Canada

The Canadian Mineral Industry 1957

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Mineral Resources Division

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FOREWORD

This annual report has been prepared by the Mineral Resources Division with the collaboration of 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 1957, and is the continuation, under a new numbering, of a long series of similar annual publications dating back to 1886.

Final Dominion Bureau of Statistics figures are used except where noted. Market quotations are mainly from standard marketing reports issued in London, Montreal and New York.

The Division is indebted to all those who contributed data, in particular to mining operators and others connected with the mineral industry.

W. Keith Buck,
Chief,
Mineral Resources Division

(Photo: 99-4, Trans-Canada Pipe Lines Limited)

Rock ditch and rock right-of-way shown here are typical throughout northwestern Ontario, where Northern Ontario Pipe Line Crown Corporation is building its section of the natural-gas pipeline from Alberta to eastern Canada. The granite underburden must first be blasted to provide working space on the right-of-way for the heavy pipeline equipment, such as the cleaning and priming machinery shown here, then the ditch must be blasted to a depth of approximately 6 feet before the 30-inch-diameter pipe can be buried.

SUMMARY OF DEVELOPMENTS IN THE CANADIAN MINERAL INDUSTRY

by
B.F. Burke

General

Canada's mineral output in 1957 reached a value of $2,190.3 million, the highest recorded since mineral production was first evaluated on a national basis. It was greater by $105.4 million, or 5.1 per cent, than the production value of the previous year. This rate of increase, however, was the lowest since 1952-53, when the gain amounted to only 4.0 per cent. During the past 10 years, production has shown an average annual increase of 13.3 per cent.

Copper, zinc, lead, iron ore, gold and a number of the minor metals suffered the most serious declines. Because of a substantial increase in uranium output and a 17-per-cent increase in the value of nickel produced, the value of metal production was 1.2 per cent above that of 1956.

The value of industrial minerals produced, inclusive of structural materials, was $466 million in 1957, $46 million more than in 1956. About 15 of the industrial minerals rose in both quantity and value of output. Kiln capacity was increased because of growing construction demands, with the result that cement went up by more than 1 million tons in output and $17.9 million in value. The value of asbestos shipments increased by $4.6 million and of salt production by $1.8 million.

Fuel-production value in 1957 rose to $564.8 million, increasing by $46.0 million over that of 1956. Continuing to decline in output and value, coal production was worth $5.1 million less than in the previous year. Petroleum production, which is worth more than the output of any other Canadian mineral, added $47.0 million to its value; in 1955-56, however, it increased by $101.0 million, and in 1954-55 by $61.7 million. Natural gas, with a production value of $21.0 million, was $4.1 million higher than in 1956. It is expected that its output will greatly increase when pipeline shipments to eastern Canada begin.

Summary

Mineral Production of Canada

	Unit of Measure	1957 Quantity	1957 Value (000's $)	1956 Quantity	1956 Value (000's $)	Increase or Decrease Quantity	Increase or Decrease 000's $
Metallics	000's						
Antimony	lb	1,361	371	2,140	688	- 779	- 317
Bismuth	"	320	585	286	545	+ 34	+ 40
Cadmium	"	2,368	4,026	2,339	3,977	+ 29	+ 49
Calcium	"	221	282	395	515	- 174	- 233
Cobalt	"	3,923	7,784	3,517	9,066	+ 406	- 1,282
Copper	000's s.t.	359	206,898	355	292,958	+ 4	-86,060
Gold	000's oz	4,434	148,757	4,384	151,024	+ 50	- 2,267
Indium	"	384	694	363	795	+ 21	- 101
Iron ore	000's l.t.	19,886	167,222	19,954	160,362	- 68	+ 6,860
Iron, remelt	000's s.t.	188	10,084	160	7,997	+ 28	+ 2,087
Lead	"	181	50,670	189	58,583	- 8	- 7,913
Magnesium	000's lb	16,770	5,255	19,212	6,080	-2,442	- 825
Manganese ore		-	-		2	-	- 2
Molybdenum (Mo)	000's lb	784	1,167	842	956	- 58	+ 211
Nickel	000's s.t.	188	258,977	179	222,205	+ 9	+36,772
Palladium, iridium, etc.	000's oz	217	7,896	163	6,681	+ 54	+ 1,215
Platinum	"	200	17,835	151	15,726	+ 49	+ 2,109
Selenium	000's lb	321	3,535	330	4,460	- 9	- 925
Silver	000's oz	28,823	25,183	28,432	25,498	+ 391	- 315
Tellurium	000's lb	32	55	8	14	+ 24	+ 41
Tin	l.t.	317	580	338	670	- 21	- 90
Titanium ore	000's s.t.	11	97	2	17	+ 9	+ 80
Tungsten (WO_3)	000's lb	1,921	5,279	2,271	6,362	- 350	- 1,083
Uranium (U_3O_8)	000's lb	13,271	136,304	4,581	45,732	+8,690	+90,572
Zinc	000's s.t.	414	100,043	423	125,437	- 9	-25,394
Total metallics			1,159,579		1,146,350		+13,229

	Unit of Measure	1957 Quantity	1957 Value (000's $)	1956 Quantity	1956 Value (000's $)	Increase or Decrease Quantity	Increase or Decrease 000's $
Industrial minerals							
Non-metallics*							
Arsenious oxide	000's lb	3,697	137	1,790	78	+1,907	+ 59
Asbestos	000's s.t.	1,046	104,490	1,014	99,860	+ 32	+4,630
Barite	"	228	2,993	321	3,031	- 93	- 38
Feldspar	"	20	393	18	365	+ 2	+ 28
Fluorspar	"	66	1,757	140	3,408	- 74	-1,651
Gypsum	"	4,577	7,745	4,896	7,260	- 319	+ 485
Iron oxides	"	8	187	9	186	- 1	+ 1
Lithia (Li_2O)	000's lb	5,140	2,827	4,789	2,644	+ 351	+ 183
Magnesitic dolomite and brucite			3,047		2,783		+ 264
Mica	000's lb	1,282	112	1,844	96	- 562	+ 16
Mineral water	000's gal	349	185	293	150	+ 56	+ 35
Nepheline syenite	000's s.t.	200	2,754	180	2,574	+ 20	+ 180
Peat moss	"	138	4,735	128	4,241	+ 10	+ 494
Pyrite, pyrrhotite	"	1,166	4,808	1,047	4,539	+ 119	+ 269
Quartz	"	2,139	3,185	2,142	3,036	- 3	+ 149
Salt	"	1,772	13,990	1,591	12,144	+ 181	+1,846
Silica brick	millions	4	656	6	737	- 2	- 81
Soapstone and talc	000's s.t.	35	428	29	365	+ 6	+ 63
Sodium sulphate	"	158	2,569	182	2,838	- 24	- 269
Sulphur in smelter gas	"	235	2,322	236	2,324	- 1	- 2
Titanium dioxide	"	186	9,741	157	7,683	+ 29	+2,058
Total non-metallics			169,061		160,342		+8,719

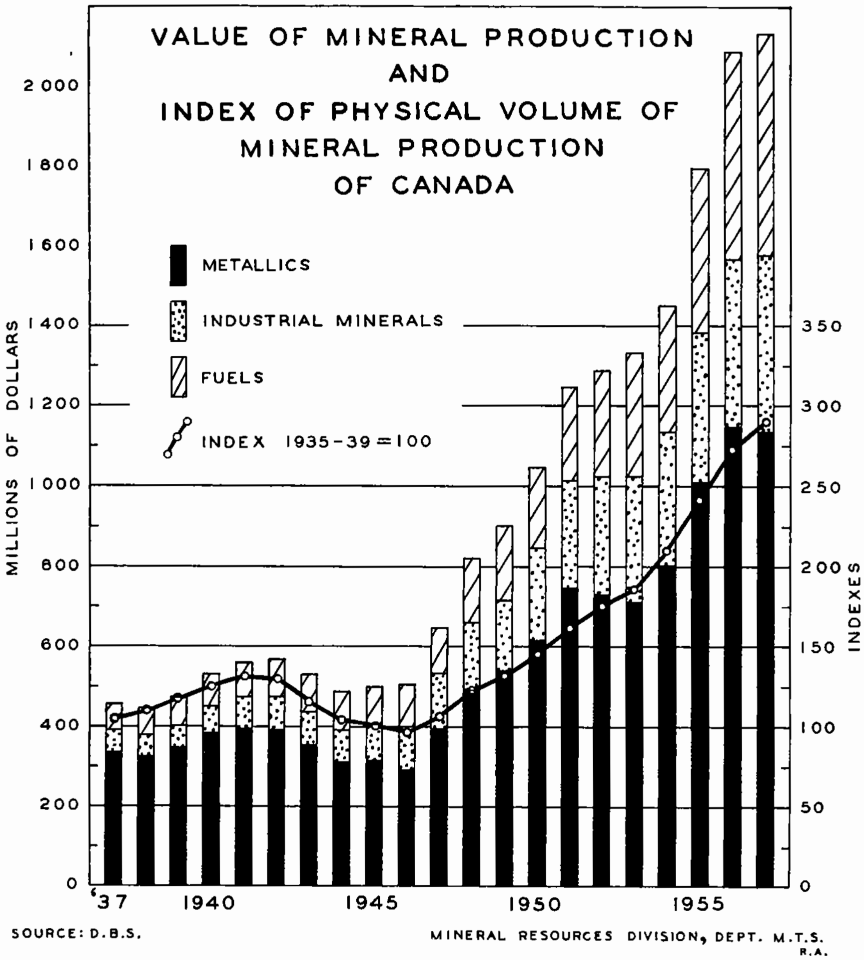
(continued)

Summary

	Unit of Measure	1957 Quantity	1957 Value (000's $)	1956 Quantity	1956 Value (000's $)	Increase or Decrease Quantity	Increase or Decrease 000's $
Structural materials							
Clays and clay products			35,922		37,785		- 1,863
Cement	000's s.t.	6,049	93,167	5,022	75,233	+ 1,027	+ 17,934
Lime	"	1,379	16,679	1,296	15,668	+ 83	+ 1,011
Sand and gravel	"	159,830	91,939	148,801	81,957	+11,029	+ 9,982
Stone	"	40,282	59,198	33,257	48,810	+ 7,025	+ 10,388
Total structural materials			296,905		259,453		+ 37,452
Total industrial minerals			465,966		419,795		+ 46,171
Fuels							
Coal	000's s.t.	13,189	90,221	14,916	95,350	- 1,727	- 5,129
Natural gas	millions of cu. ft.	220,007	20,962	169,153	16,849	+50,854	+ 4,113
Petroleum, crude	000's of bbl	181,848	453,594	171,981	406,562	+ 9,867	+ 47,032
Total fuels			564,777		518,761		+ 46,016
Grand total			2,190,322		2,084,906		+105,416

* Diatomite is included in the total but is not listed in the table. Its production is as follows: 1957 - 120 short tons - $2,400; 1956 - 2 short tons - $40.

The value of metallic minerals produced in Canada in 1957 amounted to $1,159.6 or 52.9 per cent of all mineral production. For the past 20 years the proportion contributed by metallics to total production has been decreasing. In 1947, the value of metallic mineral production was 61.3 per cent; in 1937 it was 73.1 per cent. On the other hand, the production of industrial minerals, which amounted to $57.4 million or 12.5 per cent of total value in 1937, had increased to $466 million or 21.3 per cent of the total in 1957. Owing to the substantial increases in crude petroleum, mineral fuels are playing an increasingly important role in Canadian mineral production. Fuel production in 1957 was worth $564.8 million, or 26 per cent of the total value of mineral output. In 1947 this percentage was 17.1 and in 1937 it was 14.4. Measured in value of output, industrial minerals and fuels have made greater gains than metallic minerals. This trend is indicated on the chart on page 5.


VALUE OF MINERAL PRODUCTION
AND
INDEX OF PHYSICAL VOLUME OF
MINERAL PRODUCTION
OF CANADA
METALLICS
INDUSTRIAL MINERALS
FUELS
INDEX 1935-39 = 100
MILLIONS OF DOLLARS
INDEXES
2 000
1 800
1 600
1 400
1 200
1 000
800
600
400
200
0
350
300
250
200
150
100
50
0
'37
1940
1945
1950
1955
SOURCE: D.B.S.
MINERAL RESOURCES DIVISION, DEPT. M.T.S.
R.A.

Summary

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

(millions of short tons)

	1955	1956	1957
Metallic ores			
Gold-quartz ores	16.4	14.5	14.4
Copper-gold-silver ores	9.9	10.4	10.6
Silver-cobalt ores	0.3	0.2	0.2
Silver-lead-zinc ores	7.5	7.7	6.7
Nickel-copper ores	17.0	18.5	19.3
Iron ores	17.2	23.9	26.4
Miscellaneous metallic ores	0.8	2.1	6.7
Total metallic ores	69.1	77.3	84.3
Non-metallics			
Asbestos	17.7	21.9	22.6
Feldspar and nepheline syenite	0.2	0.3	0.3
Quartz	1.0	1.3	1.3
Gypsum	4.5	4.9	4.7
Other non-metallics	1.4	1.9	1.6
Total non-metallics	24.8	30.3	30.5
Structural materials			
Stone, all kinds, (exclusive of stone used for cement and lime)	30.5	33.3	40.3
Stone for manufacture of cement	6.0	7.2	8.7
Stone for manufacture of lime	2.3	2.3	2.6
Total structural	38.8	42.8	51.6
Total ore mined and rock quarried	132.7	150.4	166.4

The very large increase in the tonnage of miscellaneous metallic ores mined in 1956 was due to the inclusion of uranium ores for the first time. A 39-per-cent increase in iron-ore tonnage mined and increases in the tonnages of copper-gold-silver and nickel-copper ores were the main causes of the 12-per-cent rise, from 1955 to 1956, in the total of metallic ores mined; and gains in these tonnages resulted similarly in another 9-per-cent increase in this total in 1957. Mainly owing to the substantial increases shown in the asbestos tonnages mined between 1955 and 1956, non-metallic ore production rose 22 per cent in 1956. Because of a considerable increase in 1957 in cement-production capacity, 21 per cent more limestone for cement manufacture was quarried that year than in 1956.

