease except Saskatchewan, where production increased about 0.2 per cent. Alberta's change, the greatest in volume, amounted to a decrease of 20.2 per cent, bituminous coal accounting for 68 per cent of the decrease. For the country as a whole, the production of bituminous coal decreased by about 14 per cent and of subbituminous coal by about 11 per cent.

In 1958 strip mines accounted for more than 36 per cent of the coal produced; in 1957 for about 35 per cent. While in New Brunswick and Alberta the proportion of strip-mined coal increased, in British Columbia it continued to decrease, dropping in 1958 to 12.5 per cent of the provincial output from about 15 per cent in 1957 and 25 per cent in 1956. In Alberta, strip mining accounted for only about 30 per cent of the bituminous-coal output but for more than 59 per cent of the subbituminous coal produced.

The output per man-day in strip mining varies from about 5 to 23 short tons, depending upon thickness and type of cover and the ratio of thickness of coal seam to that of the cover, but in all cases it is far greater than for underground mining. There was again an over-all slight increase in output per man-day. Strip mining increased 5.7 per cent, while underground mining increased 0.2 per cent.

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*Short tons (2,000 pounds) throughout this review.

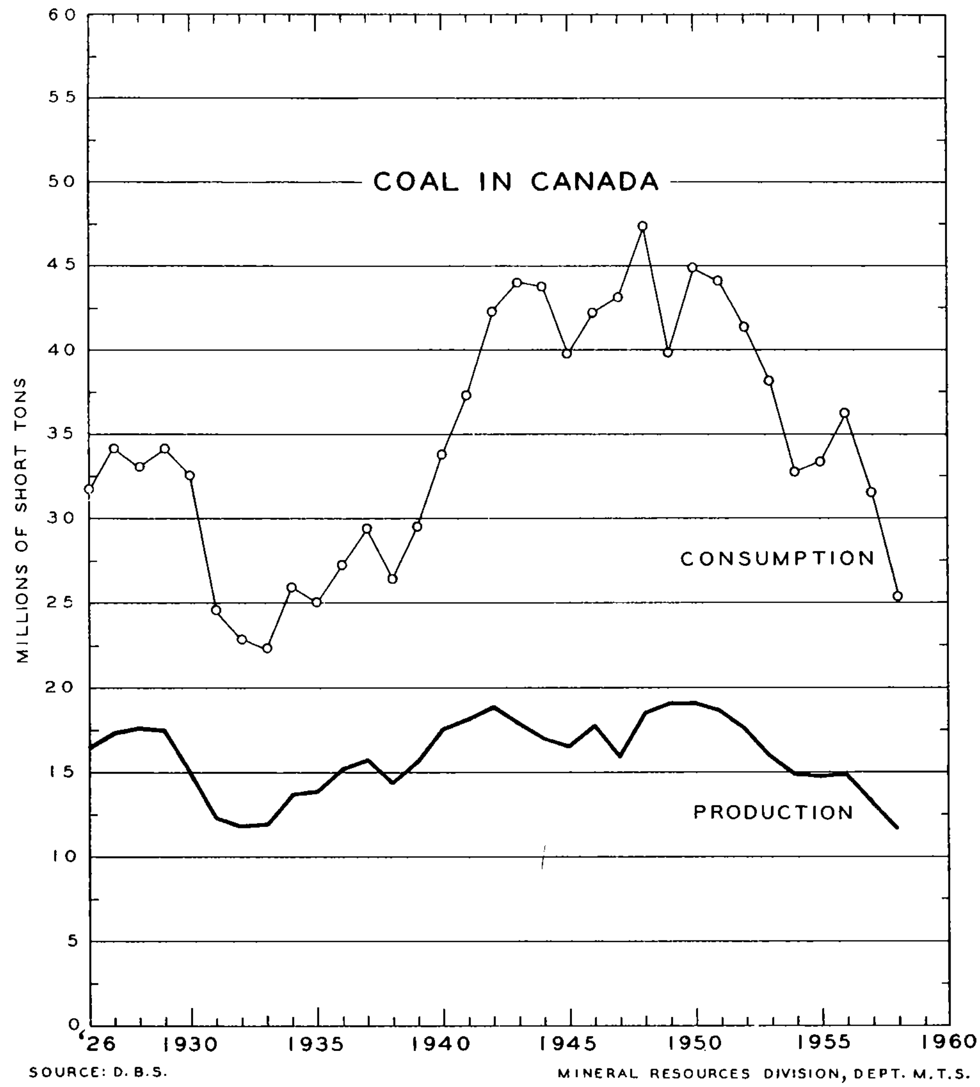
Production of Coal by Provinces and Territories, 1957[1] and 1958
(tons)

		Bituminous	Subbituminous	Lignitic	Total
Nova Scotia	1958	5,269,879	-	-	5,269,879
	1957	5,685,770			5,685,770
New Brunswick	1958	790,719	-	-	790,719
	1957	976,597	-	-	976,597
Saskatchewan	1958	-	-	2,253,176	2,253,176
	1957	-	-	2,248,812	2,248,812
Alberta	1958	834,256	1,685,645	-	2,519,901
	1957	1,266,945[2]	1,889,601	-	3,156,546
British Columbia and Yukon Territory	1958	853,435[3]	-	-	853,435
	1957	1,121,430[4]	-	-	1,121,430
Total	1958	7,748,289	1,685,645	2,253,176	11,687,110
	1957	9,050,742	1,889,601	2,248,812	13,189,155
Value $	1958	68,053,797	7,530,049	4,379,481	79,963,327
	1957	76,631,638	9,191,001	4,398,031	90,220,670

(1) Coals classed according to "A. S. T. M. Classification of Coal by Rank - A. S. T. M. Designation D388-38", A. S. T. M. Standards on Coal and Coke.
(2) Includes a small amount of semianthracite from the Cascade area.
(3) 4,344 tons from Yukon Territory.
(4) 7,731 tons from Yukon Territory.

Production of Coal, by Type of Mining, 1958

		Tons	%
Nova Scotia	Strip mines	-	-
	Underground	5,269,879	100.0
New Brunswick	Strip mines	661,603	83.7
	Underground	129,116	16.3
Saskatchewan	Strip mines	2,253,176	100.0
	Underground	-	-
Alberta	Strip mines	1,246,537	49.5
	Underground	1,273,364	50.5
British Columbia and Yukon Territory	Strip mines	106,407	12.5
	Underground	747,028	87.5
Canada	Strip mines	4,267,723	36.5
	Underground	7,419,387	63.5


COAL IN CANADA
MILLIONS OF SHORT TONS
60
55
50
45
40
35
30
25
20
15
10
5
0
CONSUMPTION
PRODUCTION
'26
1930
1935
1940
1945
1950
1955
1960
SOURCE: D. B. S.
MINERAL RESOURCES DIVISION, DEPT. M.T.S.

Average Output of Coal per Man-day for Canada, 1957 and 1958

(tons)

	1958	1957
Strip mines	15.085	14.307
Underground	2.892	2.885
All mines	4.103	3.994

The average value of Canadian coal f.o.b. mines increased from $6.841 a ton in 1957 to $6.842 in 1958. For the whole of Canada and in Nova Scotia and British Columbia, the average value of bituminous coal increased, while in Alberta it decreased. The average value of imported coal, which was $6.04 a ton in 1957, increased in 1958 to $6.07.

Comparison of Values of Canadian Coals in 1957(1) and 1958

		1958		1957	
	Average Btu/lb(2)	Average Value per Ton ($)	Average Value per Million Btu (¢)	Average Value per Ton ($)	Average Value per Million Btu (¢)
Nova Scotia					
Bituminous	13,180	9.554	35.44	9.300	35.28
New Brunswick					
Bituminous	11,900	8.374	35.25	8.386	35.24
Saskatchewan					
Lignite	7,740	1.944	12.53	1.956	12.64
Alberta					
Bituminous	12,230	6.326	25.86	6.466	28.21
Subbituminous	9,430	4.467	26.99	4.864	25.79
British Columbia					
Bituminous	13,790	6.773	24.48	6.537	23.70
Yukon Territory					
Bituminous	11,450	12.979	56.68	11.848	51.74
Canada					
Bituminous	12,980	8.783	32.77	8.467	32.62
Subbituminous	9,430	4.467	26.99	4.864	25.79
Lignite	7,740	1.944	12.53	1.956	12.64
Average	11,580	6.842	29.11	6.841	29.54

(1) The Coal Mining Industry - 1957, Dominion Bureau of Statistics.
(2) These values are calculated on the basis of the 1957 production for the various mines.

Disposition of Coal, by Province*

Nova Scotia and New Brunswick

Nova Scotia produces high- and medium-volatile bituminous coking coals in the Sydney, Cumberland (Springhill and Joggins districts) and Pictou areas and some noncoking bituminous coal in the Inverness area. The New Brunswick output, consisting entirely of high-volatile bituminous coking coal mined from one thin seam, comes mainly from the Minto area, a small proportion originating in the Beersville area.

A large part of the production from the two provinces is used locally for industrial steam-raising, household and commercial heating and the manufacture of metallurgical coke, and as railway locomotive fuel. In 1958, 2,462,222 tons, approximately 41 per cent of the output, were shipped to central Canada for industrial, commercial and railway use; shipments of this kind in 1957 amounted to 2,347,340 tons. Of this, in 1958, more than 95 per cent originated in Nova Scotia.

Because of a serious bump that occurred in Springhill No. 2 mine during October, the mine was permanently shut down. In 1957 this mine produced more than 290,000 tons of coal and employed 885 men.

Saskatchewan

Only lignite is produced, chiefly from the Bienfait and Roche Percee fields in the Souris area. Slightly less than 52 per cent of the output of 1958 was shipped to Manitoba and about 10 per cent to Ontario. These shipments were for industrial, commercial and household use, the rest being distributed within Saskatchewan for similar purposes. With the extensive developments in progress for the production of thermal power in Saskatchewan and Manitoba, Saskatchewan's lignite production will undoubtedly increase substantially.

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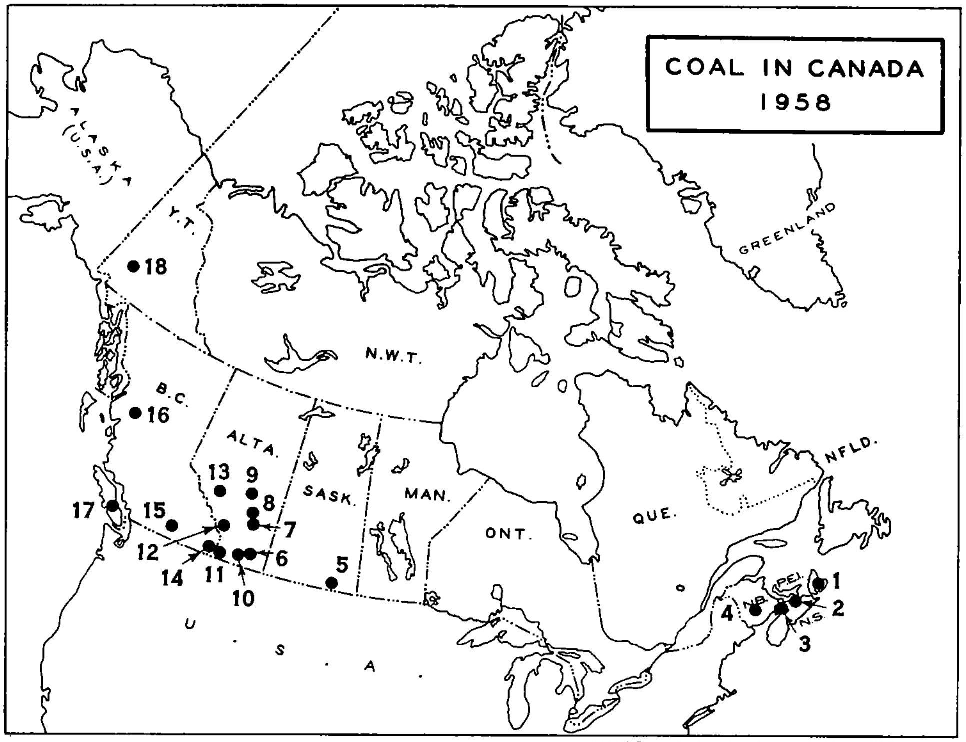
*For detailed information concerning the types and quality of coals mined in Canada, refer to the following publications:

(a) Swartzman, E., Fuels Division. Canadian Coals - Their General Characteristics, Analyses and Classification. Report No. FRL-248. June 1956.

(b) Swartzman, E. Analysis Directory of Canadian Coals. Mines Branch Publication No. 836. 1953.

(c) Swartzman, E. and T.E. Tibbetts. Analysis Directory of Canadian Coals - Supplement No. 1: 1955. Mines Branch Publication No. 850.



MINERAL RESOURCES DIVISION, DEPT. M.T.S.

Coal Areas and Principal Producers[x]

Nova Scotia

1. Sydney and Inverness* Areas (high-volatile bituminous)

Dominion Coal Co.Ltd.	(3,919)
Beaver Coal Co. Ltd.	(21)
Bras d'Or Coal Co. Ltd.	(43)
Four Star Collieries Ltd.	(69)
Indian Cove Coal Co. Ltd.	(48)
Old Sydney Collieries Ltd.	(759)
*S.J. Doucet & Sons Ltd.	(14)
*Evans' Coal Mines Ltd.	(27)

2. Pictou Area (medium- and high-volatile bituminous)

Acadia Coal Co. Ltd.	(191)
Drummond Coal Co. Ltd.	(56)
Greenwood Coal Co. Ltd.	(24)

3. Springhill and Joggins* Areas (high-volatile bituminous)

Cumberland Railway and Coal Co.+	(385)
*Cumberland Fuel and Trading Ltd.	(27)
*Joggins Coal Co. Ltd.	(75)

New Brunswick

4. Minto Area (high-volatile bituminous)

Avon Coal Co. Ltd.	(191)
Crawford Contractors Ltd.	(12)
King Mining Co. Ltd.	(63)
Mills Ltd., D.W. & R.A.	(207)
Miramichi Lumber Co. Ltd.	(314)
Mitchell, Parker D.	(11)
Newcastle Coal Co. Ltd.	(45)
Wasson Ltd., A.W.	(113)

Saskatchewan

5. Souris Valley Areas (lignite)

Manitoba & Saskatchewan Coal Co. Ltd.	(639)
North West Coal Co. Ltd.	(89)
Western Dominion Coal Mines Ltd.	(1,519)

Alberta

6. Brooks and Taber Areas* (subbituminous)

Kleenbirn Collieries Ltd.	(19)
*Alberta Coal Sales Ltd.	(35)

7. Drumheller, Sheerness* and Carbon** Areas (subbituminous)

Amalgamated Coals Ltd.	(141)
Brilliant Coal Co. Ltd.++	(21)
Century Coals Ltd.	(187)
Federated Co-ops Ltd.	(60)
Midland Coal Mining Co.	(117)
Murray Collieries Ltd.	(111)
Red Deer Valley Coal Co. Ltd.	(106)
*Lehigh Coal Co. Ltd.	(26)
*Western Dominion Coal Mines Ltd.	(129)
**McArthur, A.A.	(14)

8. Castor, Ardley* and Camrose** Areas (subbituminous)

Battle River Coal Co. Ltd.	(191)
Forrestburg Collieries Ltd.	(272)
*Allyn Mann Construction Co.	(28)
*Lynass, John H.	(13)
**Camrose Collieries Ltd.	(30)

9. Edmonton, Tofield* and Pembina** Areas (subbituminous)

Black Gem Coal Co. Ltd.	(12)
Egg Lake Coal Co. Ltd.	(21)
Starky Co. Ltd., J.B.	(39)
Sundance Mines Ltd.	(39)
White Mud Creek Coal Co. Ltd.	(20)
*Black Nugget Coal Co. Ltd., The	(28)
**Alberta Coal Co. Ltd.	(98)

10. Lethbridge Area (high-volatile bituminous)

Lethbridge Collieries Ltd.	(84)

11. Crowsnest Area (medium-volatile bituminous)

Coleman Collieries Ltd.	(238)
West Canadian Collieries Ltd.	(287)

12. Cascade Area (low-volatile bituminous and semi-anthracite)

Canmore Mines Ltd., The	(204)

13. Coalspur Area (high-volatile bituminous)

Canadian Collieries Resources Ltd.	(325)

British Columbia

14. East Kootenay (Crowsnest) Area (medium-volatile bituminous)

Crow's Nest Pass Coal Co. Ltd., The	(884)

15. Nicola - Princeton Area (subbituminous)

Mullin's Strip Mine Ltd.	(16)

16. Northern Area (medium- and high-volatile bituminous)

Bulkley Valley Collieries Ltd.	(5)

17. Vancouver Island (Comox) Area (high-volatile bituminous)

Canadian Collieries Resources Ltd.	(196)

Yukon Territory

18. Carmacks Area (high-volatile bituminous)

Yukon Coal Co. Ltd.	(8)

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xApproximate output in thousands of tons for 1957 shown in brackets after company name.

+Shut down in October 1958 owing to serious bump.

++Mine abandoned in 1958.

Alberta

Practically every type of coal is produced in Alberta. Coking bituminous coals ranging from high- to low-volatile are produced in the Crowsnest and Mountain Park areas. These are mainly industrial-steam and railway coals, but commercial and domestic markets are also supplied. Owing to the shrinking market, however, mining in the Mountain Park area has terminated and has been further seriously curtailed in the Crowsnest area. In the Lethbridge, Coalspur and several other areas of the Foothills, lower-rank bituminous noncoking coals are available, but production is at present confined mainly to the Lethbridge and Coalspur areas. The coals in these areas are distributed mainly for household and commercial use, although some is used for industrial-steam production. The coal in the Drumheller, Edmonton, Brooks, Camrose, Castor, Carbon, Sheerness, Taber, Pembina and Ardley areas is classed as subbituminous and that in the Tofield, Redcliff and several other areas is on the border between subbituminous and lignitic. These are mainly household and commercial coals, but increasing amounts are being used industrially, especially for thermal-power production. The Cascade area was the only producer of semianthracite, some of which was shipped as far as Quebec, where it competes with imported anthracitic coals.

Only about 2.1 per cent of Alberta's output of coal in 1958 was shipped to central Canada, and this was mainly for commercial use. For industrial-steam-raising and household use, about 9 per cent, which was about 79 per cent subbituminous, was shipped to Manitoba, 23.2 per cent to Saskatchewan and 21.2 per cent to British Columbia.

British Columbia

Bituminous coking coal, ranging from high- to low-volatile, is mined on Vancouver Island and in the East Kootenay (Crowsnest), Telkwa and Nicola (Merritt) areas. Small quantities of subbituminous coal are produced in the Princeton field. In the Crowsnest area, source of about 80 per cent of the province's coal production, medium-temperature (by-product) coke is manufactured, chiefly for industrial consumption in western Canada and the northwestern United States. In addition, coal is exported to the southwestern United States for blending in the manufacture of metallurgical coke. Mining on Vancouver Island was confined almost entirely to the Comox area, the coal being used within the province for industrial, commercial and household purposes. Approximately 17.5 per cent of the total production was shipped to Manitoba and about 7.6 per cent to Ontario. Approximately 8 per cent was exported to the United States. Negligible quantities were shipped to Alberta and Saskatchewan.

Movement of Coal under Subvention

Coal Moved under Subvention, 1957 and 1958

(tons)

Origin of Coal	1958	1957
Nova Scotia	2,370,131	2,372,678
New Brunswick	120,963	47,768
Saskatchewan	297,892	320,500
Alberta and British Columbia	238,358	480,734
Total	3,027,344	3,221,680

Source: Statistics from Dominion Coal Board.

Consumption

Coal

The over-all consumption of coal was about 20.0 per cent less than in 1957, consumption of Canadian coal decreasing by 11.4 per cent and of imported coal by 25.7 per cent.

Consumption of Canadian and Imported Coal, 1952-58

	Canadian Coal(1)		Imported Coal(2)		Total
	Tons	% of Consumption	Tons	% of Consumption	Tons
1952	16,749,316	40.5	24,603,789	59.5	41,353,105
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

(1) 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.

(2) 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.

The export of Canadian coal decreased slightly in 1958, but it is expected that the export of coking coal to Japan will materially increase in 1959. The importation of bituminous coal decreased by about 26.5 per cent to 12,640,634 tons in 1958.