Coal and sand-and-gravel tonnages added to those in the foregoing table raise the totals, in millions of short tons, as follows:

	Summary		
	1955	1956	1957
Total ore mined and rock quarried	132.7	150.4	166.4
Sand and gravel produced	127.5	148.8	159.8
Coal produced	14.8	14.9	13.2
Total	275.0	314.1	339.4

Production Highlights of 1957

Metals

Copper

Production of copper in all forms was up to 359,019 tons from the all-time record production of 354,860 tons in 1956. The value of production showed a decrease - at $206,897,988 as against $292,958,091 in 1956 - because of substantial drops in the price of the metal.

Production from Ontario mines amounted to 171,704 tons, nearly all of which came from the Sudbury area. Production of copper from mines of The International Nickel Company of Canada Limited alone amounted to some 40 per cent of Canada's mine production.

The surplus world-supply condition which developed in 1956 was further accentuated during 1957 with higher world production. Toward the end of the year, world producers were taking steps to curtail output. Low prices forced low-grade Canadian producers to suspend operations. British Columbia mines were particularly affected.

Nickel

Increasing for the seventh successive year, nickel production reached 187,958 tons. This was 73 per cent of Free World production, which was also at an all-time high of 258,500 tons.

The Sudbury area of Ontario was the source of 95 per cent of Canadian production, the remainder being derived from Sherritt Gordon Mines Limited at Lynn Lake, Manitoba, and from North Rankin Nickel Mines, Limited, on the west coast of Hudson Bay, Northwest Territories.

When the nickel shortage ended, in 1957, the continual supply shortage that had come to a head at the beginning of the Korean War also ended, as did premium prices for nickel. Development and exploration plans were being curtailed although The International Nickel Company of Canada Limited continued with its plans to bring the Thompson and Moak Lake mines in Manitoba to the production stage. The railway spur from Sipiwesk, Manitoba, was completed to Thompson. The Thompson mine will be equipped to produce 75 million pounds of nickel a year by mid-1960.

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Summary

Lead

Lead production in 1957 was about the same as in the previous year. Reduced output from British Columbia mines, which regularly produce about 75 per cent of the national total, was offset by production gains in New Brunswick, where Heath Steele Mines Limited opened a new mill, and in Newfoundland, where production by Buchans Mining Company Limited was increased. Output from Yukon was down slightly.

Lead was in oversupply during the year, and the price dropped from 15.5 to 12.25 cents a pound.

No work was done to bring Canada's major lead reserves at Pine Point on Great Slave Lake in the Northwest Territories into production. These deposits are owned by The Consolidated Mining and Smelting Company of Canada Limited. Adequate reserves have been proven.

Zinc

Zinc production declined by 8,892 tons in 1957, chiefly owing to reduced production following a drop in the price of zinc from 13 1/2 to 10 cents a pound. Several zinc mines were closed down, notably Barvue Mines Limited in western Quebec and two British Columbia operations of The Consolidated Mining and Smelting Company of Canada Limited - the Sullivan open pit at Kimberley and Tulsequah Mines Limited, a northwestern subsidiary.

First production was obtained from base-metal ores in the Manitouwadge district of northern Ontario, and in the Bathurst-Newcastle district of New Brunswick. Production from Sudbury district zinc-lead-copper ores was deferred, owing to low prices.

Exploratory diamond-drilling of an electromagnetic anomaly in the Mattagami Lake area, 100 miles north of Senneterre in western Quebec, outlined a large base-metal deposit containing mainly zinc. Development continued at the Snow Lake properties owned by Hudson Bay Mining and Smelting Co. Limited, 70 miles east of Flin Flon, Manitoba.

Gold

The adverse conditions facing the gold-mining industry at the end of 1956 continued into 1957. By the year-end, however, the outlook was brighter.

The premium on the Canadian dollar in relation to the United States dollar continued to rise. During the week of August 19 to 23, 1957, the price received for an ounce of fine gold at the Royal Canadian Mint dropped to a low of only $33.06. This trend was, however, reversed, and by the year-end gold was selling at $34.42 a fine ounce. The average price was $33.55 in 1957, $34.45 in 1956 and $34.52 in 1955.

The labour supply continued to be a problem early in the year, but a subsequent reduction in base-metal output resulted in the release of some miners for employment in the gold-mining industry. The higher grade of ore worked gave a small increase in gold output, but a lower gold price reduced the value to $149 million from the $151 million reached in 1956.

In spite of adverse conditions, no gold mines closed during the year. French mines Limited in British Columbia started working a portion of the old property of Kelowna Mines Hedley Limited (French mine) near Hedley, and produced a small amount of gold.

Gold continued to hold fifth place in value among minerals produced in Canada, following crude petroleum, nickel, copper and iron ore. In Free World gold output, Canada retained second place, following the Union of South Africa.

Ontario was again the leading producer, turning out 58 per cent of the total. Quebec followed with 23, Northwest Territories with 8, and British Columbia with 5 per cent.

Iron Ore

There was a slight decrease in iron-ore shipments by Canadian producers to 19,885,870 long tons* in 1957 from 19,953,820 tons in 1956. Shipments from mines in Quebec were higher during the year, but a decline in shipments from mines in Ontario and Labrador-Newfoundland left the total about the same as in 1956. The value of 1957 shipments increased to $167,221,425 from the $160,362,118 recorded in 1956. Ore imported for domestic consumption was down to 4,052,704 tons for the year from the 4,525,768 tons imported in 1956. Nearly all iron ore imported into Canada originates in the Lake Superior region of the United States.

From its mines at Wabana on Bell Island, Newfoundland, Dominion Wabana Ore Limited shipped a record total of 2,879,019 tons of ore to consumers in the United Kingdom and western Europe and to its parent company's steel plant at Sydney, Nova Scotia.

From the Schefferville area of Quebec, Iron Ore Company of Canada shipped 12.4 million tons of ore through its shipping terminal at Seven Islands on the St. Lawrence River. Production was derived from five open-pit mines in Quebec and Labrador-Newfoundland, about 350 miles north of Seven Islands. Diamond-drilling has indicated perhaps 1 billion tons of concentrating-grade iron ore on the company's holdings in the Wabush Lake area of Labrador.

In Quebec, The Hilton Mines, about 40 miles northwest of Ottawa, was being developed for production of iron-ore pellets early in 1958. Quebec Iron and Titanium Corporation shipped 726,518 tons of ilmenite, containing about 40 per cent iron, from Havre St. Pierre to its electric smelter at Sorel.

* Long tons of 2,240 pounds used throughout iron-ore section unless otherwise noted.

Summary

Shipments of remelt iron (Sorelmetal) from the smelter reached an all-time record of 187,529 tons. Quebec Cartier Mining Company continued development toward bringing its properties in the Mount Reed and Mount Wright areas of Quebec, 180 miles north of Shelter Bay, into production in 1961 at an annual production rate of 8 million tons. Exploration was continued by several companies on large deposits of concentrating-grade iron ore. Other companies continued beneficiation and market studies in connection with already indicated bodies of concentrating-grade iron ore.

In Ontario, production of direct-shipping iron ore by Steep Rock Iron Mines Limited amounted to 2,370,770 tons. Shipments of an agglomerated product, either pellets or sinter, were made by Marmoraton Mining Company, Limited, Algoma Ore Properties Limited, The International Nickel Company of Canada Limited and Noranda Mines Limited. Caland Ore Company Limited continued dredging of Falls Bay, Steep Rock Lake, and started sinking a large production shaft on its leased area a few miles east of the Steep Rock Iron Mines operations. Lowphos Ore Limited began construction of milling facilities to bring its beneficiating-grade magnetite deposit, north of Sudbury, into production during 1958. As in Quebec, several companies with iron-ore prospects in the province continued exploration, or beneficiation and market studies, during 1957.

From British Columbia, shipments of beneficiated magnetite were made to Japan by Texada Mines Limited, Argonaut Mine Division of Utah Company of the Americas and Empire Development Company Limited. Exploration of iron-ore prospects in the province continued throughout the year but at a slower pace than in preceding years.

Considerable uncertainty exists in the iron-ore industry concerning the market potential for 1958 because of a continuing low rate of steel production in the United States, Canada's largest iron-ore customer. A slackening in that country's steel production began in July and continued for the remainder of the year. The rate, which had been at 90 per cent of capacity in June, declined in December to about 55 per cent of the January 1, 1957, capacity of 133.5 million net tons. The decline continued during the early months of 1958.

Titanium

Since Canada's titanium industry is based almost entirely on the manufacture of titanium-dioxide slag for pigment manufacture, the curtailment in the United States defence purchase program of the metal has had no direct effect on the industry in this country. New records were established in 1957 for shipments of ilmenite ($FeTiO_3$) by Quebec Iron and Titanium Corporation (QIT) from Havre St. Pierre, Quebec, to the smelter site at Sorel, and in shipments of titanium-dioxide slag and remelt iron (Sorelmetal) from the smelter to the company's customers. Canada's first plant for the manufacture of titanium-base pigments, that of Canadian Titanium Pigments Limited (CTP), a subsidiary of National Lead Company of the United States, was officially opened at Varennes, Quebec, on September 11. Its output will result in considerable reduction of Canadian imports of titanium-dioxide pigments, which have amounted to between 30,000 and 40,000 tons annually valued at from $10 million to $15 million.

Also in 1957, shipments amounting to approximately 15,000 gross tons of ilmenite, to be used as heavy aggregate in concrete for shielding nuclear reactors, were reported by QIT and Continental Iron and Titanium Mining Limited. Some finely ground ilmenite was sold for use as a weighting material (filler) in the coating applied to gas- and oil-transmission pipelines. Minor tonnages of ilmenite were shipped from the Baie St. Paul area of Quebec to manufacturers of ferrotitanium in the United States.

In the spring of 1957, the cutback in United States military requirements for titanium metal caused a serious decline in production and consumption for the rest of the year. The recently booming metal industry in that country was advised at the May 21 meeting of the Titanium Producers and Fabricators Industry Advisory Committee that military requirements for titanium over the next few years would be substantially below the 30,000 tons a year estimated late in 1956. Toward the end of the year, sponge-metal manufacturers were operating at less than 50 per cent of capacity.

Uranium

A threefold increase over the production of 1956 placed uranium sixth in value of production among Canadian minerals. Ontario turned out 3,985 of the 6,636 tons of uranium precipitate (U_3O_8) produced. Saskatchewan followed with 2,231 tons and the remaining 419 tons came from the Northwest Territories.

Eleven new mines and seven new processing plants went into production during the year in the Northwest Territories and in the Lake Athabasca, Blind River and Bancroft areas, and two established producers in the Lake Athabasca area increased milling capacities. The total rated milling capacity of the industry was thereby increased from 9,250 tons a day at the end of 1956 to 27,100 tons at the end of 1957.

Output of the industry is expected to more than double during 1958 because most of the producers that entered the field in 1957 will have reached full production, and six new mines and processing plants will be in operation in 1958. The daily milling capacity will then be 43,000 tons, and the yield about 45 tons of precipitate a day.

Fuels

Crude Petroleum and Natural Gas

The year 1957, which followed 10 years of uninterrupted expansion, was a period of mixed trends for the Canadian oil and gas industries. Exploratory drilling was at record levels during the year, but field-development drilling was down about 10 per cent from the 1956 peak. Gas-pipeline construction had its greatest year while oil-pipeline work was more restricted than in past years. In petroleum-refining the year was principally one of planning construction projects to be undertaken during the next two years. In marketing, domestic demand for oil advanced at a rate of less than one half the average annual increase experienced since 1946 while natural gas consumption began to show very marked increases.

In gas-pipeline construction, more than 1,800 miles of gathering and transmission lines were placed in the ground, and over 2,500 miles of distribution lines added to systems in communities. In oil-pipeline work, the 156-mile extension of the Interprovincial Pipe Line Company's system to the Toronto area is of particular significance as it will reduce the dependence on foreign crude oil and widen the market in Ontario for western Canada crude.

Major refinery expansion was carried out in the Toronto area and a new refinery of 20,000-bbl daily capacity was planned for each of the refining centres in Montreal, Toronto and Vancouver.

In the aggregate, the oil and gas industries had a favourable year in 1957: the value of crude-oil production reached $453.6 million and that of natural gas $21.0 million. Crude oil was again Canada's leading mineral commodity with a production value $195 million greater than that of nickel, which was in second place.

Petroleum and natural gas together now account for 22 per cent of the annual value of Canada's mineral production. The present status of these industries indicates that this ratio will be maintained. In addition, during the next few years the increasing use of natural gas will have widespread secondary benefits on the whole Canadian economy.

Coal

The increasing competition from oil and gas, aided by a milder winter, resulted in an almost 12-per-cent decrease in coal output to 13,189,000 tons. This was 31 per cent below the record of 19,139,000 tons set in 1950.