Exports of Coal, 1957 and 1958

(tons)

Destination	1958	1957
United States[1]	321,906	351,024
St. Pierre and Miquelon	11,393	15,311
Japan	5,240[2]	29,976
Pakistan	5	-
Total	338,544	396,311
Value $	2,907,513	3,357,959

(1) Includes a small quantity to Alaska.
(2) This value is taken from the official Canadian export-trade statistics. However, according to the Annual Report for 1958, Mines Division, Department of Mines and Minerals, Province of Alberta, a total of 21,952 tons of bituminous mine run and slack coal was shipped from the mines to Japan during the year under review.

Imports of Coal, 1957 and 1958[a]

(tons)

Country of Origin		Anthracite	Bituminous	Total
United States	1958	1,490,743	12,640,634[b]	14,131,377
	1957	1,790,827	17,196,880[c]	18,987,707
United Kingdom	1958	65,275	-	65,275
	1957	134,671	-	134,671
Total	1958	1,556,018	12,640,634	14,196,652
	1957	1,925,498	17,196,880	19,122,378
Value $	1958	19,130,513	67,687,832	86,818,345
	1957	24,605,035	91,711,554	116,316,589

(a) From Trade of Canada: includes briquettes but does not include coal imported and subsequently sold for use on board ships.
(b) Includes 1,035 tons of lignite and 41,820 tons of briquettes.
(c) Includes 2,116 tons of lignite and 73,306 tons of briquettes.

As a result of the continuing increase in competition from gas and oil, there was a further decrease in the household and commercial consumption of coal and coke. Of the coal and coke consumed for these purposes, about 97 per cent was coal.

Consumption of Fuels for Household and Building Heating, 1947-58

	Fuel Oil and Distillate(1) (barrels)	Natural Gas(2) (M cubic feet)	Manufactured Gas(2) (M cubic feet)	Coal and Coke(3) (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	68,104,400	112,939,734	5,232,899	6,061,924

(1) The Petroleum Products Industry. Dominion Bureau of Statistics.

(2) The Crude Petroleum and Natural Gas Industry. Dominion Bureau of Statistics. Manufactured and natural gas used for household and commercial purposes.

(3) "Sales of Coal and Coke by Retail Fuel Dealers." The Coal Mining Industry. Dominion Bureau of Statistics. Not available prior to 1947.

Continued dieselization of the railroads also cut heavily into the consumption of coal by railway locomotives, the oil accounting for 65.6 per cent of the total of coal and oil on an estimated heat-equivalent basis. It is of interest to note that as dieselization increased the apparent efficiency increased, the fuel consumed in terms of tons of coal per million gross ton miles of traffic decreasing from 93.4 tons in 1947 to 25.0 tons in 1958.

Fuel Consumed by Railway Locomotives, 1943-58

	Coal(1)	Fuel and Diesel Oil(1)	Estimated Heat Equivalent of Oil in Terms of Coal(2)	Estimated Heat Equivalent of Oil as Percentage of Total of Coal and Oil
	(thousands of tons)	(millions imp. gal)	(thousands of tons)	
1943	11,987	79.0	538.6	4.3
1944	11,993	80.9	551.6	4.4
1945	12,084	78.3	533.8	4.2
1946	11,632	82.2	560.4	4.6
1947	12,331	86.7	591.1	4.6
1948	12,422	96.3	656.6	5.0
1949	11,444	139.3	949.7	7.7
1950	10,452	217.9	1,485.6	12.4
1951	10,505	260.4	1,775.4	14.5
1952	9,798(3)	291.9	1,990.2	16.9
1953	8,323(3)	308.2	2,101.3	20.2
1954	6,502(3)	326.6	2,226.8	25.5
1955	5,587(3)	384.6	2,622.2	31.9
1956	5,587(3)	444.6	3,031.3	35.2
1957	3,322(3)	419.4	2,859.5	46.3
1958	1,394	390.6	2,662.8	65.6

(1) Railway Transport, Dominion Bureau of Statistics.
(2) Estimated in terms of coal at 13,000 Btu/lb, oil being taken at 9.33 lb/gal with a calorific value of 19,000 Btu/lb.
(3) Inclusive of railway briquettes.

Briquettes

Briquettes available for consumption decreased again very sharply - from 467,825 tons in 1957 to 239,770 in 1958. About 46 per cent of the amount marketed in Canada (about 54 per cent of the Canadian output) was used by railways in western Canada, mostly as locomotive fuel. With continued dieselization of the railways, the market for locomotive briquettes was reduced by 61.5 per cent - from 287,000 tons in 1957 to 110,607 tons in 1958. The Saskatchewan output remained almost constant at 41,142 tons. These briquettes, used almost entirely for household and commercial purposes, are made from carbonized lignite. About 38.5 per cent of the 128,512 tons manufactured in Alberta was prepared from semianthracite in the Cascade area and the remainder from medium-volatile bituminous coals in the Crowsnest area. In British Columbia 34,396 tons of briquettes (about 85 per cent railway fuel), an output more than 59 per cent below that of 1957, were prepared from medium-volatile bituminous coal in the East Kootenay (Crowsnest) area.

Relation of Fuel Consumed by Railway Locomotives to Gross Ton Miles of Traffic(1)

	Traffic in Millions of Gross Ton Miles(2)	Coal and Oil Consumed in Terms of Thousands of Tons of Coal(3)	Fuel Consumed in Terms of Tons of Coal per Million Gross Ton Miles of Traffic	Oil Consumed as Percentage of Fuel Total
1947	138,329.9	12,922	93.4	4.6
1948	136,408.9	13,079	95.9	5.0
1949	133,306.4	12,394	93.0	7.7
1950	133,103.8	11,938	89.7	12.4
1951	148,547.1	12,280	82.7	14.5
1952	156,671.3	11,788	75.2	16.9
1953	151,194.5	10,424	68.9	20.2
1954	162,538.7	8,729	53.7	25.5
1955	178,757.1	8,209	45.9	31.9
1956	203,629.4	8,619	42.3	35.2
1957	184,347.4	6,181	33.5	46.3
1958	162,030.1	4,057	25.0	65.6

(1) Railway Transport, Dominion Bureau of Statistics.

(2) Freight-train cars plus passenger-train cars, exclusive of locomotives and tenders.

(3) Oil has been estimated in terms of coal at 13,000 Btu/lb, oil being taken at 9.33 lb/gal with a calorific value of 19,000 Btu/lb.

Beneficiation

The rapidly expanding competition of liquid and gaseous fuels and the necessity for increased mechanization to reduce costs continue to give impetus to efforts to improve the quality of the coal produced by the use of modern methods of beneficiation such as cleaning, drying, dust- and freeze-proofing and briquetting.

As a result of the success, from a technical and coal-marketing viewpoint, of the two mechanical coal-cleaning plants for washing plus 1/4-inch coal in the Minto area of New Brunswick, one of the companies installed additional equipment to clean the 0 x 1/4 inch fines. The two plants make it possible to clean more than 40 per cent of the output of New Brunswick.

In Nova Scotia, although plans have been completed for the establishment of a large central mechanical cleaning plant to process coals from the mines of the largest operator in the Sydney area, the plant has not yet been established. Owing to the increased production of fines resulting from mechanical mining, the Mines Branch initiated a co-operative investigation to determine the most suitable manner of beneficiating such fines by means of briquetting with and without the aid of binders. In addition to studying the beneficiation of the coals, the Mines Branch inaugurated an extensive combustion program for the development of special grates and other devices to facilitate the efficient burning of Nova Scotia high-volatile bituminous strongly coking and strongly swelling coals. The Branch also initiated a research program on methods of reducing the corrosive oxides of sulphur in the flue gases liberated from the high-sulphur coals.

A major problem continues to be the cleaning of fines with a view to preparing a product with a uniform and satisfactory ash content that will find greater acceptance in the various markets. For this purpose, the Mines Branch has established a pilot cyclone plant to be used for studying separations both in water and in heavy media. In addition, the Branch co-operated with industrial organizations in preparing carbonized briquettes for the chemical industry and in conducting laboratory- and plant-scale tests on coal-cleaning and on the use of fine coal in agglomerates as a reducing agent in the smelting of minerals. The Branch also continued to conduct investigations on the coking properties of various Canadian coals in relation to special preparation for export and use in prospective steel-industry developments.

COKE

E.J. Burrough

The production of coke in Canada is confined almost exclusively to the manufacture of metallurgical coke in standard slot-type coke ovens. The coke is used in the operation of iron blast furnaces and in the production of nonferrous base metals. The operation of gas-retort plants, which in Great Britain accounts for about half the total carbonization load, has no counterpart in Canada. Early in the nineteenth century, small gas-retort plants were installed in towns on the St. Lawrence River and gradually most of the larger urban centres in Canada were served with manufactured gas from plants of this type. At the end of World War I the popularity of these plants declined and, with competition from electricity and other methods of producing domestic gases, they were gradually superseded. At a few of the larger centres, by-product coke ovens were installed to produce manufactured gas for city distribution and by-product coke for domestic fuel.

Coke - Production and Trade

	1958		1957	
	Short Tons	$	Short Tons	$
Production				
From bituminous coal				
Ontario	2,543,149	36,584,484	2,948,497	43,919,104
Nova Scotia, New Brunswick and Newfoundland......	413,515	6,894,844	550,895	8,454,234
Quebec	352,521	6,909,529	429,030	8,457,561
Alberta and British Columbia	173,920	2,253,102	190,778	2,611,557
Total	3,483,105	52,641,959	4,119,200	63,442,456
Of pitch coke	8,155	163,278	5,395	128,303
Of petroleum coke ..	462,797(1)	5,638,024	273,296(2)	3,668,318
Total................	3,954,057	58,443,261	4,397,891	67,239,077
Bituminous coal used to make coke				
Imported	4,023,937		4,667,809	
Canadian	765,021		1,052,516	
Total	4,788,958		5,720,325	
Imports (all types)				
United States	605,609	9,205,703	1,077,325	17,010,356
United Kingdom	87	2,900	64	2,166
Total	605,696	9,208,603	1,077,389	17,012,522
Exports (all types)				
United States	117,733	1,545,570	126,021	1,668,902
United Kingdom	23,949	1,097,018	14,682	661,468
Other countries	3,520	132,596	17,595	757,794
Total	145,202	2,775,184	158,298	3,088,164

(1) Includes catalytic carbon produced at petroleum refineries.
(2) Salable petroleum coke only. Excludes catalytic carbon.

The advent of western natural gas in the industrial centres of Ontario and Quebec will reduce the consumption of coal by carbonization by eliminating the markets for manufactured gas. These markets have already been reduced by the unrestricted use of gas reserves from both the United States and southern Ontario. The by-product coke ovens now produce commercial coke on a reduced scale for foundry and other uses, the surplus gas being used as fuel. The modern coke-oven unit used in the production of metallurgical coke has been more or less standardized on units of 17 inches in oven width and capacities approaching 20 tons per unit charge, and the batteries are constructed of pure-silica brick shapes. The plants are operated for maximum throughput.

Increased activity in construction of plant for the production of blast-furnace coke has been shown in recent years, new plant being installed and obsolete batteries in existing equipment replaced. In 1957 a new battery of 45 ovens was completed at Dominion Foundries and Steel, Limited, Hamilton, Ontario, and 57 Wilputte ovens were under construction at the property of Algoma Steel Corporation, Limited, Sault Ste. Marie, Ontario.

The slight decrease in the production and trade figures for 1957 compared with those of previous years may be related to the reduction in steel output and, to a lesser extent, to the curtailment of manufactured-gas output.

About 80 per cent of the coal processed for the manufacture of coke was from the United States.

Though most of the coke produced in Canada is used in the ferrous and the nonferrous metallurgical industries, limited amounts of by-product coke are used in domestic heating. The production of retort coke, a by-product of the gas industry, continues to decline toward extinction with the substitution of natural gas for manufactured gas in domestic use.

In Canada petroleum coke is used mainly in the production of electrodes for the aluminum industry.

Pitch coke is produced in Canada only from surplus coal-tar pitch that is not required for such other industrial uses as the production of electrodes or briquettes.

Apart from the standard by-product-coke ovens, there are in Canada: a Curran Knowles carbonization plant at the Crowsnest Pass collieries in Michel, British Columbia; a distinctive coking stoker-type plant designed and operated by Shawinigan Chemicals Limited, Shawinigan, Quebec; and two small plants operating gas retorts.

About 80 per cent of the coal used in the production of coke in Canada is processed at six plants in eastern Canada, namely: Dominion Steel and Coal Corporation, Limited, at Sydney, Nova Scotia, with rated annual capacity of 1,001,900 tons of coal; Quebec Natural Gas Corporation at Ville La Salle, Quebec, with rated annual capacity of 656,000 tons of coal; Algoma Steel

Oil and Gas Wells Completed, 1957-58

	All Wells				Exploratory				Development			
	Total	Oil	Gas	Abandoned	Total	Oil	Gas	Abandoned	Total	Oil	Gas	Abandoned
1958												
Alberta	1,628	959	229	440	483	60	87	336	1,145	899	142	104
Saskatchewan	803	507	18	278	222	32	6	184	581	475	12	94
British Columbia	90	17	22	51	55	5	10	40	35	12	12	11
Manitoba	91	59	0	32	16	1	0	15	75	58	0	17
Northwest Territories	9	0	0	9	9	0	0	9	0	0	0	0
Total, western Canada	2,621	1,542	269	810	785	98	103	584	1,836	1,444	166	226
Ontario	353	22	149	182	104	3	7	94	249	19	142	88
Quebec	13	0	0	13	13	0	0	13	0	0	0	0
Maritimes	5	0	0	5	5	0	0	5	0	0	0	0
Total, eastern Canada	371	22	149	200	122	3	7	112	249	19	142	88
Total, Canada	2,992	1,564	418	1,010	907	101	110	696	2,085	1,463	308	314
1957												
Alberta	1,435	874	125	436	495	77	70	348	940	797	55	88
Saskatchewan	1,302	893	17	392	355	50	5	300	947	843	12	92
British Columbia	91	12	41	38	60	4	25	31	31	8	16	7
Manitoba	224	139	0	85	76	4	0	72	148	135	0	13
Northwest Territories	5	0	1	4	5	0	1	4	0	0	0	0
Total, western Canada	3,057	1,918	184	955	991	135	101	755	2,066	1,783	83	200
Ontario	421	46	162	213	127	2	8	117	294	44	154	96
Quebec	19	0	1	18	19	0	1	18	0	0	0	0
Maritimes	2	0	1	1	0	0	0	0	2	0	1	1
Total, eastern Canada	442	46	164	232	146	2	9	135	296	44	155	97
Total, Canada	3,499	1,964	348	1,187	1,137	137	110	890	2,362	1,827	238	297

Footage Drilled, Oil and Gas Wells, by Provinces, 1957-58

	Total		Exploratory	Development
	1957	1958	1958	1958
Alberta	7,472,525	9,116,712	2,609,738	6,506,974
Saskatchewan	5,361,723	3,382,070	907,164	2,474,906
British Columbia	494,782	484,287	361,035	123,252
Manitoba	515,849	197,771	34,214	163,557
Northwest Territories	13,837	36,493	36,493	-
Western Canada	13,858,716	13,217,333	3,948,644	9,268,689
Ontario	507,677	473,118	178,820	294,298
Quebec	54,306	26,149	26,149	-
Maritimes	3,529	30,630	30,630	-
Eastern Canada	565,512	529,897	235,599	294,298
Total, Canada	14,424,228	13,747,230	4,184,243	9,562,987

Natural-gas Wells and Natural-gas Reserves, 1958

	Gas Wells at Year-end		Gas Reserves at Year-end*
	In Production (No.)	Capable and Capped (No.)	(Mcf)
Alberta	575	1,576	20,222,824,000
British Columbia	64	149	1,687,626,000
Saskatchewan	88	191	1,165,003,000
Manitoba	-	-	2,345,000
Northwest Territories	-	2	29,427,000
Western Canada	727	1,918	23,107,225,000
Ontario	2,931	...	186,783,000
Quebec	-	-	83,000
Maritimes	47	47	961,000
Eastern Canada	2,978	...	187,827,000
Total, Canada	3,705	...	23,295,052,000

*Source: Canadian Petroleum Association.
...Not available.

for 10 per cent of those drilled in 1957. They accounted for 52 per cent of all hydrocarbon discoveries made in 1958 but for only 45 per cent of those made in 1957. Western Canada had the highest gas-discovery rate, 13 per cent, eastern Canada having only 6 per cent. The above tables summarize drilling activity for the past two years and give other pertinent statistics.

The Canadian Petroleum Association estimates that from year-end 1957 to year-end 1958 natural-gas reserves increased 12.3 per cent - from

20,742,131,000 to 23,295,052,000 Mcf. The largest increase occurred in the Waterton gas field (Area 1), which is in the Alberta Foothills near the United States border.

British Columbia

Significant gas discoveries were made in the Fort Nelson and Laprise Creek areas in the northeast as exploration activity moved farther north.

Two gas discoveries were made in the Fort Nelson area 220 miles north of Fort St. John. One well, in a drill-stem test, flowed over 8,000 Mcf a day from the Slave Point formation of Middle Devonian age. This discovery and two Slave Point discoveries of last year indicate the possibility that major gas production will be developed in the region.

In the Sikanni Chief region three gas discoveries were made. The most important was at Laprise Creek, 100 miles north of Fort St. John; this well was completed with an initial potential of 25,000 Mcf a day from a formation of Triassic age. Other discoveries were made at Blueberry, 55 miles northwest of Fort St. John, and at Boundary Lake, 32 miles northeast of Fort St. John.

Natural-gas production increased sevenfold over the production of 1957 because of the full year's operation of the Westcoast Transmission gas pipeline.

There were 45 million acres of land under lease and permit to exploration companies at the end of the year, 29 million acres more than during 1958. Most of this increase was on lands taken up in the Smithers-Prince Rupert area in the interior of the province. This region had previously been considered as a geologically disturbed area of volcanic and sedimentary rocks, unsuitable for oil and gas exploration.

Alberta

Alberta was the largest contributor to Canada's natural-gas production, producing 71 per cent of the national total, or nearly 239 million Mcf. In spite of this, the number of capped gas wells increased from 766 to 871. Productive gas wells, however, increased from 418 to 575.

Exploration activity in Alberta was highlighted by reef and foothills exploration which resulted in four significant discoveries - Berland River, Lovett River, Panther River and Wildcat Hills, which are 260, 170, 64 and 32 miles respectively, northwest of Calgary. The Berland River well, a Devonian reef discovery, holds promise of being one of the world's larger gas wells. Panther River, although a significant gas discovery in the Fairholme (Upper Devonian), contains very little hydrocarbon gas but about 86 per cent hydrogen sulphide. The Lovett River and Wildcat Hills wells are both Mississippian discoveries in the Alberta Foothills.

Exploratory step-out drilling in the Waterton area has 'proved up' a gas field of considerable size, with reserves in the same order as those of the Pincher Creek gas field, 12 miles to the east. Along the Sundre-Westward Ho trend, 40 miles northwest of Calgary, several exploration step-outs have discovered large new gas pools, the most important of which is Carstairs. The remaining discoveries have extended known gas fields or have been smaller ones the significance of which remains to be evaluated. Many of these discoveries were in the Medicine Hat-Kinsella area.

Saskatchewan and Manitoba

Exploratory drilling in both Saskatchewan and Manitoba was down in 1958. New discoveries in Saskatchewan were disappointing, none of the five gas discoveries being significant. Manitoba did not discover any gas fields in previous years, and none were found in 1958.

Ontario

Ontario celebrated the hundredth anniversary of the discovery of oil in Canada. Gas was not discovered until 1866. Exploration was active, much of the work being on lands underlying Lake Erie. Of the eight gas discoveries only four were significant. Two of the significant discoveries were made in Lake Erie, but their productive capability remains to be evaluated. On the mainland there were two small gas discoveries of significance.

Gas production was at a 40-year high of 16 million Mcf. The previous high is believed to have been in 1896, when production, according to estimates, was 26 million Mcf.

Other Areas

Production in the Maritimes was limited to a small oil-and-gas field near Moncton, New Brunswick. Production continued to decline and dropped to 124,000 Mcf from last year's 176,000 Mcf.

In the Northwest Territories, natural gas produced from the Norman Wells oil field increased to 24,000 Mcf from the 19,000 produced in 1957. In both the Maritimes and the Northwest Territories, exploration was limited and failed to result in any new oil or gas production.