Output per man-day again showed a slight increase - 7.5 per cent for strip mining and 3.6 per cent for underground mining. The latter continues to show a steady increase in productivity per man-day, reflecting the influence of increasing and improved mechanization.

Industrial Minerals

Asbestos

Production of asbestos in 1957 was not affected by the general business recession. Shipments, at 1,046,086 short tons were 3 per cent higher than in 1956 and their value reached a peak of $104,489,431.

Expansion of facilities in the Eastern Townships was continued, and three new mines were being prepared for production early in 1958. Since the program of expansion commenced in 1950 it has involved capital expenditures of almost $100 million. In the Burlington peninsula area of Newfoundland, an important deposit of chrysotile asbestos was explored by Advocate Mines Limited. The company estimated ore reserves at 23 million tons and is planning construction of a 2,000-ton mill.

Cement

Production of cement increased by more than 1 million tons over the production of 1956 and reached 6,049,098 short tons, an all-time record. The increase resulted from enlarged kiln facilities at existing plants. Annual plant capacity at year-end was 6,825,000 short tons and was expected to reach 7,350,000 early in 1958 with the entry of two new plants into production. This was to climax a program of industry-wide expansion that began shortly after World War II.

The increased production of 1957 gave the industry a favourable trade balance for the first time since 1945. Imports were valued at $1,870,318, exports at $6,052,491.

Salt

The salt industry set a new record in 1957 when 1,771,559 tons valued at $ 13,989,703 were produced. The industry has changed radically since 1955 when the mining of pure rock salt began on a large scale at Ojibway, Ontario, near Windsor. Not only has the production of salt almost doubled since 1954, but Canada has become a salt-exporting country and reduced import demand. The development of the vast salt resources continued in 1957, the emphasis being placed on the mining of rock salt and on the production for export of brine. The original producer of rock salt - Malagash Salt Company Limited, Malagash, Nova Scotia, now a subsidiary of The Canadian Salt Company Limited - was sinking a shaft in a salt deposit at Pugwash, Nova Scotia. Dominion Rock Salt Company, Limited, was developing a rock-salt mine at Goderich, Ontario. The Canadian Rock Salt Company Limited, a subsidiary of The Canadian Salt Company Limited, developed its mine at Ojibway to the stage where 500 tons an hour can be produced. Another subsidiary of The Canadian Salt Company Limited, Canadian Brine Company, was preparing another property near Ojibway, from which brine will be obtained for export to Detroit. Production of this brine was planned for 1958, and exports, at the rate of 1 million tons of salt in brine form, will be delivered through 10-inch pipelines already laid at the bottom of the Detroit River.

Sulphur

Output of sulphur in all forms increased about 15 per cent over that of 1956 to a record 850,925 tons. This was the result of two factors, namely, a trebling of the production of elemental sulphur derived from the cleaning of sour natural gas and increased use of by-product pyrite for the production of sulphuric acid, mainly for the expanding uranium industry.

The rapid production increase of the past few years has placed Canada among the world's top producers. A further increase in output is expected owing to developments under way. The International Nickel Company of Canada Limited announced a new source of high-purity elemental sulphur in its process developed at Port Colborne, Ontario, for the recovery of nickel by direct electrolysis of nickel matte. The build-up of markets for natural gas in eastern Canada points to a tenfold increase by 1960 in the production of elemental sulphur from the cleaning of sour natural gas in western Canada. In Montreal, Laurentide Chemicals and Sulphur Ltd. announced plans to recover 100 tons of sulphur a day from oil-refinery and chemical wastes. The plant was expected to be in operation early in 1958.

Lime

An output of 1,378,617 tons valued at $16,678,614 made 1957 the greatest production year in the long history of the lime industry. Chemical and other industrial users took more than 82 per cent of the output. The needs of Canadian uranium mines will amount to an estimated 950 tons of lime a day when all mills are in operation. To help supply this new market the plant of Gypsum, Lime and Alabastine, Canada, Limited, at Beachville, Ontario, has been enlarged by the addition of a large rotary kiln and a large shaft kiln. North American Cyanamid Limited (now Cyanamid of Canada Limited) has also built a rotary kiln plant at its Beachville limestone quarry.

Fluorspar

Illustrative of how the production of a so-called strategic material can change radically when it is no longer required for stockpiling is the fact that Canada's fluorspar output dropped in 1957 to 66,245 tons from the previous year's record-breaking total of 140,071 tons. A prolonged strike at the Arvida works of the Aluminum Company of Canada Limited also contributed to a lessening of production, the aluminum industry being one of the main markets for fluorspar. The decreased demand resulted in the shut-down of the mine of St. Lawrence Corporation of Newfoundland Limited, one of the two principal producers. Nearly all of Canada's fluorspar production comes from Newfoundland.

Potash

International attention was focused on the progress being made toward getting the rich but deeply buried potash deposits of Saskatchewan into production. At the close of the year 12 different companies held land along Saskatchewan's potash belt. They were financed by Canadian, United States, French and German capital. Two of them, namely, Potash Company of America Limited and International Minerals & Chemical Corporation (Canada) Limited, are sinking shafts and building large surface plants in which to process the potash for industrial use. Each company is spending in excess of $30 million on the project. Potash Company of America, the most advanced, had reached a depth of more than 2,500 feet with its shaft at year-end and had another 700 feet to go to reach the potash. Its shaft and plant are 14 miles east of Saskatoon. International Minerals & Chemical Corporation is sinking its shaft at Esterhazy, near Yorkton.

Provincial Distribution of Mineral Production*

Ontario, Canada's leading mineral-producing province, provides more than half of the national metal output. It is the only producer of calcium and of platinum and platinum metals. Ontario also leads in the output of nickel, copper, gold, magnesium and uranium, and is a substantial producer of industrial minerals consisting chiefly of structural materials.

Alberta, by virtue of its large petroleum and natural-gas output, ranks second to Ontario. No metals, with the exception of very minor amounts of gold and silver from placer deposits, are produced in this province. Salt and structural materials form the industrial-minerals output.

Quebec, ranking third in value of mineral production, is the leading producer of industrial minerals. Feldspar, spodumene, magnesitic dolomite and brucite, and iron oxides come only from Quebec. Ninety-five per cent of Canada's asbestos is produced in this province. Substantial quantities of mica, peat moss, talc and soapstone, and structural materials such as cement, lime, sand and gravel, and stone are produced in Quebec. It is second to Ontario in the output of metals and is the leading producer of iron ore, molybdenum and titanium.

British Columbia is the largest producer of lead, zinc and silver, and leads in the production of antimony, bismuth, cadmium and tin, which are obtained in silver-lead-zinc mining operations. It is now the only province producing tungsten concentrates.

Newfoundland is the second largest producer of iron ore and lead. Most of its other mineral production consists of copper, gold, silver and zinc from one producer, Buchans Mining Company Limited. With the exception of a small tonnage of fluorspar from Ontario, Newfoundland is Canada's only producer of fluorspar.

Copper, lead, silver and zinc are produced in New Brunswick. Nova Scotia, with the exception of very minor amounts of gold, produces no metals but is Canada's largest producer of gypsum and barite. In recent years it has also been the greatest coal-producing province in Canada.

The mineral production of the Northwest Territories and Yukon consists for the most part of metallic minerals, chiefly gold, silver, lead, zinc, uranium and nickel. No industrial minerals are produced, but there is a minor output of coal, petroleum and natural gas.

* See map at end of report.

Summary

Mineral Production of Canada, by Provinces, 1957

	Metallics		Industrial Minerals		Fuels		Total	
	$ (000's)	% of Canada Total	$ (000's)	% of Canada Total	$ (000's)	% of Canada Total	$ (000's)	% of Canada Total
Newfoundland	77,372	6.7	5,310	1.1	-	-	82,682	3.8
Nova Scotia	1	-	15,180	3.3	52,878	9.4	68,059	3.1
New Brunswick	4,790	0.4	9,957	2.1	8,374	1.5	23,121	1.1
Quebec	200,572	17.3	205,484	44.1	-	-	406,056	18.5
Ontario	600,980	51.8	140,355	30.1	7,488	1.3	748,824	34.2
Manitoba	33,716	2.9	14,280	3.1	15,468	2.7	63,464	2.9
Saskatchewan	77,463	6.7	10,907	2.4	85,092	15.1	173,461	7.9
Alberta	14	-	23,524	5.0	386,674	68.5	410,212	18.7
British Columbia	129,551	11.2	40,969	8.8	8,411	1.5	178,931	8.2
Northwest Territories	21,100	1.8	-	-	301	0.5	21,400	1.0
Yukon	14,020	1.2	-	-	91	0.02	14,112	0.6
Canada	1,159,579	100.0	465,966	100.0	564,777	100.0	2,190,322	100.0

Mineral Consumption in Relation to Production

The consumption of minerals is not evaluated in the same way as their production. In the case of production, the evaluation method makes it possible to obtain the total value; in the case of consumption it does not. Extensive consumption data on an individual basis are nevertheless available. Consumption information for most of the metallic minerals is obtained directly from the consuming industries and in most cases is on a quarterly basis. In the case of non-metallics, information on consumption is obtained in conjunction with other statistical material and for the most part is not as up to date as that for metals. For some commodities no consumption data are available, and in such cases indicated or apparent consumption is used. This is calculated as production plus imports less exports and, although it takes no account of producers' and consumers' stocks, it gives a fair estimate of consumption. In most cases no information on the value of the commodity is obtained. It is, therefore, not possible to compare the total value of consumption with that of production. The following table, however, shows in quantity the production and consumption of the main mineral commodities for the years for which complete data for both are available.

Consumption of the Main Minerals in Canada in Relation to Production

Mineral	Unit of Measure	Year	Production	Consumption	Per Cent Consumption of Production	Remarks
Aluminum	s.t.	1957	556,715	77,984	14.0	Consumption: producers' domestic shipments
Antimony	lb	1957	1,360,731	1,401,000	103.0	Production: antimony content of antimonial lead and flue dust, and dore slag Consumption: antimony regulus
Arsenic	"	1957	3,697,137	460,562	12.5	Refined white arsenic
Asbestos	s.t	1957	1,046,086	15,526	14.8	Production less exports
Barite	"	1957	228,048	21,300	9.3	Apparent consumption
Bauxite	"	1957	nil	1,832,767	-	
Bismuth	lb	1957	319,941	53,415	16.7	
Cadmium	"	1957	2,368,130	176,598	7.5	
Cement	s.t.	1957	6,049,098	5,803,162	95.8	Apparent consumption
Chromite	"	1957	nil	70,971	-	
Coal	"	1957	13,189,155	31,516,119	239.0	
Cobalt	lb	1957	3,922,649	215,352	5.5	
Copper	s.t.	1957	359,109	118,225	32.9	
Feldspar	"	1957	20,450	14,723	72.0	
Fluorspar	"	1957	66,245	70,761	106.8	
Graphite	"	1956	nil	3,078	-	
Gypsum	"	1957	4,577,492	1,171,169	25.6	
Iron ore	l.t.	1957	19,885,870	5,965,805	30.0	Apparent consumption
Iron oxide	s.t.	1957	7,518	5,999	80.4	Consumption in coke and gas industries only
Lead	"	1957	181,484	74,583	41.1	Consumption: refined lead from primary and secondary sources
Lime	"	1957	1,378,617	1,370,616	99.4	Apparent consumption
Magnesium	"	1957	8,385	790	9.4	Consumption estimated
Manganese	s.t.	1957	nil	195,088	-	
Mercury	lb	1957	nil	215,344	-	
Mica	"	1957	1,282,416	4,526,926	353.0	
Molybdenum	"	1957	783,739	698,420	89.1	Production: Mo content Consumption: molybdenum addition agents, Mo content
Natural gas	M cu. ft.	1957	220,006,682	168,783,456	76.7	Consumption estimated
Nepheline syenite	s.t.	1957	200,016	24,000	12.0	
Nickel	"	1957	187,958	4,532	2.4	Consumption: metallic nickel only

Summary

Consumption of the Main Minerals in Canada in Relation to Production (cont'd)

Mineral	Unit of Measure	Year	Production	Consumption	Per Cent Consumption of Production	Remarks
Petroleum, crude	bbl	1957	181,848,004	238,620,908	131.2	Consumption: crude run to stills
Phosphate rock	s.t.	1957	nil	772,715	-	
Potash (muriate)	"	1957	nil	136,645	-	Consumption: imports of potash for fertilizers
Quartz and silica	"	1957	2,139,246	2,480,120	115.9	
Salt	"	1957	1,771,559	1,681,154	94.9	Apparent consumption
Selenium	lb	1957	321,392	15,572	4.8	
Silver	oz	1957	28,823,298	10,730,255	37.2	Consumption: includes mint consumption
Sodium sulphate	s.t.	1957	157,800	163,472	103.6	
Sulphur	"	1957	850,925	431,202	50.7	Production: sulphur content of pyrite, smelter gases and sulphur from natural gas Consumption: elemental sulphur only
Talc and soapstone	"	1957	34,725	34,674	99.9	
Tin	l.t.	1957	317	3,622	1,142.6	
Titanium (ilmenite)	s.t.	1957	824,432	635,067	77.0	Production: ilmenite shipped Consumption: ilmenite treated
Tungsten	lb	1957	1,523,736	277,972	18.2	Production: W content of scheelite shipments Consumption: W content addition agents
Uranium (U_3O_8)	s.t.	1957	6,636	-	-	Production (U_3O_8): all exported
Zinc	"	1957	413,741	54,420	13.2	Consumption: primary virgin

It is difficult to relate consumption to production in all cases because for certain commodities complete consumption data are not available. For some mineral commodities the consumption and production data do not cover the same things. In the case of sulphur, for instance, production refers to the sulphur content of pyrite, the content of smelter gases and elemental sulphur derived from natural gas, while complete information on consumption is available only for elemental sulphur. Ilmenite consumption refers to the tonnage treated during the year. The resultant product, titanium-dioxide slag, was exported.