Natural-gas Supply

Of the 417 million Mcf of natural gas produced, waste or flared gas accounted for 19 per cent instead of 27 per cent as in 1957. The resultant net gas production amounted to 337 million Mcf, or 54 per cent more than in the preceding year. Withdrawals from storage of natural gas in fields in Alberta and southwestern Ontario amounted to 7 million Mcf in 1958. Imports into southwestern Ontario increased only slightly and raised the national total to 35 million Mcf. The gas supply for the whole of Canada was 350 million Mcf, 53 per cent more than in 1957.

Natural-gas Demand

Exports made up 26 per cent of the natural-gas demand, having increased 322 per cent. Westcoast Transmission Company Limited was the largest exporter, accounting for more than 78 million Mcf of the 91 million Mcf exported. This is the greatest export total ever attained, the previous record having been made in 1896, when 23 million Mcf were exported from southwestern Ontario to Buffalo and Detroit. Sales of natural gas increased 22 per cent to 206 million Mcf, and accounted for 59 per cent of the total gas demand. The sales were distributed among the provinces as shown in the table on page Plant loss, fuel for pipelines, 'fill' in new distribution systems and gas unaccounted for made up 15 per cent of total gas demand and increased to 52 million Mcf.

Natural Gas - Supply and Demand
(Mcf)

	1958	1957
Supply		
Net production*	337,803,726	220,006,682
Changes in storage		
Out of storage	4,053,200	3,690,888
Into storage	-26,055,958	-25,059,234
Net changes in storage	-22,002,758	-21,368,346
Total domestic supply	315,800,968	198,638,336
Imports	34,716,151	30,550,944
Total supply	350,517,119	229,189,280
Demand		
Export	91,705,547	21,715,003
Domestic sales		
Residential	75,137,525	61,237,933
Industrial	90,080,229	75,384,932
Commercial	37,802,209	30,979,564
Miscellaneous	3,002,392	1,181,027
Total domestic sales	206,022,355	168,783,456
Line pack and adjustment for pressure differences	5,912,688	7,072,655
Plant use and metering differences	40,227,028	33,429,330
Natural gas not accounted for	6,649,501	- 1,811,164
Total demand	350,517,119	229,189,280

*Withdrawals from storage in Alberta are included in this item.

	Sales of Natural Gas, 1958		
	Mcf	$	Number of Customers December 31, 1958
Atlantic Provinces			
Domestic	85,129	242,380	3,278
Industrial			
Commercial	627	2,202	29
Total	85,756	244,582	3,307
Ontario and Quebec			
Domestic	29,803,215	41,933,453	642,896
Industrial	16,742,451	13,085,334	4,794
Commercial............	6,695,349	9,004,350	39,141
Total	53,241,015	64,023,137	686,831
Manitoba and Saskatchewan			
Domestic	6,759,079	5,493,828	58,501
Industrial	12,854,420	3,857,738	675
Commercial	4,969,248	2,619,958	5,613
Total	24,582,747	11,971,524	64,789
Alberta			
Domestic	33,165,949	12,991,858	167,306
Industrial	58,770,688	7,371,280	495
Commercial	23,941,899	6,717,419	17,477
Total	115,878,536	27,080,557	185,278
British Columbia			
Domestic	5,324,153	6,911,673	80,774
Industrial	1,712,670	655,951	92
Commercial	2,195,086	2,648,173	11,768
Total	9,231,909	10,215,797	92,634
Canada			
Domestic	75,137,525	67,573,192	952,755
Industrial	90,080,229	24,970,303	6,056
Commercial	37,802,209	20,992,102	74,028
Miscellaneous	3,002,392	1,410,491	91
Total	206,022,355	114,946,088	1,032,930
Previous totals			
1957	168,783,456*	83,163,566	645,646
1956	143,725,649	64,652,458	514,162
1955	117,800,311	55,181,479	484,306

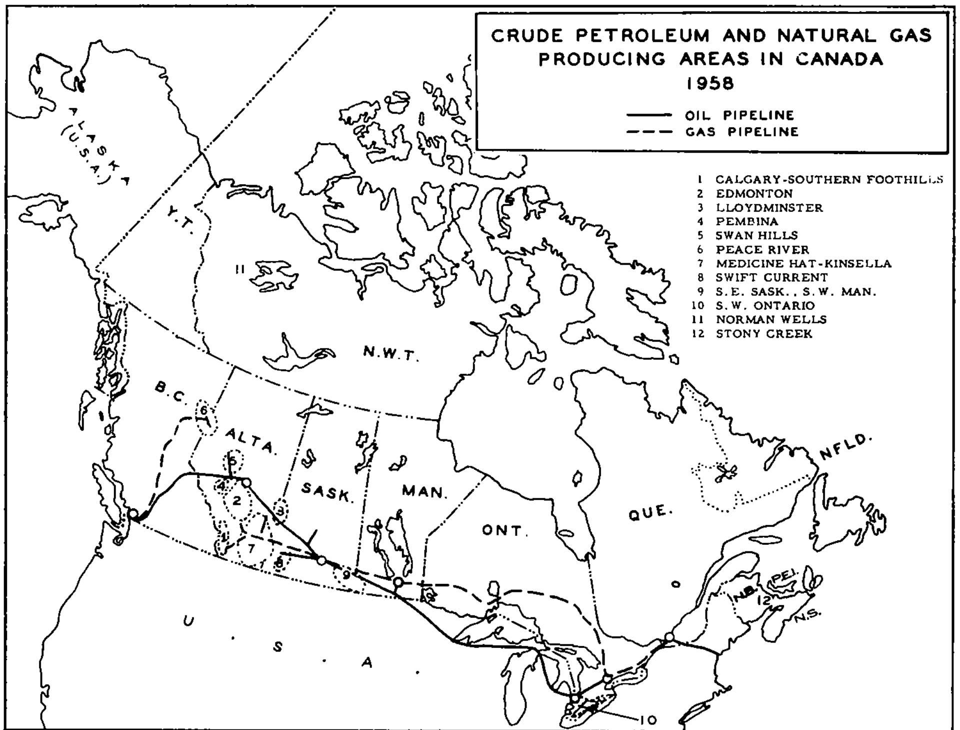
*Miscellaneous sales not included in final statistics for 1957 have been added.

Production of Natural Gas

	1958		1957	
	Mcf	$	Mcf	$
Gross production				
New Brunswick	123,957		176,417	
Ontario	16,147,986		14,400,913	
Saskatchewan	42,568,346		33,559,826	
Alberta	294,398,314		244,224,735	
British Columbia	64,051,785		8,547,100	
Northwest Territories	24,100		19,243	
Total	417,314,488		300,928,234	
Field waste				
Saskatchewan	23,748,551		19,565,479	
Alberta	55,348,723		61,083,915	
British Columbia	413,488		272,158	
Total	79,510,762		80,921,552	
Net production				
New Brunswick	123,957	197,199	176,417	156,641
Ontario	16,147,986	5,974,755	14,400,913	5,328,338
Saskatchewan	18,819,795	1,881,980	13,994,347	1,368,647
Alberta	239,049,591	20,080,166	183,140,820	13,735,562
British Columbia	63,638,297	3,915,239	8,274,942	366,867
Northwest Territories	24,100	8,197	19,243	6,446
Total	337,803,726	32,057,536	220,006,682	20,962,501

Natural-gas Fields Producing 7,500,000 Mcf or More in 1958

	1958	1957
Alberta		
Pembina	34,412,892	33,196,779
Jumping Pound	26,282,574	21,880,534
Viking-Kinsella	24,716,158	20,767,679
Turner Valley	24,373,934	27,149,772
Pincher Creek	18,589,168	13,613,494
Leduc-Woodbend	13,814,401	15,737,163
Pouce Coupe South	13,659,073	5,911,171
Provost	11,124,629	1,917,843
Pouce Coupe	10,818,305	2,733,666
Gordondale	9,195,784	2,310
Medicine Hat	8,485,630	7,980,258
Alexander	7,536,814	6,688,400
British Columbia		
Fort St. John	26,158,789	4,536,832
Fort St. John Southeast	13,714,423	1,910,729
Buick Creek West	9,579,318	632,879
Saskatchewan		
Coleville	12,663,937	10,326,062
Steelman	12,492,637	8,371,006



CRUDE PETROLEUM AND NATURAL GAS PRODUCING AREAS IN CANADA 1958

R.A. MINERAL RESOURCES DIVISION, DEPT. M.T.S.

Transportation

In 1958, natural-gas pipelines became an important and extensive element in Canada's transportation system. They moved low-cost fuel from Alberta and British Columbia hundreds of miles east and west to Canada's industrial and commercial centres.

In October 1958, the Trans-Canada pipeline, running from Alberta to Montreal, a distance of 2,290 miles, was completed and put into service. The Westcoast Transmission pipeline completed its first full year of operation in November. Thus Canada had a pipeline network that almost spanned the continent. Natural-gas-pipeline mileage at the end of the year was at an all-time high, the figures indicating the second largest increase in gas-pipe mileage ever recorded. Some of the increase resulted from the conversion of manufactured-gas pipelines to natural gas. Gas-pipeline mileage at the end of the year totalled more than 27,000 miles, or 5,800 miles more than at the end of 1957. The table on page 486 gives Canada's gas-pipeline mileage by type of pipeline.

One hundred and eight gas-pipeline companies were in operation at the end of 1958, 10 companies accounting for some 75 per cent of all the gas-pipeline mileage in Canada.

Gas-pipeline Mileage in Canada, Year-end, 1953-58(1)

	1953	1954	1955	1956	1957	1958
Gathering (2)						
New Brunswick............	21	21	21	10	11	11
Ontario....................	2,446	2,079	2,166	851	940	940
Saskatchewan	115	188	474	99	92	311
Alberta....................	1,624	1,820	1,915	948	972	1,634
British Columbia	-	6	6	6	121	213
Total......................	4,206	4,114	4,582	1,914	2,136	3,109
Transmission(3)						
New Brunswick............	-	-	-	11	11	11
Quebec....................	-	-	-	-	27	27
Ontario....................	-	-	-	1,284	2,520	3,466
Manitoba	-	-	-	-	354	375
Saskatchewan	-	-	-	635	1,093	1,395
Alberta....................	-	-	-	1,797	2,127	2,581
British Columbia	-	-	-	37	1,102	1,102
Total	-	-	-	3,764	7,234	8,957
Distribution						
New Brunswick	65	65	65	65	65	65
Quebec....................	-	-	-	-	963	971
Ontario	2,258	3,560	3,778	4,667	5,770	8,095
Manitoba	-	-	-	146	433	510
Saskatchewan	31	80	162	339	879	947
Alberta....................	1,503	1,506	1,672	1,879	2,075	2,202
British Columbia	-	5	6	925	1,902	2,380
Total......................	3,857	5,216	5,683	8,021	12,087	15,170
Total (Canada - all lines) ...	8,063	9,330	10,265	13,699	21,457	27,236

(1) Includes small mileages omitted in previous years.
(2) Includes transmission lines for 1953-55.
(3) Does not include 210 miles of Trans-Canada pipeline laid in 1956.