With allowance, however, for certain shortcomings, particularly in consumption data for the non-metallics, the table shows that of the 44 metals and non-metals listed, 17 metals and 13 non-metallic minerals are produced in excess of domestic requirements (in excess supply). It is necessary to import for consumption requirements four commodities in the metal class and 10 non-metallics. The degree of self-sufficiency can be determined readily by reference to the column showing consumption as a percentage of production.

Canada in Relation to the World

The importance of Canada in the world as a producer of certain important metals and non-metals is shown in the table on page 22. Production statistics are shown for the world and six leading producing countries.

Exports of Minerals and Their Products

The total value of exports of minerals and their products amounted to $1,872.7 million in 1957. These exports include raw materials, semi-processed products and fully manufactured goods. In the raw-material classification are included all ores and concentrates and also matte, speiss and slag. This group includes material of mineral origin at the unprocessed stage - for example, crude petroleum or crude asbestos. The semi-processed class includes products such as pig iron, ferro-alloys, copper ingot and bars, and milled asbestos. In the fully manufactured class are products of metal or mineral origin in which manufacture is so far advanced that they are consumable without further processing. All manufactured articles of iron and steel, non-ferrous products such as copper tubing, silver manufactured products and asbestos products belong to this group.

In 1957, exports of these three classes of mineral products amounted to 38.7 per cent of Canada's total export trade; in 1956 they amounted to 35.7 per cent. Raw materials and semi-processed manufactures (inclusive of aluminum), which together are directly the products of Canada's mining, smelting and refining industries, accounted for 31.1 per cent of the total value of export trade in 1957 and for 28.9 per cent in 1956. Over the same period their export value increased by $117.6 million.

Canada's Role in the World in 1957 as a Producer of Certain Important Minerals

Metal or Non-metal	World Production	Rank 1	2	3	4	5	6
Nickel		CANADA	U.S.S.R.	New Caledonia	Cuba	United States	Union of S.A.
(short tons)	313,500	187,958	55,000	33,470	22,245	10,070	4,562
	100%	60.0%	17.5%	10.7%	7.1%	3.2%	1.5%
Asbestos		CANADA	U.S.S.R.	Union of S.A.	S. Rhodesia	United States	Italy
(short tons)	2,050,000	1,046,086	500,000	157,296	132,124	43,653	37,797
	100%	51.0%	24.4%	7.7%	6.4%	2.1%	1.8%
Zinc		United States	CANADA	U.S.S.R.	Australia	Mexico	Peru
(short tons)	3,196,893	531,735	413,741	375,000	274,320	267,889	170,257
	100%	16.6%	12.9%	11.7%	8.6%	8.4%	5.3%
Aluminum		United States	CANADA	U.S.S.R.	France	W. Germany	Norway
(short tons)	3,696,990	1,647,709	556,715	550,000	176,182	169,576	105,429
	100%	44.6%	15.1%	14.9%	4.8%	4.6%	2.9%
Platinum and		Union of S.A.	CANADA	U.S.S.R.	Colombia	United States	Japan
platinum metals	1,197,000	609,065	416,147	125,000	26,000	18,531	625
(fine ounces)	100%	50.9%	34.8%	10.4%	2.2%	1.5%	0.05%
Cobalt							
(short tons)		Belgian Congo	CANADA	United States	N. Rhodesia	Fr. Morocco	
	15,600	8,945	1,961	1,649	1,330	466	
	100%	57.3%	12.6%	10.6%	8.5%	3.0%	
Gypsum		United States	CANADA	France	United Kingdom	U.S.S.R.	India
(000's short tons	34,000	9,195	4,578	3,860	3,721	3,300	1,024
	100%	27.0%	13.5%	11.4%	11.0%	9.7%	3.0%
Cadmium		United States	S.W. Africa	CANADA	Mexico	Belgium	U.S.S.R.
(000's pounds	21,070	10,549	2,838	2,368	1,673	1,488	1,050
	100%	50.0%	13.5%	11.2%	7.9%	7.1%	5.0%
Gold		Union of S.A.	U.S.S.R.	CANADA	United States	Australia	Ghana
(fine ounces)	39,620,000	17,031,690	10,000,000	4,433,894	1,817,197	849,757	791,623
	100%	43.0%	25.2%	11.2%	4.6%	2.1%	2.0%
Silver		Mexico	United States	CANADA	U.S.S.R.	Peru	Australia
(troy ounces)	228,700,000	47,148,425	36,279,000	28,823,298	25,000,000	24,844,684	15,739,439
	100%	20.6%	15.9%	12.6%	10.9%	10.9%	6.8%
Iron ore		United States	U.S.S.R.	France	CANADA	Sweden	W. Germany
(long tons)	425,650,984	106,148,418	82,908,707	56,855,059	19,885,870	19,664,245	18,480,867
	100%	25.0%	19.5%	13.4%	4.7%	4.6%	4.3%
Copper		United States	Chile	N. Rhodesia	U.S.S.R.	CANADA	Belgian Congo
(short tons)	3,861,996	1,092,744	533,855	480,313	465,000	359,109	267,026
	100%	28.3%	13.8%	12.4%	12.0%	9.3%	6.9%
Lead		Australia	United States	U.S.S.R.	Mexico	CANADA	Peru
(short tons)	2,429,043	350,880	338,216	310,000	236,858	181,484	151,183
	100%	14.4%	13.9%	12.8%	9.8%	7.5%	6.2%

Note: All figures for U.S.S.R. are estimates.

Canada's imports in 1957 amounted to $5,705.4 million - $864.7 million in excess of exports. This imbalance of trade would have been considerably larger if exports of minerals and their products of the three classes had not increased by $162.3 million. This increase did much to counteract a decrease of $20.8 million from 1956 to 1957 in the value of the agricultural and wood products exported.

Exports of Three Classes of Minerals and Their Products by Degree of Manufacture, 1957 and 1956

($ millions)

	1957	1956	Increase or Decrease $ Millions	Increase or Decrease %
Iron and its products				
Raw material	152.3	144.4	+ 7.9	+ 5.5
Semi-processed	92.7	77.6	+ 15.1	+19.5
Fully manufactured	273.8	236.8	+ 37.0	+15.6
Total	518.8	458.8	+ 60.0	+13.1
Non-ferrous metals and products				
Raw material	312.9	229.4	+ 83.5	+36.4
Semi-processed	636.3	672.2	- 35.9	- 5.3
Fully manufactured	57.0	57.9	- .9	- 1.6
Total	1,006.2	959.5	+ 46.7	+ 4.9
Non-metallic minerals and products (including fuels)				
Raw material	196.0	157.6	+ 38.4	+24.4
Semi-processed	111.6	103.0	+ 8.6	+ 8.3
Fully manufactured	40.1	31.5	+ 8.6	+27.3
Total	347.7	292.1	+ 55.6	+19.0
Total minerals and their products				
Raw material	661.2	531.4	+129.8	+24.4
Semi-processed	840.6	852.8	- 12.2	- 1.4
Fully manufactured	370.9	326.2	+ 44.7	+13.7
Total	1,872.7	1,710.4	+162.3	+ 9.5

Exports of Minerals and Their Products in Relation to Total Export Trade, 1957 and 1956

	1957 $ Millions	1957 % of Total Exports	1956 $ Millions	1956 % of Total Exports
Raw material	661.2	13.7	531.4	11.1
Semi-processed	840.6	17.4	852.8	17.8
Fully manufactured	370.9	7.7	326.2	6.8
Total	1,872.7	38.8	1,710.4	35.7
Total exports of all products	4,889.1	100.0	4,789.4	100.0

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Summary

Exports of Minerals and Their Products by Destination, 1957

($ millions)

	United Kingdom	United States	Other Countries	Total
Iron and its products	42.5	268.7	207.6	518.8
Non-ferrous metals and products	236.9	581.7	187.6	1,006.2
Non-metallic minerals and products	16.3	269.6	61.8	347.7
Total minerals and products	295.7	1,120.0	457.0	1,872.7
Percentage*	15.8	59.8	24.4	100.0

* These export distribution percentages closely follow Canada's total export trade of all products.

Prices of Main Minerals

The market for durable goods expanded from 1954 to 1956 throughout Canada and the Western World. This increasing demand for commodities, chiefly of mineral composition, resulted in an increase in the output of durable consumer products. In Canada between 1954 and 1956 the output of this class of manufactures increased 22.8 per cent, but between 1956 and 1957 it declined 4.3 per cent. Wholesale prices of all commodities rose 4.8 per cent between 1954 and 1957. In the case of non-ferrous metals and products, however, prices rose 18.9 per cent between 1954 and 1956, the sharpest increase taking place between 1954 and 1955. However, prices dropped in 1957, and the wholesale price level of these commodities was 11.6 per cent lower in 1957 than in 1956. This decline in basic-commodity prices of products upon which the Canadian mineral industry is so dependent was not as severe as that experienced in the United States. There the price level of non-ferrous metals and products increased 25.7 per cent between 1954 and 1956 and dropped 12 per cent in 1957.

The decrease in base-metal prices in 1957 throughout the Free World resulted chiefly from an excess of production over consumption. For a number of years following World War II the mine production capacity of copper, lead and zinc steadily increased. Demand for these metals was strong. A point was reached, however, where production exceeded demand, and prices began to weaken. Copper prices, which had reached an all-time high in 1956 partly because of production curtailment due to a number of strikes against large producers and partly because of speculation, suffered the most severe decline. The abrupt curtailment of United States Government stockpile purchases in 1957 led to depressed conditions in the lead and zinc industry. The closing-off of an outlet for about half a million tons a year of these metals, together with declining consumer demand for lead and zinc products, brought about price declines in these two metals. In addition, the United States Government found it necessary in April 1957 virtually to discontinue the barter program. This program, whereby surplus agricultural products were exchanged for certain metals and minerals, had supported the prices of lead and zinc. Its discontinuance eliminated a much needed outlet for excess output. Market supplies of lead and zinc were increased at a time when demand was falling, and this caused prices to weaken.

Average Annual Prices,* Main Minerals, 1956 and 1957

	1957	1956	Increase or Decrease (cents or dollars)	Per Cent Increase or Decrease
Copper, U.S. domestic, cents per lb	29.576	41.818	-12.242	-29.3
Lead, Common, N.Y., cents per lb	14.658	16.013	- 1.355	- 8.5
Zinc, Prime Western, East St. Louis, cents per lb	11.399	13.494	- 2.095	-15.5
Tin, Straits, N.Y., cents per lb	96.261	101.409	- 5.148	- 5.1
Silver, N.Y., cents per oz	90.820	90.826	- 0.006	
Aluminum ingot, cents per lb	27.516	26.010	+ 1.506	+ 5.8
Antimony, N.Y., boxed, cents per lb	36.590	36.470	+ 0.120	+ 0.3
Cobalt metal, dollars per lb	2.03	2.58	- 0.55	-21.3
Magnesium ingot, cents per lb	35.250	33.979	+ 1.271	+ 3.7
Nickel, f.o.b. Port Colborne (duty included), cents per lb	74.000	65.165	+ 8.835	+13.6
Bismuth, cents per lb	2.25	2.25		
Cadmium, cents per lb	169.650	170.000	- 0.350	- 0.2
Mercury, dollars per flask (76 lb)	246.978	259.923	-12.945	- 5.0
Selenium, dollars per lb	11.375	15.000	- 3.625	-24.2
Calcium, dollars per lb	2.05	2.05	-	-
Molybdenum metal, dollars per lb	3.35	4.075	- 0.725	-17.8
Titanium metal, dollars per lb	2.46	3.20	- 0.74	-23.1
Tungsten metal, dollars per lb	4.00	5.00	- 1.00	-20.0
Chromium metal, dollars per lb	1.29	1.26	+ 0.03	+ 2.4
Gold, Canadian dollars per oz	33.55	34.45	- 0.90	- 2.6
Platinum, dollars per oz	89.374	103.896	-14.522	-14.0

(table continued on next page)

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Summary

Average Annual Prices,* Main Minerals, 1956 and 1957 (cont'd)

	1957	1956	Increase of Decrease (cents or dollars)	Per Cent Increase or Decrease
Iron ore 51.5% Fe, dollars per l.t.				
Lower Lake ports				
Mesabi non-Bessemer	11.40	10.825	+ 0.575	+ 5.3
Mesabi Bessemer	11.55	10.96	+ 0.59	+ 5.4
Old Range, non-Bessemer	11.65	11.04	+ 0.61	+ 5.5
Old Range, Bessemer	11.80	11.18	+ 0.62	+ 5.5
Cobalt ore, dollars per lb of Co contained, 9%, f.o.b. Cobalt, Ont.	1.30	1.30	-	-
Titanium ore (ilmenite), 59.5% TiO_2, f.o.b. Atlantic ports, dollars per l.t.	26.25 to 30.00	26.15		
Molybdenite, 90-95% MoS_2, dollars lb of contained Mo	1.18	1.13	+ 0.05	+ 4.4
Sulphur, dollars per l.t.	25.75	26.50	- 0.75	- 2.8

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

Employment, Salaries and Wages in the Mineral Industry

Employment in the Canadian mineral industry in 1957 was 145,464. This includes employment in smelting and refining but excludes employment in clay products and in petroleum-refining and the operation and maintenance of oil and gas pipelines.

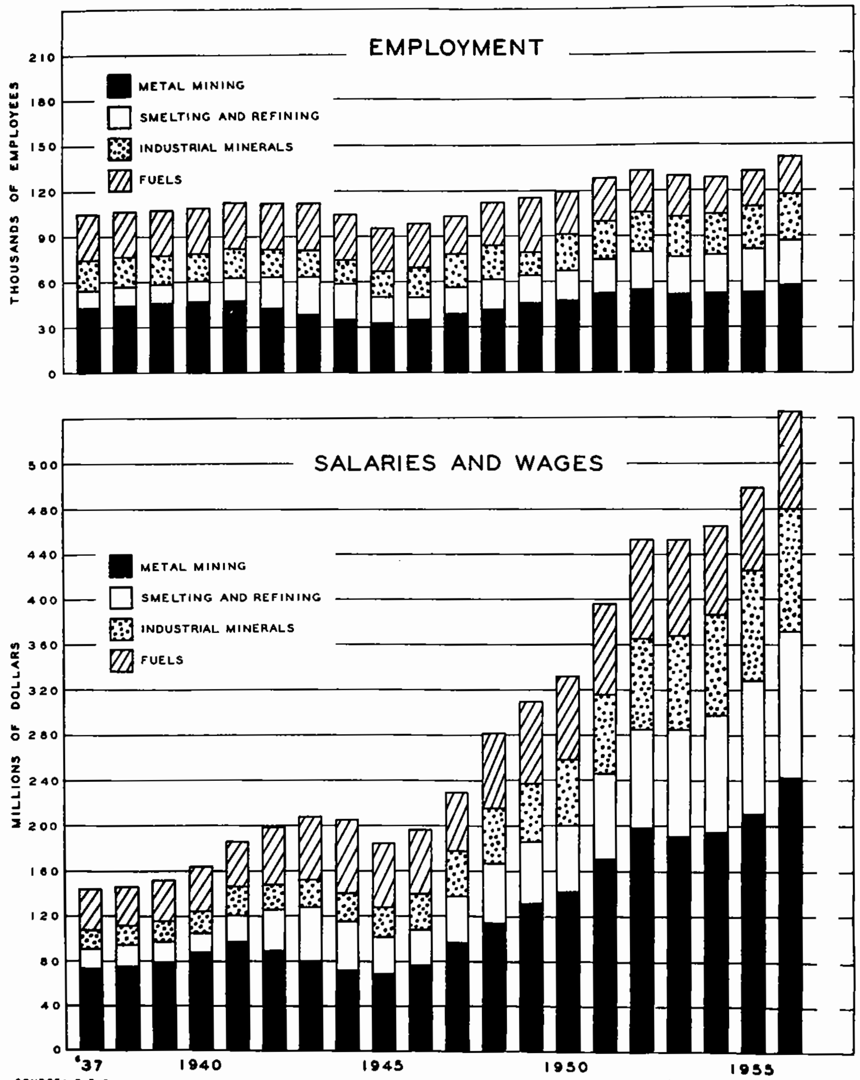
Final figures for 1956 are given in the following table:

Employees and Their Earnings in the Mineral Industry, 1957

	Number of Employees	Earnings ($ millions)
Metals	92,167	413.3
Industrial minerals	31,312	114.3
Fuels	21,985	82.0
Total	145,464	609.6

CANADIAN MINERAL INDUSTRY

1937—1956



SOURCE: D.B.S.

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

Summary

The foregoing table does not include petroleum-refining or oil- and gas-pipeline operation, nor does it include certain individuals and syndicates engaged in prospecting and general exploration. This is particularly the case with respect to fuels, from which oil and gas exploration and prospecting and magnetometer surveys, etc., are excluded. Complete employment and salary-and-wage data on these types of mining endeavour are not available. The chart on page 27 shows employment and salaries and wages in the mineral industry from 1926 to 1956 inclusive.

Railway Transportation of Minerals

Mine products transported by Canadian railways in 1957 amounted to 73.3 million tons. They constituted the largest single group of revenue-freight products for that year and accounted for 42.1 per cent of all revenue freight moved. Of the 73.3 million tons carried, 8.8 million, or 12.0 per cent, were reoeived from United States rail connections. The largest part of this was anthracite and bituminous coal imported from Canada.

Mine Products Transported by Canadian Railways, 1957

	Millions of Short Tons
Anthracite coal	2.1
Bituminous coal	14.7
Coke	2.1
Petroleum, crude	0.8
Iron ore and concentrates	19.7
Aluminum ore and concentrates	2.7
Copper ore and concentrates	1.0
Copper-nickel (nickel) ore and concentrates	3.3
Lead ore and concentrates	0.3
Zinc ore and concentrates	0.7
All other ores and concentrates	1.6
Barytes	0.05
Clay and bentonite	0.4
Sand and gravel	6.7
Stone and rock	8.2
Asbestos	1.0
Gypsum, crude	3.4
Asphalt	0.5
Salt	1.1
Phosphate rock	0.7
Sulphur	0.3
All other mine products (chiefly industrial minerals)	2.0
Total	73.3*

* If certain miscellaneous products of mineral origin and semi-fabricated or fully processed are added to this total, the tonnage of revenue freight of mineral origin would be 96.3 million tons, or 56.0 per cent of all revenue freight transported (see following table).

Products of Mineral Origin Transported by Canadian Railways, 1957

	Millions of Short Tons
Gasoline	4.2
Fuel oil	3.4
Petroleum and coal products, other	0.8
Iron and steel ingot, bloom, pig iron	0.9
Iron and steel bar, pipe, sheet, structural material	3.8
Iron and steel castings and forgings	1.1
Rails and fastenings	0.3
Scrap and waste metal	1.1
Aluminum ingot, etc.	0.5
Matte	0.3
Copper bar, ingot, etc.	0.6
Lead and zinc bar, ingot, etc.	0.5
Nickel bar, ingot, etc.	-
Metals and alloys, other	0.3
Fertilizers	2.0
Cement	2.2
Brick, building tile and artificial stone	0.4
Lime and plaster	0.5
Sewer pipe and drain tile	0.07
Sulphur	-
Total, products of mineral origin	23.0
Total, primary mine products	73.3
Total, all products of mineral origin	96.3

Consumption of Fuels and Electricity in the Mineral Industry

Statistics for 1957 indicate that the Canadian mineral industry expended $148.4 million on the purchase of fuels and electricity. This does not include the value of electricity the industry generated for its own use and for sale. The following table analyzes the quantity and value of fuels and electricity used in the three main types of mining and in smelting and refining.

Summary

Consumption of Fuel and Electricity in the Canadian Mineral Industry, 1957

	Metal-mining	Smelting and Refining	Total, Metal-mining, Smelting and Refining	Industrial Minerals	Mineral Fuels	Total, Mineral Industry
Coal and coke						
Short tons	186,680	1,307,626	1,494,306	1,606,395	117,961	3,218,662
$	2,814,214	19,030,867	21,845,081	18,615,768	689,589	41,150,438
Gasoline and kerosene						
Gal	3,486,570	745,914	4,232,484	11,768,769	6,016,946	22,018,199
$	1,470,321	266,548	1,736,869	4,363,900	2,312,145	8,412,914
Fuel oil						
Gal	43,178,805	67,971,634	111,150,439	73,827,836	5,385,651	190,363,926
$	8,361,128	7,588,700	15,949,828	9,575,765	1,112,199	26,637,792
Liquefied petroleum gas						
Gal	385,488	57,873	443,361	113,055	188,911	745,327
$	182,507	21,497	204,004	61,768	42,654	308,426
Manufactured gas						
M cu. ft.	8,352	163,318	171,670	1,249,622	1,500	1,422,792
$	5,601	100,728	106,329	198,402	550	305,281
Natural gas						
M cu. ft.	1,000	1,660,195	1,661,195	8,159,245	8,934,732	18,755,172
$	375	219,348	219,723	1,531,476	863,412	2,614,611
Other fuels						
$	447,473	72,971	520,444	452,875	13,934	987,253
Total, fuels						
$	13,281,619	27,300,659	40,582,278	34,799,954	5,034,483	80,416,715
Electricity purchased*						
Millions of kwh	2,823	13,668	16,491	1,435	328	18,254
$	18,306,764	32,174,132	50,480,896	11,664,350	5,798,742	67,943,988
Total value fuels and electricity purchased						
$	31,588,383	59,474,791	91,063,174	46,464,304	10,833,225	148,360,703
Electricity generated for own use						
Millions of kwh	546	1,037	1,583	31	13	1,627

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

In 1957 the mineral industry consumed 18,755,172 M cubic feet of natural gas valued at $2,614,611. It is expected that its consumption of this fuel will greatly increase when, in the near future, natural gas from western Canada is made available to the mineral industry in eastern Canada. The electricity consumed by the smelting and refining industry includes that used by the aluminum-smelting industry.

Capital Investment in the Canadian Mineral Industry

Estimated Book Value

Information on the total book value of Canadian industry is not available on a current basis. Statistics available at the end of 1954, however, indicate that investment in the Canadian mining and smelting industry amounted to $2,900 million. This does not include investment in petroleum refining and merchandising. Certain operations probably classified under manufacturing should be included under mining and smelting. It is not believed, however, that the amount of investment is very large. The statistics would not change much if further refinements in classification were possible.

Estimated Investment and Control of Capital
in the Mining and Smelting Industry
at the End of 1948, 1954 and 1955

	Mining, Smelting and Refining			Total Investment, All Industry ($ billions)	Mining, Smelting and Refining as Percentage of Total Investment, All Industry
	Owned in Canada ($ billions*)	Owned outside Canada ($ billions)	Total ($ billions)		
1948	0.7	0.4	1.1	16.0	6.9
1954	1.2	1.7	2.9	28.0	10.4
1955	1.3	2.1	3.4	30.6	11.1

* One billion = 1,000,000,000.

Annual Capital and Repair Expenditures

A survey is conducted annually of the capital and repair expenditures of all industrial organizations. Companies are requested to supply information with respect to their prospective expenditures for the year ahead. This information is then classified by industry and published in a D.B.S. report entitled Private and Public Investment in Canada, Outlook. Capital expenditures on construction include the cost of procuring, constructing and installing new durable plant whether for replacement of worn or obsolete assets or as net additions to existing assets. Included are purchases from persons and firms outside the business, together with the value of work on capital assets undertaken by the firm with its own working force. Repair expenditures refer to outlays to repair and improve existing assets in the form of buildings, industrial structures, and machinery and equipment.

In certain respects the industrial classification of the following statistical table does not agree with that used in other presentations in this review. This information is of value, however, in assessing the role the mineral industry plays in the general economy.

Capital and Repair Expenditures
in the Canadian Mineral Industry
1956 to 1958

($ millions)

	Capital Expenditures			Repair Expenditures			Capital and Repair Expenditures		
	Construction	Machinery and Equipment	Total	Construction	Machinery and Equipment	Total	Construction	Machinery and Equipment	Total
Mining, quarrying, oil wells, smelting and refining									
1956	378	164	542	19	62	81	397	226	623
1957	407	199	606	22	69	91	429	268	697
1958	267	95	362	22	66	88	289	161	450
Total, all industry									
1956	5,301	2,723	8,024	1,082	1,348	2,430	6,383	4,071	10,454
1957	5,784	2,933	8,717	1,237	1,387	2,624	7,021	4,320	11,341
1958	5,955	2,462	8,417	1,275	1,324	2,599	7,230	3,786	11,016

Taxes Paid by the Mineral Industry

For five important divisions of the industry, tax-payment statistics are available. For other important divisions - for example, petroleum and natural gas, coal-mining and uranium-mining - such statistics are not available.

The two following tables show the taxes paid by the five important divisions. The first table gives the total of the taxes paid by these groups to the federal, provincial and municipal governments from 1951 to 1956 inclusive, while the second shows in more detail the 1956 taxation payments these divisions made to the three types of government.

Taxes Paid by Five Important Divisions of the Mineral Industry, 1952 to 1957 Inclusive

($ millions)

	1957	1956	1955	1954	1953	1952
Auriferous quartz mining industry ..	5.9	6.2	6.2	5.9	5.4	...
Copper-gold-silver mining industry	19.2	26.1	18.1	13.0	15.8	21.1
Silver-lead-zinc mining and smelting industry	12.7	20.8	23.0	16.6	15.0	25.4
Nickel-copper mining, smelting and refining industry	46.6	48.9	24.6	27.6	30.4	36.7
Asbestos mining industry..........	12.1	11.7	9.2	9.2	14.8	14.6
Total	96.5	113.7	81.1	72.3	81.4	104.9

Taxes Paid to Federal, Provincial and Municipal Governments by Five Important Divisions of the Mineral Industry, 1957

	Federal Income Tax	Provincial Tax	Municipal Tax	Total
Auriferous quartz mining industry	3,133,517	1,996,938	789,106	5,919,561
Copper-gold-silver mining industry	13,411,009	4,572,134	1,198,828	19,181,971
Silver-lead-zinc mining and smelting industry ...	8,695,903	2,352,325	1,691,097	12,739,325
Nickel-copper mining, smelting and refining industry	32,278,135	12,860,969	1,447,061	46,586,165
Asbestos mining industry .	7,623,668	3,102,099	1,331,767	12,057,534
Total	65,142,232	24,884,465	6,457,859	96,484,556

The following table shows the federal income tax declared for the fiscal year ended March 31, 1956, by companies in the mineral and related industries. Federal income tax declared by all companies mining lode deposits, placer deposits, quarries and oil and gas wells amounted to $97.4 million. This was 7.4 per cent of the total federal tax declared by companies and corporations of all industries.