The main pipeline project completed in 1958 was the 853 miles of 30-inch line constructed by Trans-Canada Pipe Lines Limited from Port Arthur to Toronto. Northern Ontario Pipe Line Crown Corporation owns 367 miles of this line under an agreement with Trans-Canada. The initial capacity of the line was 260,000 Mcf a day.

Trans-Canada supplies seven major natural-gas-distribution systems in Ontario. One in Quebec, three in Manitoba and one in Saskatchewan received interim service.

During the period of market build-up in 1957-58, natural gas was imported from the United States and was used to supply the Toronto, Montreal, Ottawa and adjacent market areas. During 1958 one important new area, Sudbury, was served by the completion of the Trans-Canada pipeline and the distribution system of Northern Ontario Natural Gas Co. Ltd. In southern Ontario, all the larger communities except Peterborough are now supplied with natural gas.

Other major projects completed last year were: an extension of the Westcoast gathering system in northeastern British Columbia; the laying of 400 miles of additional distribution lines by British Columbia Electric Company Limited in Vancouver; and the extension of a grid pipeline system by Saskatchewan Power Corporation in the southern part of that province.

Alberta Gas Trunk Line Company Limited, the principal supplier of Trans-Canada Pipe Lines Limited, completed 125 miles of lines including an extension to Pincher Creek. This company gathers natural gas from several Alberta fields including Cessford, Blindloss, Provost and Pincher Creek and delivers it to Trans-Canada at the Alberta-Saskatchewan border.

Natural-gas Processing

With the completion of the new 'big inch' natural-gas pipelines, natural-gas processing became one of the more important industries in western Canada. The growth of the industry is well illustrated by the increase in capacity. The daily capacity of all processing plants amounted in 1956 to 402,000 Mcf, in 1957 to 845,000 Mcf, and in 1958 to 1,237,000 Mcf. The increase is due to the completion of nine new plants and the expansion of the Pincher Creek processing plant. The main plants constructed during the year were at Taylor in British Columbia, at Pembina, Cessford, and the Alexander Indian Reserve in Alberta, and at Steelman in Saskatchewan.*

The locations of the largest plants in western Canada and their daily capacities are: Taylor, British Columbia, 300,000 Mcf; Cessford, Alberta, 125,000 Mcf; and Pincher Creek, Alberta, 120,000 Mcf.

It is expected that in 1959 construction will continue at a rapid rate. Four plants, the largest of which are at Okotoks, near Calgary, and at Colville, Saskatchewan, were planned or under construction by the end of 1958.

Royal Commission on Energy

The Royal Commission on Energy held extensive hearings on gas and oil during the first half of the year. Seventy-seven briefs were submitted in hearings at Calgary, Regina, Victoria, Winnipeg, Toronto and Montreal. The Commission recommended, among other things, (1) that the export of Canada's surplus gas, which it found desirable, should be permitted, (2) that oil and gas pipelines should be regulated as to prices, tolls, rates and tariffs and (3) that a National Energy Board should be established "to exercise effective control over the export and the import into Canada and the movement across provincial boundaries of all energy and sources of energy".

*Department of Mines and Technical Surveys, Operators List 5, Petroleum Refineries in Canada, January 1959.

Production from Natural-gas-processing Plants

	Plant Condensate (barrels)	Natural Gasoline (barrels)	Propane (barrels)	Butane (barrels)	Propane-butane Mix (barrels)	Sulphur (short tons)
			Alberta			
1950	-	446,384	141,070	33,906	-	-
1951	-	515,027	248,554	84,527	-	-
1952	-	579,873	337,678	140,228	-	8,931
1953	-	602,771	433,083	198,401	-	18,298
1954	18,083	682,378	529,117	245,189	-	22,320
1955	160,100	868,416	796,482	492,051	-	29,093
1956	164,573	913,572	925,716	591,638	-	33,464
1957	153,278	968,162	1,111,355	747,709	-	100,706
1958	116,568	978,085	1,054,702	659,661	7,376	122,326
			British Columbia			
1958	118,208(e)	335,352	69,095	81,609	-	62,604

(e) Estimated.

CRUDE PETROLEUM

R.A. Simpson

Production in Canada of crude oil declined to 165,496,196 barrels in 1958 from the previous year's record high of 181,848,004 barrels. Alberta, Manitoba and New Brunswick all produced less, the decline in Alberta amounting to more than 24 million barrels, or a significant 17 per cent. Saskatchewan's 7,765,059-barrel increase was the most striking, being equivalent to 21 per cent of the previous year's output.

Alberta accounted for 68.4 per cent of production (75.6 per cent in 1957), Saskatchewan for 27 per cent (20.3 per cent in 1957), Manitoba for 3.5 per cent (3.3 per cent in 1957), and Ontario, the Northwest Territories, British Columbia and New Brunswick for the remaining 1.1 per cent (0.8 per cent in 1957).

There were 11,559 producing oil wells in western Canada at the end of 1958 - 7,811 in Alberta, 2,961 in Saskatchewan, 736 in Manitoba, 29 in British Columbia and 22 in the Northwest Territories. There were 13,159 wells capable of production, but lack of markets kept 1,600 inoperative.

Reserves

Proved reserves of crude oil in Canada showed a net increase of 290 million barrels during 1958. Allowing for the full 12 months' production, proved reserves at the end of the year totalled 3,165,904,000 barrels, according to a compilation of the Canadian Petroleum Association. Reserves in Alberta rose by more than 211 million barrels to 2,572,610,000, and Saskatchewan's increased by more than 76 million barrels to 497,372,000. Although the Northwest Territories had the third largest proved reserves in Canada, the year's additions were almost negligible and the result of production in that area was a half-million-barrel decline to 52,409,000 barrels. Manitoba, too, had a disappointing year with respect to oil discovery; and, because of revision to earlier compilation and withdrawals during the year, the province's proved reserves dropped by 6 3/4 million barrels to 27,600,000. British Columbia's reserves quadrupled but still amounted to only 8,958,000 barrels. Ontario's doubled to 6,978,000 barrels. In New Brunswick, no reserves were added, and production resulted in a reduced year-end reserve total of 77,000 barrels.

A total of 89,533,000 barrels of liquid petroleum gases added to reserves, brought the reserves of liquid hydrocarbons to 484,193,000 barrels. Of this 422,580,000 barrels were in Alberta, 34,037,000 in Saskatchewan and 27,576,000 in British Columbia.

(text continued on page 492)

Crude Oil - Production, Trade and Consumption, 1948-58

(barrels)

	Production	Imports	Exports	Consumption(1)		
				Domestic(2)	Imported(3)	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

(1) For 1948-50, inclusive - as reported in Petroleum Products Industry; for 1951-58, inclusive - receipts at refineries as reported by Refined Petroleum Products.

(2) 'Domestic' includes crude naphtha and absorption gasoline to 1950 only.

(3) 'Imported' includes reduced crude for all years.

Crude-oil Production, by Province and Field

	1958(1)		1957(2)	
	Barrels	$	Barrels	$
Alberta				
Pembina	33,093,712		37,185,478	
Leduc-Woodbend	14,910,033		18,295,291	
Redwater	13,074,440		21,184,682	
Fenn-Big Valley	5,571,322		7,797,735	
Joffre	5,367,841		3,223,567	
Bonnie Glen	4,225,487		8,176,121	
Joarcam	3,476,187		4,259,153	
Sturgeon Lake South	2,893,305		2,636,989	
Harmattan-Elkton	1,980,071		1,579,240	
Acheson	1,693,896		2,346,727	
Stettler	1,658,511		2,020,135	
Wizard Lake	1,583,277		4,377,067	
Keystone	1,466,262		789,508	
Turner Valley	1,458,661		1,594,881	
West Drumheller	1,299,420		1,460,725	
Innisfail	1,244,998		186,788	
Erskine	1,225,780		1,238,025	
Wainwright	1,140,954		997,105	
Sundre	1,105,664		926,814	
Other fields	14,808,026		17,216,285	
Total	113,277,847	283,262,592	137,492,316	355,555,140
Saskatchewan				
Steelman	11,278,609		9,565,662	
Weyburn	6,034,630		3,423,773	
Dollard	3,121,587		2,078,998	
Carnduff	2,999,708		1,588,562	
Midale	2,464,275		2,478,273	
Nottingham	2,451,278		2,309,424	
Coleville-Smiley	2,369,061		3,123,557	
Fosterton	2,043,201		1,907,023	
Success	1,585,149		1,656,214	
Cantuar	1,184,313		1,346,888	
Instow	1,045,919		640,010	
Alida	1,022,118		749,322	
Other fields	7,026,300		5,993,383	
Total	44,626,148	96,704,863	36,861,089	79,325,064

(table continued on next page)

Wells of All Types Drilled to Completion - Western Canada

	Oil Wells		Gas Wells		Dry Holes		Total	
	1958	1957	1958	1957	1958	1957	1958	1957
British Columbia	16	11	23	41	51	40	90	92
Alberta	959	874	227	125	443	449	1,629	1,448
Saskatchewan	507	899	18	20	278	383	803	1,302
Manitoba	61	127	-	-	31	97	92	224
Northwest Territories	-	-	-	1	9	3	9	4
Total	1,543	1,911	268	187	812	972	2,623	3,070

Source: Provincial governments.

The 11,559 wells producing in western Canada at the end of the year were 87.7 per cent of those capable of production. The 87.7 per cent, however, were producing at about half their potential.