If certain industrial groups closely dependent on the mineral industry, such as metallurgical and metal-fabricating industries, producers of non-metallic mineral products, and industries engaged in petroleum-refining and the production of petroleum products, are included, then the taxes declared by the mining and these related groups amounted to $277.6 million, or 21.1 per cent of federal income taxes declared by all industrial concerns for the fiscal year ended March 31, 1955.

Summary

Federal Income Tax Declared by Companies in the Mining and Related Industries, Fiscal Year Ended March 31, 1956

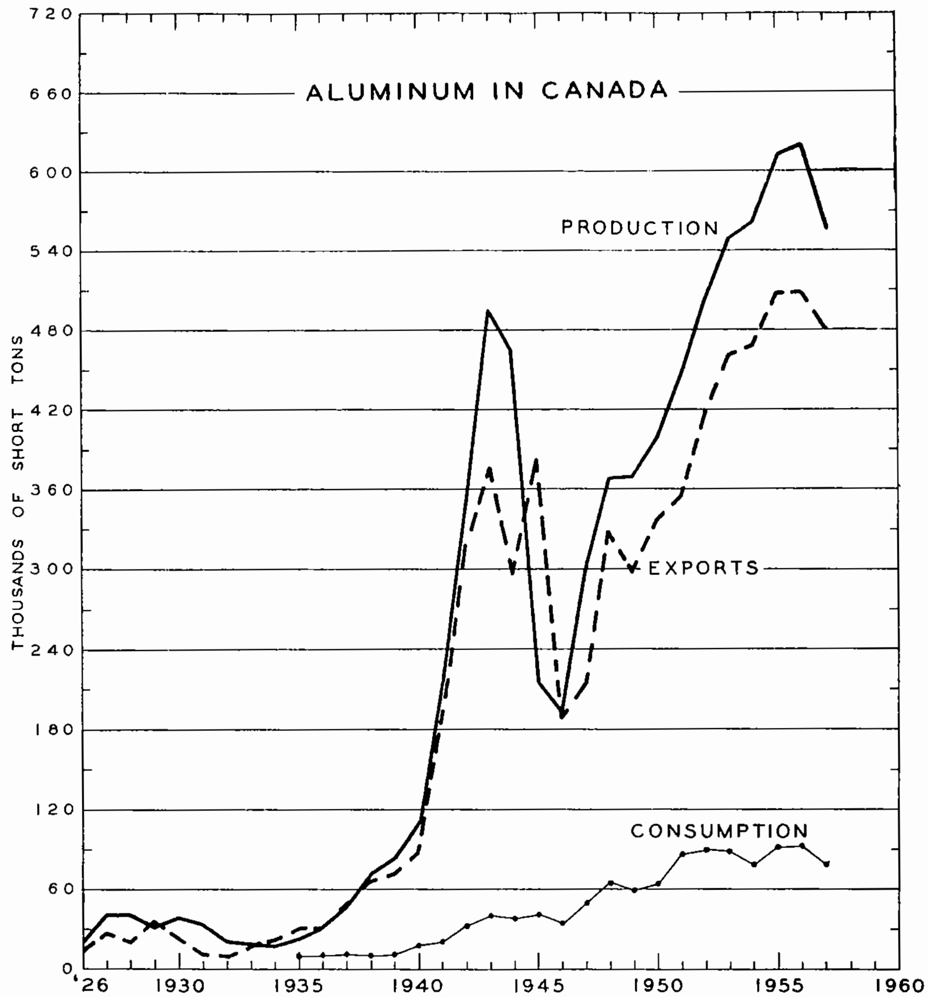
	Tax Declared ($ millions)
Mining, quarrying and oil wells	
Gold-mining	4.0
Other metal-mining	73.2
Coal-mining	1.1
Oil and natural gas	7.7
Non-metal mining	8.2
Quarries	2.3
Mineral and oil prospecting	0.9
Total	97.4
Metallurgical and metal-fabricating industries	
Primary iron and steel	48.0
Iron castings	13.6
Miscellaneous iron and steel products	4.6
Aluminum products	1.6
Other non-ferrous metal products	18.1
Total	85.9
Non-metallic mineral products	
Abrasives, asbestos, cement and clay products	12.7
Miscellaneous non-metallic mineral products	8.4
Fertilizers and industrial chemicals	9.1
Total	30.2
Petroleum and products	
Petroleum-refining and products	44.9
Miscellaneous petroleum and coal products	4.7
Fuel, gasoline and other petroleum products	14.5
Total	64.1
Total, mining and related industries	277.6
Total, all industry	1,316.7
Mining and related industries as percentage of all industry	21.1%

ALUMINUM

by
H. D. Worden

Canada is the second largest producer of primary aluminum metal. Production, which reached a low of 200,000 tons* annually at the end of World War II, increased steadily in the postwar period to 620,321 tons in 1956. In

(text continued on page 38)



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

* Short tons throughout.

Aluminum - Production, Trade and Consumption

	1957		1956	
	Short Tons	$	Short Tons	$
Production				
Ingot	556,715		620,321	
Imports				
Bauxite and alumina				
British Guiana	1,111,014	6,145,576	1,401,594	7,453,380
Surinam (Netherlands Guiana)	371,716	2,075,284	457,061	2,425,586
Jamaica	363,946	23,312,851	178,628	11,879,101
French West Africa.	338,175	1,838,769	311,974	1,697,010
United States.......	64,208	4,375,545	16	5,114
Japan.............	13,354	780,136	19,858	1,174,365
France	7,073	303,188	-	-
Total.............	2,269,486	38,831,349	2,369,131	24,634,556
Cryolite				
Denmark	6,697	1,370,306	3,856	824,793
West Germany	2,756	561,170	14,331	3,355,528
Italy	4,717	1,007,309	-	-
Others............	1,748	369,514	123	29,713
Total.............	15,918	3,308,299	18,310	4,210,034
Aluminum products				
Semi-manufactured.		5,266,381		11,514,512
Fully manufactured.		22,588,720		21,590,071
Total.............		27,855,101		33,104,583
Exports				
Primary forms				
United States.......	215,544	95,816,699	213,298	93,201,472
United Kingdom....	173,403	78,956,383	239,665	107,867,763
West Germany	18,952	8,987,814	9,300	2,463,817
Italy	10,948	5,138,183	5,093	2,294,178
Australia..........	7,430	3,750,509	5,148	2,570,449
Mexico............	5,976	2,826,722	4,510	2,123,522
Brazil.............	5,640	2,697,800	1,948	940,693
Japan	5,083	2,319,298	130	58,077
Other countries	35,694	16,935,106	29,902	15,911,715
Total.............	478,670	217,428,514	508,994	227,431,686
Semi-fabricated				
India..............	4,482	2,624,853	1,120	632,931
United States.......	3,294	2,848,983	3,079	2,340,905
Pakistan	1,059	637,931	-	-
Australia..........	996	584,421	60	102,826
Other countries	2,762	1,912,631	2,819	1,709,191
Total.............	12,593	8,608,819	7,078	4,785,853

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

	1957 Short Tons	1957 $	1956 Short Tons	1956 $
Exports - (cont'd)				
Manufactured				
United States.......		301,955		735,462
Venezuela		129,373		44,264
Korea.............		88,841		58,575
Other countries		589,302		518,800
Total.............		1,109,471		1,357,101
Scrap				
United States.......	9,100	2,235,349	4,759	998,377
West Germany......	1,160	307,648	1,428	500,457
Japan.............	926	373,212	1,476	594,562
Italy..............	877	327,999	1,097	398,136
Other countries	316	104,275	221	97,320
Total.............	12,379	3,348,483	8,981	2,588,852
Consumption*				
Aluminum ingot	77,984		91,869	

* Producers' domestic shipments.

Aluminum - Production, Trade and Consumption, 1947-57

(short tons)

	Production (ingot)	Imports (primary forms)	Exports (primary forms)	Consumption* (ingot)
1947	299,066	616	213,716	50,265
1948	367,079	25	327,108	65,433
1949	369,466	40	296,906	58,767
1950	396,882	63	335,726	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

* Producers' domestic shipments.

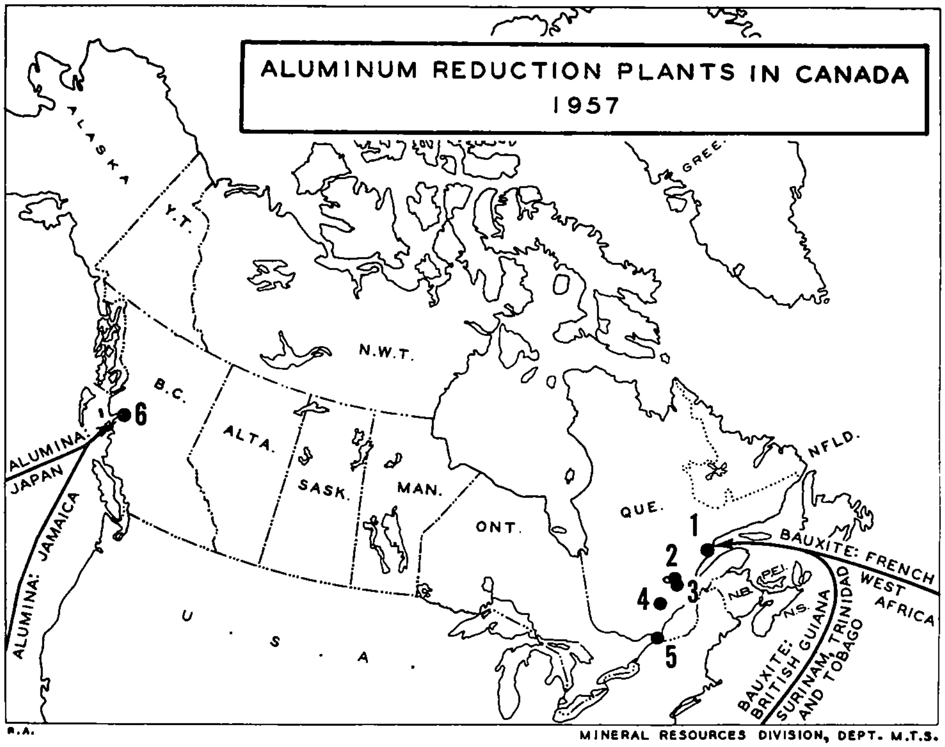
1957, however, the production rate was checked by mid-year and the output declined to 556,715 tons owing largely to a four-month strike at the Arvida, Quebec, plant of Aluminum Company of Canada Limited (ALCAN) involving 6,500 hourly-paid employees. When smelting resumed in September, world surpluses were clearly evident and subsequent production at Arvida was limited to 90 per cent of capacity for the remainder of the year. Beginning in January 1958, ALCAN reduced production to 80 per cent of rated capacity by curtailing production at its Arvida, Shawinigan and Kitimat plants.

Surplus aluminum on world markets affected expansion plans at ALCAN's plant at Kitimat, British Columbia. In October, construction work on No. 6 and No. 7 pot-lines was deferred pending an upturn in demand for the additional capacity, which amounted to 80,000 tons. The decision affected 1,700 workers. At the end of 1957 the fifth pot-line was taken off regular production, one half of it to be used for experimental work, the other half to remain idle. Hydroelectric-generator installation work continued throughout the year at Kemano, British Columbia, so that ALCAN's ultimate smelter capacity of 500,000 tons a year in the province can be installed when markets require the metal. Preparedness was also the reason why ALCAN continued its hydro development work at Chute-des-Passes on the upper Peribonca River. Here a million-horsepower hydro plant, costing an estimated $135 million, is scheduled for completion in 1959. The current hydro-power installation plans will provide the foundation on which smelter capacity can be readily expanded to 1 million tons annually.

Export sales of primary aluminum forms, which provide an outlet for approximately 85 per cent of production, declined 6 per cent in volume owing to a 27 1/2-per-cent drop in sales to the United Kingdom. The table on page 36 and 37 indicates that sales to all other countries increased substantially, with the exception of those to the United States, which showed only a small increase. The value of exports of foil and kitchenware, included in the table under "Manufactured", decreased to $230,610 and $68,737 respectively from $468,672 and $118,421 in 1956.

World production in 1957 is estimated at 3,696,990 tons; in 1956 it reached 3,683,515 tons. The first-mentioned amount includes a possible output of 550,000 tons in Russia, which in 1957 marketed an unprecedented quantity of aluminum in western Europe. The United States is the largest producer of primary aluminum, with combined annual smelting capacity of nearly 2 million tons. In 1957 its production dropped to an estimated 1,648,000 tons from the 1,679,000 tons produced in 1956.

Cheap hydroelectric power is a primary requisite for a profitable aluminum industry. For this reason Shawinigan Falls (now Shawinigan), Quebec, was selected in 1899 by Northern Aluminum Company Ltd. for a smelter site. In 1925, the name of the smelter was changed to Aluminum Company of Canada Limited (ALCAN) and by 1926 a second plant was established at Arvida on the Saguenay River. Today this plant is the largest single producer of aluminum in the world. It has 22 pot-lines with an annual capacity of 370,000 tons of aluminum in the form of remelting ingot, sheet ingot, extrusion ingot and wire



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

bar. ALCAN's plant at nearby Isle Maligne has three pot-lines with an annual capacity of 115,000 tons. The company's reduction plants in Quebec at Shawinigan and Beauharnois have, respectively, four and two pot-lines rated at 68,000 and 37,000 tons annually. ALCAN in 1954 commenced production at Kitimat, British Columbia, and by 1956 had completed construction of five pot-lines with an annual capacity of 180,000 tons, which remained unchanged during 1957 owing to deferred construction. Canadian British Aluminum Company Limited (CBALCO), the only other smelting company, established production in November 1957 by operating one of its four planned pot-lines at Baie Comeau, Quebec. Each pot-line will have a rated annual capacity of 45,000 tons.

In summary, current domestic aluminum-production capacity is 815,000 tons a year; deferred completion of some 375,000 tons of primary smelting capacity will bring production to 1,200,000 tons.

Bauxite and Alumina

Bauxite, the principal ore of aluminum, is not found in Canada. Labradorite and nepheline syenite, containing up to 30 per cent alumina (Al_2O_3), are plentiful, but they are not competitive with bauxite in the production of aluminum. Four tons of bauxite are required to make 2 tons of alumina, which in turn produce about 1 ton of metallic aluminum. Alumina is extracted from bauxite by a leaching process in which caustic soda is used.

Aluminum Limited, ALCAN's parent company, controls subsidiary companies that mine bauxite and produce alumina. Canada's main source of bauxite is in British Guiana. Here, Demerara Bauxite Company Ltd., at Mackenzie, has a capacity for producing 2,800,000 tons of beneficiated bauxite and the company also plans installations for annual production of 250,000 tons of alumina. Construction time for the ancillary equipment has been extended to defer the date of plant completion one year - to 1960.

Other sources of bauxite are Surinam and French West Africa. Alumina is imported principally from Jamaica, where it is produced by Alumina Jamaica Limited, now a wholly owned subsidiary of ALCAN. The construction, at Kirkvine, Jamaica, of a 550,000-ton alumina plant was completed during 1957 and 470,000 tons of alumina were produced. Designed especially to supply the Kitimat smelter, the plant also assisted in supplying the Quebec smelters with alumina during the strike period. The Arvida alumina plant extracted 785,000 tons of alumina in 1957 and 1,150,000 tons in 1956.

Uses and Consumption

Aluminum has good heat and electrical conductivity and its alloys have special physical and chemical properties covering a wide range of tensile strength and resistance to corrosion. The metal can be wrought, i.e. rolled, extruded, drawn, spun, forged, pressed and powdered, or cast in sand moulds, permanent moulds or dies. It is easily machined and has a bright attractive appearance.

In order of tonnages consumed, aluminum finds its most important use in transportation, building and construction, household and commercial appliances, electrical equipment, and packaging and canning. Large quantities are used by other industries also and many industries use chemical derivatives of aluminum or alumina.

New uses are continually being developed to keep up with variations in current interest and the advances in metallurgy and chemistry. The 1958 prospects of a plentiful supply will permit technological developments to be applied to new products. In addition, a small reduction in metal prices will encourage manufacturers to use aluminum in place of established materials whose only advantage has been cost.

The following companies use more than 40 tons of aluminum ingot and ingot alloy annually:

Algoma Steel Corporation Limited	Sault Ste. Marie, Ont.
Barber Die Casting Co. Limited	Hamilton, Ont.
Canadian Steel Improvement Ltd.	Toronto, Ont.

Dominion Foundries and Steel Limited	Hamilton, Ont.
The Hoover Co. Limited	Hamilton, Ont.
Industrial Engineering Limited	Vancouver, B.C.
Metals & 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.
The Steel Company of Canada Limited	Hamilton, Ont.
Supreme Aluminum Industries Limited	Toronto, Ont.
Z. Wagman & Son Limited	Toronto, Ont.
R.D. Werner Co. (Canada) Limited	Oshawa, Ont.

Prices

The Canadian price of aluminum ingot was 24.5 cents a pound throughout 1957.

Tariffs

Canada

	British Preferential	Most Favoured Nation	General
Alumina	free	free	free
Sulphate of alumina	"	10% ad valorem	15% ad valorem
Cryolite	"	free	free
Bauxite	"	"	"
Aluminum pigs, ingots, blocks, notch bars, slabs, billets, blooms and wire bars	"	2¢ per lb	5¢ per lb
Wire and cable	"	22 1/2% ad valorem	30% ad valorem
Aluminum scrap	"	free	free

United States

Bauxite, crude, not refined or otherwise advanced in condition	free (tax of 50¢ a ton suspended)
Aluminum oxide	free

87875-1—4½

Aluminum

Tariffs - United States (cont'd)

Aluminum and alloys in which aluminum is the component material of chief value	
In crude form (not including scrap)	1.3¢* per lb
In bars, blanks, circles, coils, disks, plates, rectangles, rods, sheets, squares and strips	2.7¢* per lb
Aluminum scrap	free (1 1/2¢-per-lb tax suspended)

* To be reduced 5 per cent on June 30, 1958, under the General Agreement on Tariffs and Trade, which provides systematic aluminum-tariff reductions over a period of years ending on June 30, 1958.

ANTIMONY

by

D.B. Fraser

Antimony is produced in Canada as a by-product of the electrolytic refining of lead. The Consolidated Mining and Smelting Company of Canada Limited, at Trail, British Columbia, is the only producer. Its output is in the form of antimonial lead derived from lead concentrates obtained from ores of the company's Sullivan mine at Kimberley, British Columbia, and from lead-silver ores and concentrates containing antimony shipped by other mines to Trail for treatment. Metallic antimony has not been produced in Canada since 1944, when the antimony refinery at Trail, which had been turning out antimony metal since 1939, was closed.

Antimonial lead produced at Trail normally contains about 25 per cent antimony, though other grades are turned out. Lead bullion from the smelter contains about 1 per cent antimony, and the antimonial lead is recovered from anode residues formed in the electrolytic refining of the bullion. The output in 1957 was 454 tons of contained antimony. In addition, slags and flue dusts containing 226 tons of antimony were shipped to outside smelters for their antimony content.

World production of primary antimony in 1957 was an estimated 53,000 tons. The principal producing countries, on a mine basis, were: China (16,500 tons); the Union of South Africa (11,021); Bolivia (7,026); Mexico (5,734); Yugoslavia (1,950); and Czechoslovakia (1,800). The United States, the principal consumer, used 11,931 tons of primary antimony in 1957, of which 709 tons were obtained from domestic sources. In addition, 22,565 tons were recovered in the United States from secondary material.

Because antimony prices have been generally unstable in past years, output in most countries, including Canada (see accompanying graph), has varied considerably. Peak wartime production, in 1941, was 1,593 tons. Since World War II, output has averaged 844 tons a year. The peak indicated for 1951 includes the antimony content of slags and flue dust not reported in previous years.

Occurrences and Developments

Several occurrences or deposits of the principal antimony mineral, stibnite (Sb_2S_3), have been explored and partly developed in Canada, 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

Antimony - Production, Trade and Consumption

	1957		1956	
	Pounds	$	Pounds	$
Production				
Antimony content of antimonial lead alloy.....	908,547	332,508	1,808,642	660,154
Antimony content of flue dust and dore slag.......	452,184	37,934	331,790	27,373
Total	1,360,731	370,442	2,140,432	687,527
Imports				
Antimony metal				
China	1,041,241	185,177	1,018,876	184,906
United Kingdom	355,115	88,009	686,039	149,680
Hong Kong	198,614	35,132	-	-
Other countries	199,876	41,147	98,715	18,691
Total	1,794,846	349,465	1,803,630	353,277
Antimony oxides				
United Kingdom	246,760	56,224	198,880	47,139
United States............	54,937	14,913	56,230	14,508
West Germany	44,090	11,520	-	-
Belgium	20,160	4,299	6,721	1,587
Total	365,947	86,956	261,831	63,234
Antimony salts				
United States	23,030	15,518	17,916	11,374
West Germany..........	2,205	1,111	2,205	1,112
Total	25,235	16,629	20,121	12,486
Exports				
Antimony content antimonial lead alloy.....	674,060		1,054,360	
Consumption				
Antimony regulus in production of:				
Antimonial lead alloy....	891,174		1,050,686	
Type metal............	175,308		175,812	
Babbitt	169,895		150,101	
Solder	78,295		34,862	
Cable alloys	1,000		2,282	
Antimonial oxide........	1,103		661	
Batteries	7,148		6,890	
Other uses	76,659		56,055	
Total	1,400,582		1,477,349	

Antimony - Production, Trade and Consumption, 1947-57

(pounds)

	Production(1) (all forms)	Imports (regulus)	Consumption(3) (regulus)
1947	1,150,463	2,880,513	2,378,000
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

(1) Antimony content of antimonial lead alloy produced and antimony recovered from flue dust and dore slag.

(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.

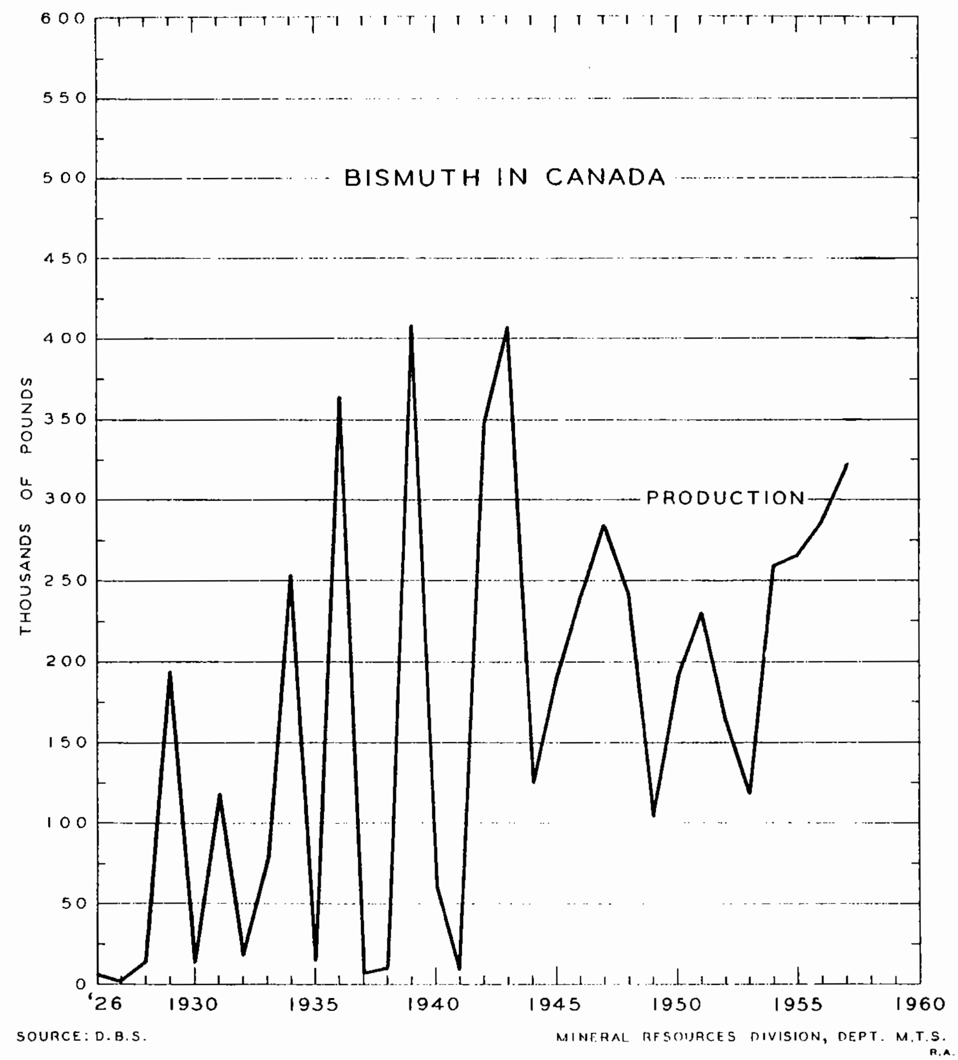
county, Quebec; Gray Rock property, near Bralorne in the Bridge River district, Stuart Lake mine, near Fort St. James, and the Caroline property, near Slocan City in the West Kootenay district, British Columbia; Highet Creek deposit, Mayo district, and the Wheaton River deposits near Whitehorse, Yukon.

During the latter part of 1957 an investigation of the West Gore deposits in Nova Scotia was begun by Canadian Alumina Corp. Limited. The main shaft of the old workings was de-watered to 200 feet, and after visual examination of the stopes it was decided that development through the old workings was not feasible. If the results of a diamond-drilling program undertaken at that time are favourable, the company plans to de-water a second shaft on the property and continue the exploration program underground.

Uses and Consumption

Antimony is used chiefly to impart hardness and mechanical strength to lead. Electric storage batteries for cars and trucks absorb large amounts of antimonial lead with an antimony content ranging from 4 to 12 per cent. Antimony is also an important constituent in lead cable covering, bearing metal, type metal and solders.