Oil Wells - Western Canada
(at year-end)

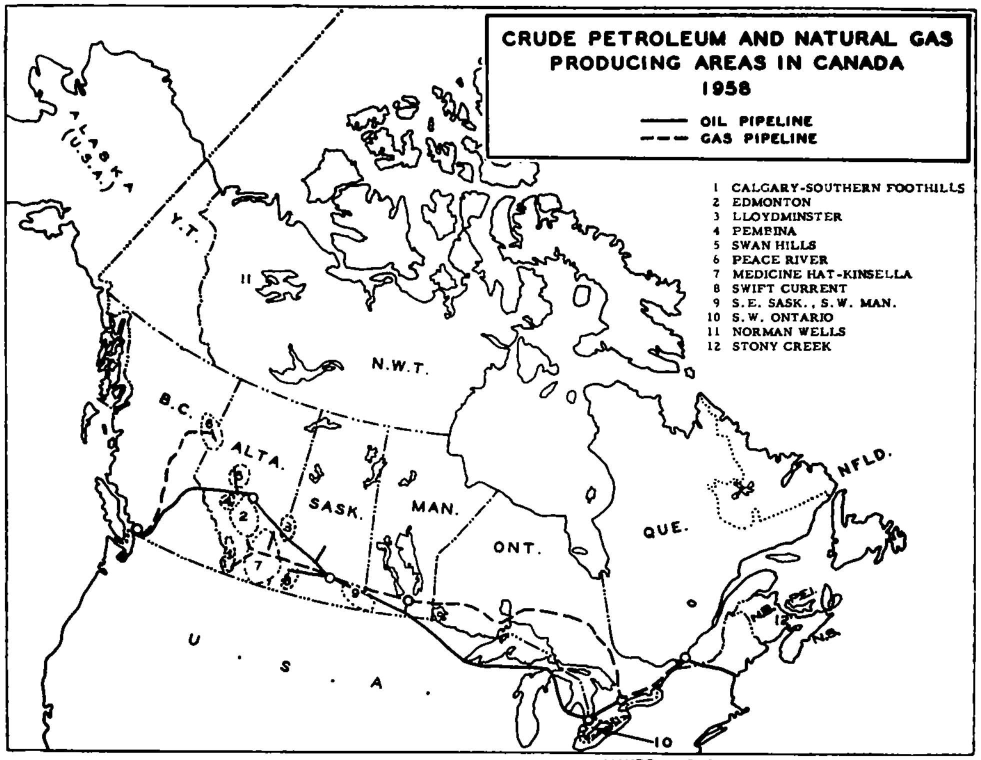
	Producing Wells			Wells Capable of Production		
	1958	1957	1956	1958	1957	1956
British Columbia	29	15	9	39	22	9
Alberta	7,811	7,136	6,743	8,536	8,015	7,390
Saskatchewan	2,961	2,652	2,047	3,655	3,226	2,414
Manitoba	736	735	646	877	846	736
Northwest Territories	22	19	31	38	38	38
Total	11,559	10,557	9,476	13,145	12,147	10,587

Development by Areas

Eastern Canada

The petroleum-producing industry of eastern Canada has a much longer history than that of western Canada, but the fields that have been discovered are relatively small and production has never exceeded a million barrels a year. By far the greater part of production has come, and continues to come, from Ontario. Production on a per-well basis is small, amounting to about 450 barrels annually. For this reason and because they produce a relatively small part of the Canadian total, the wells are not grouped with those of western Canada in this review.

Of the 353 wells drilled in 1958 in Ontario, 249 were development and 104 exploratory. Sixteen offshore exploratory wells were drilled in Lake Erie, of which one found oil and three found gas. The 38 development wells drilled offshore resulted in 30 successful completions. Onshore drilling accounted for 83 exploratory and 217 development wells. There were three successful



MINERAL RESOURCES DIVISION, DEPT. M.T.S.

exploratory oil wells and five successful exploratory gas wells. Total development drilling, both onshore and offshore, resulted in 19 successful oil wells and 142 successful gas wells, the remaining 88 being dry holes.

Thirteen exploratory wells were drilled in Quebec, in the St. Lawrence Lowlands, none of which found commercial oil or gas. Five wells, all unsuccessful, were drilled in the Maritime Provinces: three in Prince Edward Island and one each in New Brunswick and Nova Scotia.

British Columbia

Ninety wells were drilled to completion in British Columbia in 1958. Of these, 55 were exploratory and 35 development. Sixteen wells found oil and 23 found gas. Of the successful oil wells, five were exploratory and 12 were development. There were 51 dry holes drilled.

Two important oil discoveries were made during the year: Beatton River and Milligan Creek, both about 80 miles northwest of Fort St. John and about 6 miles apart, and both completed as Triassic D wells. By the end of the year Milligan Creek had been classed as a field, with five producing wells. The only other successful oil development drilling was in the Boundary Lake field, where at year-end 20 wells were capable of production.

Boundary Lake, British Columbia's largest producing field, provided almost 70 per cent of the provincial output. The Fort St. John field ranked second. Together, they produced about 97 per cent of the provincial total.

Alberta

Exploratory wells drilled in 1958 totalled 486, of which 60 were successful oil-well completions, 87 were gas wells and 339 were dry holes. The most significant oil find was the Shell-Petrol Simonette No. 12-9 well, which is north of the equally significant gas strike at Berland River. Both are about 175 miles northwest of Edmonton. The discovery, situated in a Leduc reef with a pay thickness of 100 feet, produced a light-gravity oil.

The attention of the industry continued to be focused on the Swan Hills-Virginia Hills-Whitecourt region northwest of Edmonton, where a number of important discoveries were made. Production in this region is from the Swan Hills member of the Upper Devonian-Beaverhill Lake formation. The original Swan Hills discovery, along with those at Kaybob and Virginia Hills, was made in 1957. Results of work done since then indicate that fields in the area may rank with Canada's largest. The largest producing well discovered in the area during 1958 was the Pan American-British American Swan Hills 14-33 well, about 2 miles south of the Swan Hills field, which penetrated 250 feet of pay with a potential production of 1,344 barrels a day. Other successes widened the area of prospective oil accumulation in the Beaverhill Lake formation.

After the Union Red Earth 4-20 discovery of light-gravity oil in the Beaverhill formation, drilling in the Redearth Creek area, about 100 miles north of the Swan Hills field, pointed to a second production zone in this region. Other drilling near the Redearth Creek field resulted in the completion of four successful oil wells in the Granite Wash, the original production zone.

Development drilling accounted for 1,143 wells, of which 899 were successful oil wells, 140 successful gas wells and 104 dry holes. More than 40 per cent of all development drilling in Alberta was done in the Pembina field - Canada's largest - which at year-end had 2,101 wells capable of production. Companies continued to develop secondary recovery operations in Pembina to increase the ultimate recovery of oil from the field. The D-2 production zone of the Devonian of the Joffre field, the second productive horizon in this field, was being rapidly developed during 1958. Sixty-five successful oil wells were completed in this horizon. Development drilling in the Keystone field added 66 new oil wells to the total. Other fields where significant development drilling was done included Wainwright, Innisfail and Harmattan-Elkton.

Saskatchewan

The total of wells drilled in Saskatchewan in 1958 was 803. This was 40 per cent lower than the total of the previous year. The number of successful oil wells completed amounted to 507 of which only 42 were exploratory, the remaining 465 being successful development wells. No outstanding discoveries were made during the year.

More than 90 per cent of all development drilling was done in the southeastern part of the province. Work in the Steelman field made up one quarter of the provincial total, and drilling in the Weyburn field accounted for 11 per cent. Other fields, in decreasing order of development wells drilled, were Carnduff, Midale, Alameda and Glen Ewen. Fewer than 20 wells were drilled during the year in each of the remaining Saskatchewan fields.

Manitoba

Exploratory and development work in 1958 was considerably below that of 1957. Only 92 wells were drilled during the year. One of them, an outpost well at Scallion, was classed as a successful exploratory oil well. There were 15 exploratory dry holes. Out of the 76 development wells completed 60 found oil. Thirty-three of these development wells were drilled in the Routledge field and 29 were drilled in the North Virden field.

Yukon and Northwest Territories

The search for oil and gas in the Territories was more than double in scope and intensity during 1958. The main areas of search were in the Eagle Plains and Peel Plateau regions and along the Arctic coast. Nine wells, all exploratory, were drilled, but none found oil or gas. There was no development drilling in the Norman Wells field, the only oil field in the Territories.

Transportation

The construction of oil-pipeline systems in Canada has kept pace with the development of producing fields, refinery facilities and export requirements. A good indication of this progress is the increase in crude-oil-pipeline mileage from the completion of the first phase of the Interprovincial pipeline in 1950 to the completion of the Trans Mountain line in 1953, and from then to the present. By the end of 1958, the construction of loops, extensions and new feeder systems had increased the length of crude-oil pipelines in Canada to 7,148 miles. The year-to-year figures given in the following table are exclusive of United States extensions to the Interprovincial and Trans Mountain systems. These extensions, which carry Canadian crude oil exclusively, totalled 1,360 miles at the end of 1958.

Oil-pipeline Mileage in Canada

Year-end	Miles	Year-end	Miles
1950	1,423	1954	4,656
1951	1,577	1955	5,079
1952	2,500	1956	6,051
1953	3,794	1957	6,873
		1958	7,148

Interprovincial Pipe Line Company

The Interprovincial is the longest oil pipeline in the world. It originates in Alberta's Redwater field, but its main receiving station is at Edmonton, where the bulk of crude oil to be shipped is delivered. In addition to deliveries from Redwater, the line takes deliveries from 11 other pipelines in the three Prairie Provinces. It delivers crude oil to five pipelines in Canada and three in the United States. The system, either directly or in conjunction with its connecting carriers, transports Canadian crude oil to refineries situated as follows: Saskatoon, Moose Jaw and Regina in Saskatchewan; Brandon and Winnipeg in Manitoba; Sarnia, Clarkson, Port Credit and Trafalgar in Ontario; St. Paul-Minneapolis and Wrenshall (Minnesota), Superior (Wisconsin) and West Branch, Bay City and Midland (Michigan) in the United States.

Additions made in Ontario in 1957 extended the line to Clarkson and Port Credit from Sarnia, and looping programs farther west provided the company with two complete pipelines from Regina to Superior, Wisconsin. In 1958, four more loops with a total length of 82 miles were added between Edmonton and Regina. When they were finished, there were two complete pipelines from Edmonton to Superior.

Deliveries for the year totalled 109.5 million barrels, almost 10 per cent more than for 1957. Refineries in western Canada took 29.5 million barrels; those in the United States and Ontario accepted 21.3 and 58.7 million barrels respectively.

Trans Mountain Oil Pipe Line Company

The Trans Mountain pipeline carries crude oil from Edmonton to Vancouver and has an extension into the United States to refineries at Ferndale and Anacortes, in the State of Washington. In addition to accepting crude oil from seven feeder lines at Edmonton, it takes deliveries at Edson from the Peace River pipeline, which carries crude from areas northwest of Edmonton. Deliveries of crude can be made to refineries at Kamloops and Vancouver in British Columbia as well as to the United States refineries already mentioned.

Conditions in British Columbia and competition from water-borne crudes resulted in a 48-per-cent decrease in Trans Mountain's 1958 deliveries, which dropped to 29.6 million barrels from the 1957 total of 56.5 million. Of the 1958 total, 69.7 per cent was for refineries in British Columbia and 30.3 per cent was for refineries in Washington.

Federated Pipe Lines Ltd.

During 1958 Federated completed a 10- and 12-inch pipeline 123 miles long from the new Swan Hills field to Edmonton. The crude was being delivered solely by gravity flow, although provision had been made during construction to permit pumps to be installed when additional capacity was required.

Other Oil Pipelines

The other crude-oil pipelines in Canada undertook no major construction during 1958. Extensions to gathering systems were completed by Britamoil Pipe Line Company Limited (21 miles), Cremona Pipe Lines Ltd. (20 miles), the Gibson group of companies (11 miles), Peace River Oil Pipe Lines Co. Ltd. (3 miles), Pembina Pipe Line Ltd. (37 miles), Rangeland Pipe Line Co. Ltd. (18 miles), Trans-Prairie Pipelines Ltd. (31 miles) and Westspur Pipe Line Co. (79 miles).

Petroleum-processing

Two new refineries came on stream in 1958 with a combined crude-oil capacity of 38,000 barrels a day. Three small refineries with a combined crude-oil-processing capacity of 2,600 barrels a day ceased operations during 1958. Other refineries completed additions to established facilities, with the net result that at the end of 1958 the industry had a crude-oil capacity of 827,407 barrels a day.

The refinery of Cities Service Oil Company Limited at Trafalgar, west of Toronto, went on stream in November with a crude capacity of 20,000 barrels a day. The refinery is connected to sources of western Canada crude via the Interprovincial pipeline. The refinery of The British American Oil Company Limited, at Port Moody, near Vancouver, went on stream in October. This refinery is connected to sources of Alberta crude oil via the Trans Mountain pipeline.

The refineries that ceased operations during 1958 included: Bonnyville Oil Refineries Ltd., at Bonnyville, Alberta, which had a crude capacity of 1,000 barrels a day; Petroleum Fuels Limited, at Moose Jaw, Saskatchewan, which had a crude capacity of 1,100 barrels a day; and Radio Oil Refineries Limited, at East Kildonan, Manitoba, which had a crude-oil-treating capacity of 500 barrels a day.

The 42 refineries in Canada were operated by 22 companies. Imperial Oil Limited operated nine refineries whose daily crude-oil capacity was 38.5 per cent of the national total. The remaining distribution was as follows: The British American Oil Company Limited, six refineries, 17 per cent; Shell Oil Company of Canada Limited, two refineries, 10 per cent; Texaco Canada Limited, two refineries (formerly the refineries of McColl-Frontenac Oil Company Limited), 8.5 per cent; and 18 other companies, 23 plants, 26 per cent.

Crude-oil Refining Capacity, by Regions

	1939		1945		1950	
	Bbl/day	%	Bbl/day	%	Bbl/day	%
Maritimes	32,750	18.4	34,250	14.8	22,300	6.2
Quebec	64,500	31.5	59,000	25.5	143,000	39.9
Ontario	44,500	21.7	75,450	32.6	75,200	21.0
Prairies and Northwest Territories	35,570	17.3	41,515	18.0	89,525	24.9
British Columbia	22,700	11.1	21,000	9.1	28,850	8.0
Canada	200,020	100.0	231,215	100.0	358,875	100.0

	1955		1957		1958	
	Bbl/day	%	Bbl/day	%	Bbl/day	%
Maritimes	18,300	3.0	44,300	5.8	49,300	6.0
Quebec	210,000	34.0	255,800	33.6	264,800	32.0
Ontario	148,800	24.0	198,510	26.1	228,822	27.6
Prairies and Northwest Territories	174,850	28.3	189,035	24.8	187,735	22.7
British Columbia	66,500	10.7	74,250	9.7	96,750	11.7
Canada	618,450	100.0	761,895	100.0	827,407	100.0

Canadian Crude Oil as a Percentage of Refinery Receipts, by Regions

	1939	1940	1945	1950	1955	1957	1958
Maritimes	0	0	0	0	0	0	0
Quebec	0	0	0	0	0	0	0
Ontario	0.4	1.2	0.5	1	78.8	86.1	93.7
Prairies and Northwest Territories	37.0	92.3	58.2	99	100	100	100
British Columbia	0	0	0	0	100	100	100
Canada	17.0	16.4	11.7	24.4	54.7	53.2	55.6

Marketing and Trade

Crude oil delivered from domestic oil fields to refineries within Canada totalled 134,513,998 barrels in 1958, about 6 per cent above the 1957 total of 126,914,237 barrels. Deliveries of foreign crude oil to refineries within Canada amounted to 107,444,741 barrels, a drop of 3.9 per cent from the 111,905,473 barrels delivered in 1957. Nearly all the increase in deliveries went to Ontario refineries, which received almost 11 per cent more crude oil in 1958 than in 1957. Deliveries to refineries in Quebec, the Maritimes and British Columbia were slightly below those of 1957, while deliveries to plants in the Prairie Provinces were up less than 1 per cent.

Venezuela continued as the leading supplier of the crude-oil imported into Canada, providing Canadian refineries during 1958 with more than 71 million barrels of crude, or 66 per cent of all imports of this commodity. Middle East countries supplied 31.8 million barrels, or 29.6 per cent. Of this total, 18.3 million barrels came from Kuwait, 13.2 million from Saudi Arabia and the remainder from Iran and Iraq. The United States and Trinidad supplied, respectively, 1.7 million and 2.0 million barrels of crude oil, or 1.6 and 1.8 per cent of crude-oil imports.

Exports of Canadian crude oil have gone almost entirely to the United States, principally to the areas served by pipelines originating in Canada. The industry looked with a good deal of optimism on the markets of the Pacific Northwest and the north central tier of states adjacent to the Canadian border. In 1958 this region continued to take Canadian crude at about the same rate as in 1957, and more than 21 million barrels went to the upper mid-continent states, about half a million more barrels than in 1957. There was, however, a 66-per-cent decline in exports to the Puget Sound region. Two companies stopped taking Canadian crude, and a third reduced its purchases for refineries located there.

Imports of petroleum products dropped in 1958 to 30,435,271 barrels from the 34,644,099 barrels imported in 1957. More than two thirds of all product imports was fuel oil, two thirds of this being light fuel oil for domestic heating and the remainder heavy fuel oil for industry. Aviation gasoline and motor gasoline made up one sixth of product imports. The remaining one sixth comprised all other products, the chief of which were petroleum coke and lubricating oils.

In the United States, voluntary import controls on crude oil continued in 1958. United States refining companies demanded less Canadian crude than the quotas permitted.

There is no tariff on crude oil entering Canada. There is a United States import tax of 5 1/4 cents a barrel on Canadian crude oil testing under 25° A.P.I. gravity, and 10 1/2 cents a barrel on oil testing at or above that gravity.

Regional Consumption of Petroleum Products

The following table gives the net sales of products, by regions, during 1958.

	Motor Gasoline	Kerosene and Stove Oil	Diesel Oil	Light Fuel Oils 2 and 3	Heavy Fuel Oils 4, 5 and 6
	(barrels)	(barrels)	(barrels)	(barrels)	(barrels)
Newfoundland	907,518	688,001	836,776	581,369	1,553,563
Maritimes	5,794,936	2,163,293	2,013,064	3,466,634	3,798,871
Quebec	19,031,183	6,093,930	4,163,389	13,413,160	15,918,699
Ontario	34,742,627	4,369,412	4,835,180	25,392,335	10,124,524
Manitoba	5,010,462	157,759	1,011,639	2,906,241	1,554,925
Saskatchewan	7,843,438	258,622	2,069,955	2,521,253	2,583,783
Alberta and Northwest Territories	10,017,555	238,525	3,298,766	1,076,282	1,949,183
British Columbia	8,789,354	1,933,398	3,429,716	3,179,167	5,764,285
Total	92,137,073	15,902,940	21,658,485	52,536,441	43,247,833

Source: Dominion Bureau of Statistics.

In Newfoundland, the Maritime Provinces, Quebec and British Columbia, there are relatively high sales of heavy fuel oils, which are used to a large extent for bunkering ships. The sale of such oils in Ontario was chiefly for industrial purposes, but additional sales may result from the increase in ocean traffic that the opening of the St. Lawrence Seaway has brought to the Great Lakes. Ontario also used large quantities of light fuel oils for domestic heating and its large motoring public accounts for the heavy sales of motor gasoline.

Supply and Demand - All Oils

(barrels)

	1958	1957
Supply		
Production		
Crude oil	165,496,196	181,848,004
Natural gasoline and liquid petroleum gases	2,816,962	2,980,504
Total, Canada	168,313,158	184,828,508
Total, Canada, barrels per day	461,132	506,379
Imports		
Crude oil (including small quantities of natural gasoline)	107,444,741	111,905,473
Products	30,451,414	34,644,099
Total	137,896,155	146,549,572
Changes in stock		
Crude oil	- 949,217	699,643
Products	+ 5,782,519	-2,661,024
Total, net	+ 4,833,302	-1,961,381
Total supply	311,042,615	329,416,699
Demand		
Exports		
Crude oil	31,679,429	55,674,228
Products	960,901	3,635,832
Total	32,640,330	59,310,060
Domestic sales		
Motor gasoline	92,137,073	87,724,628
Middle distillates	94,155,317	87,645,800
Heavy fuel oil	43,247,833	48,596,728
Other products	30,194,206	28,701,008
Total	259,734,429	252,668,164
Uses and losses		
Refinery	18,845,108	17,811,405
Field and pipeline	- 31,114	1,409,122
Total, plant	18,813,994	19,220,527
Total demand	311,188,753	331,198,751
Oils not accounted for	- 146,138	1,782,052
Domestic demand, all oils, total	278,548,423	271,888,691
Domestic demand, all oils, barrels per day	763,146	744,901