Bismuth



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, considerable research has been directed toward the possible use as coolants in atomic piles of low-melting-point bismuth alloys having low neutron-capture qualities.

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

Bismuth - United States Consumption, by Principal Uses, 1957*

	Pounds	Per Cent of Total
Fuse metal	251,900	17
Solder	94,100	6
Other alloys	698,600	47
Selenium rectifiers	8,700	1
Pharmaceuticals	291,300	19
Other uses	153,800	10
Total	1,498,400	100

* Mineral Industry Survey, Bureau of Mines, U. S. Dept. of the Interior.

Prices

Bismuth metal sold at $2. 25 a pound throughout 1957.

CADMIUM

by

D. B. Fraser

Cadmium, a minor constituent of most zinc ores in Canada, is recovered as a by-product in the refining of zinc. The Consolidated Mining and Smelting Company of Canada Limited (Cominco)at Trail, British Columbia, and Hudson Bay Mining and Smelting Co. Limited at Flin Flon, Manitoba, produce refined cadmium from the treatment of zinc concentrates from their own and custom ores. The metal is recovered in cadmium-rich precipitates that result from the purification of the zinc electrolyte used in the electrolytic process for making refined zinc. The precipitates, containing about 55 per cent cadmium, are leached and the cadmium is extracted by electrolysis. About 70 per cent of the cadmium in zinc concentrates is recoverable, and metal of a purity not less than 99.95 per cent is produced in the form of balls, sticks or slabs. Other amounts of cadmium, not all of which are reported, are produced from zinc concentrates exported to foreign smelters.

Canada's cadmium output has increased in proportion to the growth in zinc production. The 2,368,130 pounds turned out in 1957, as shown in the graph on page 56, made the highest total on record, topping the previous all-time high of 2,339,421 pounds produced in 1956. The output of refined cadmium was 2,018,463 pounds.

World production of cadmium in 1957, on a mine basis, was 21,070,000 pounds. The United States, South West Africa, Canada and Mexico 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 901 tons of metallic cadmium at its Trail refinery, derived 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, its northwestern subsidiary, Tulsequah Mines Limited, the latter now closed, and numerous custom shippers supplied other amounts in zinc concentrates treated at Trail. The company does not disclose the cadmium recovered from individual sources.

Reeves MacDonald Mines Limited, at Remac, recovered 150,152 pounds of cadmium in zinc concentrates.

Other producers of zinc concentrates containing recoverable amounts of cadmium included Canadian Exploration,Limited, near Salmo; Britannia

Cadmium - Production, Exports and Consumption

	1957		1956	
	Pounds	$	Pounds	$
Production				
All forms(1)				
British Columbia......	1,956,028	3,325,248	1,937,807	3,294,272
Saskatchewan	187,439	318,646	116,960	198,832
Manitoba	38,909	66,145	40,026	68,044
Yukon	185,754	315,782	244,628	415,868
Total	2,368,130	4,025,821	2,339,421	3,977,016
Refined(2)	2,018,463		1,932,887	
Exports				
United States	1,117,877	1,647,608	1,199,964	1,706,649
United Kingdom	818,803	1,262,256	675,162	1,052,519
Argentina	4,800	8,400	-	-
Other countries	200	381	47,559	65,317
Total	1,941,680	2,918,645	1,922,685	2,824,485
Consumption				
By industries				
Aircraft	9,497		8,534	
Automotive	24,761		35,165	
Electrical	37,831		46,244	
Hardware	42,507		52,582	
Solders	10,626		5,654	
Miscellaneous	51,376		58,241	
Total	176,598		206,420	

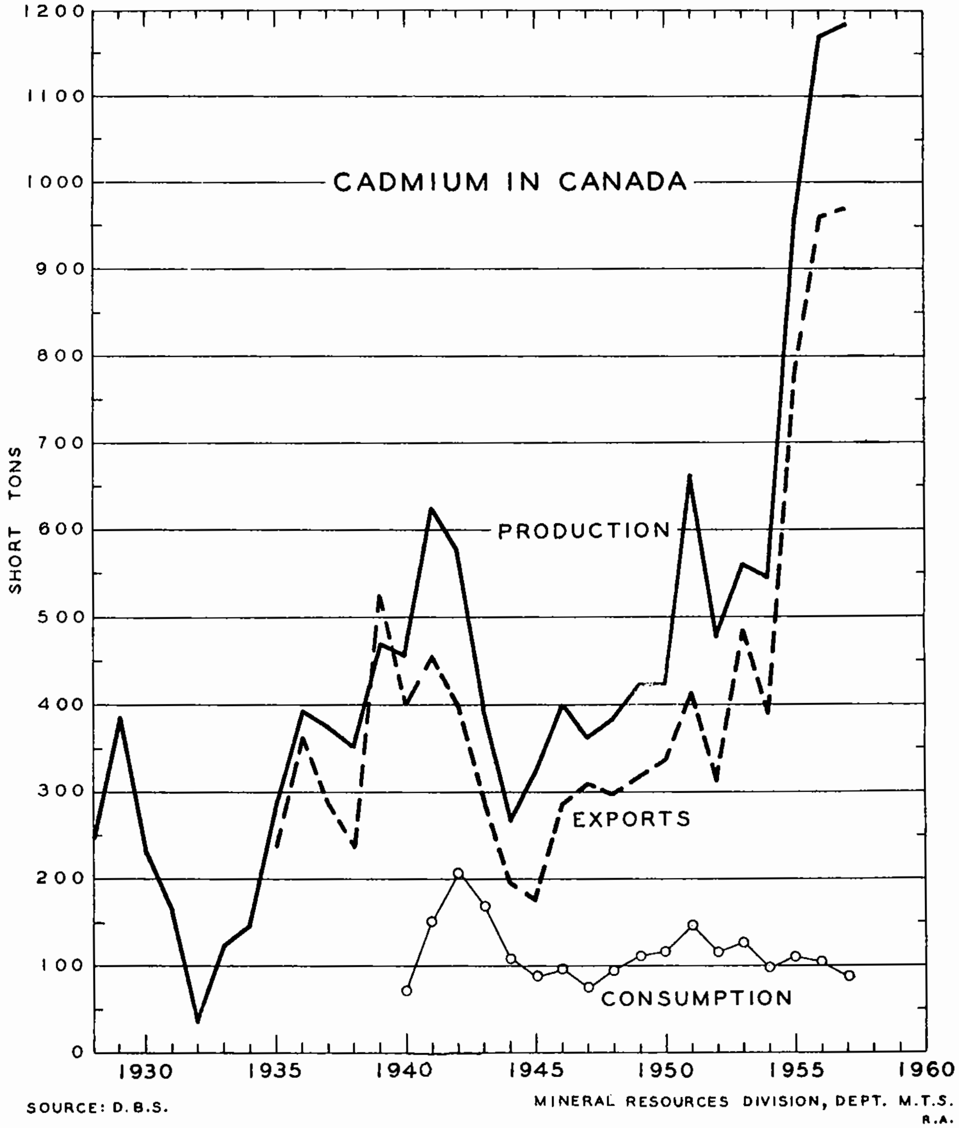
(1) Production of refined cadmium from domestic ores plus cadmium content of ores and concentrates exported.
(2) Includes some metal derived from foreign ores.

Mining and Smelting Company Ltd., on Howe Sound; Sheep Creek Mines Limited, Lake Windermere district; Sunshine Lardeau Mines Ltd., near Camborne; ViolaMac Mines Limited, near Sandon; and Silver Standard Mines Limited, near Hazelton.

Yukon

United Keno Hill Mines Limited, in the fiscal year ended September 30, 1957, recovered 236,271 pounds of cadmium in zinc concentrates that were shipped to Trail for treatment. The adjoining Galkeno Mines Limited ceased

Cadmium



CADMIUM IN CANADA
PRODUCTION
EXPORTS
CONSUMPTION
SHORT TONS
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
1930
1935
1940
1945
1950
1955
1960
SOURCE: D.B.S.
MINERAL RESOURCES DIVISION, DEPT. M.T.S.
R.A.

CHROMITE

by

R. J. Jones

Canadian consumption of ferrochrome, which provides the main use for chromite in Canada,began at a high level in 1957 but declined when the demand for stainless steels was reduced. Since a large part of the chromium alloys consumed in Canada goes into the production of stainless steels, the market is quickly and materially affected by changes in the output of these materials. Total chromium alloy sales in Canada were somewhat higher in 1957 than in 1956. Canadian consumption of chromite increased from 69,835 tons* in 1956 to 70,971 tons in 1957. Exports of ferrochrome, which had been decreasing since 1952, increased slightly during 1957 because of larger shipments to the United States. Special grades of low-carbon ferrochrome are imported into Canada, as the demand for them is still not sufficient to warrant manufacture.

Canada has no known deposits of commercial-grade chromite ores. During World War II, some chromite was produced in the area between Quebec City and Sherbrooke in the Eastern Townships of Quebec, 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 low in grade. The material is high in iron, and there is need for an economical method of bringing the chrome-iron ratio within market requirements.

A new company, Strannar Mines Limited, was formed as a joint venture of Gunnar Mines Limited and Strategic Materials Corporation with the object of producing ferrochrome from low-grade material of the Bird River area, near Lac du Bonnet in southeastern Manitoba. The Niagara Falls, Ontario, plant of Strategic Materials Corporation will be used to test the application of the Udy process on a pilot-plant scale.

Some exploration work was carried out by Anarchist Chrome Company Limited on its prospect on Anarchist Mountain, 1 1/2 miles from Bridesville, British Columbia. Belair Mining Corporation Ltd. did some diamond-drilling and trenching on its property near Rock Creek, British Columbia.

Chromite is consumed in Canada by Electro Metallurgical Company (Division of Union Carbide Canada Limited) at Welland, Ontario, where high- and low-carbon chromium alloys are produced in a modern plant using electric furnaces. Exothermic chromium alloys are produced by Chromium Mining and

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* Short tons throughout unless otherwise specified.

87875-1—5½

Chromite - Trade and Consumption

	1957		1956	
	Short Tons	$	Short Tons	$
Imports, chromite				
U.S.S.R.	34,423	1,143,576	-	-
Philippines	28,000	493,650	-	-
Union of South Africa	23,978	306,804	18,468	220,466
Rhodesia and Nyasaland ..	12,402	330,259	6,593	201,667
United States	6,050	233,558	18,142	693,351
Turkey	5,600	215,775	2,120	87,805
Cuba	1,000	27,750	2,093	56,953
Other countries	-	-	17,549	269,169
Total	111,453	2,751,372	64,965	1,529,411
Exports, ferrochrome				
United States	9,984	2,213,457	9,327	1,887,804
United Kingdom	225	60,261	246	58,806
Belgium.................	70	19,984	177	50,016
Mexico	34	13,160	32	11,817
Other countries	19	5,028	115	27,271
Total	10,332	2,311,890	9,897	2,035,714
Consumption, chromite	70,971		69,835	

Smelting Corporation Limited at Sault Ste. Marie, Ontario, in electric furnaces.

Canadian Refractories Limited produces chrome refractories for furnace linings in its plant at Marelan, about 50 miles west of Montreal.

World Production

World production in 1957, according to the United States Bureau of Mines, was estimated at 5,125,000 tons. The leading producing countries were: Turkey (1,052,665 tons); Russia (850,000); the Philippines (799,744); the Union of South Africa (733,616); and Southern Rhodesia (654,078).

Trade and Consumption, 1947-57

	Imports	Exports	Consumption	
	Chromite	Ferrochrome	Chromite	Ferrochrome
	(short tons)	(short tons)	(short tons)	(short tons)
1947	98,322	27,734	59,588	2,285
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

United States production in 1957 was 166,157 tons from mines in Alaska, California, Montana and Oregon, the entire output being shipped to the United States Government at high incentive prices. Some 175,000 tons of chrome ore and/or chrome concentrate have been delivered to the General Services Administration out of a goal of 200,000 tons to be reached by June 30, 1959.

Consumption and Uses

World consumption of chromium is about 3 1/2 times the combined consumption of nickel, tungsten, molybdenum and cobalt, the United States consuming about one third of the total.

Approximately 55 per cent of all chromite consumed is metallurgical-grade, 30 per cent refractory-grade, and 15 per cent chemical-grade.

Metallurgical-grade Chromite

For metallurgical consumption in the manufacture of ferrochrome, chromite should contain 45 to 50 per cent Cr_2O_3 with a chromium-iron ratio which varies from 2.8:1 to 3:1. The material should be in lump form, as it is used in electric furnaces, and should contain as little silica as possible.

Ferrochrome is consumed mainly as low-carbon or high-carbon ferrochrome, both of which contain from 67 to 71 per cent chromium. Low-carbon ferrochrome is used in stainless and in heat-resistant steels because of its low carbon content. These steels are widely used in the chemical and petrochemical industries. High-carbon ferrochrome is used in the production of other chromium-bearing steels and alloy cast irons. Chromium in these steels greatly increases corrosion resistance. In cast iron, chromium increases hardness, strength and resistance to corrosion.

Chromium metal is used in the production of high-temperature, corrosion-resistant alloys as well as 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. The main uses of high-temperature alloys are in the jet and gas-turbine engine industry for such parts as nozzle guide vanes and turbine blades. They are also used in heat exchangers, boiler superheaters and superchargers.

Chromium plating is extensively used to produce brilliant, non-tarnishing and durable finishes. Many articles such as dies, gauges and punches are plated with a thicker layer to improve wearing qualities.

Refractory-grade Chromite

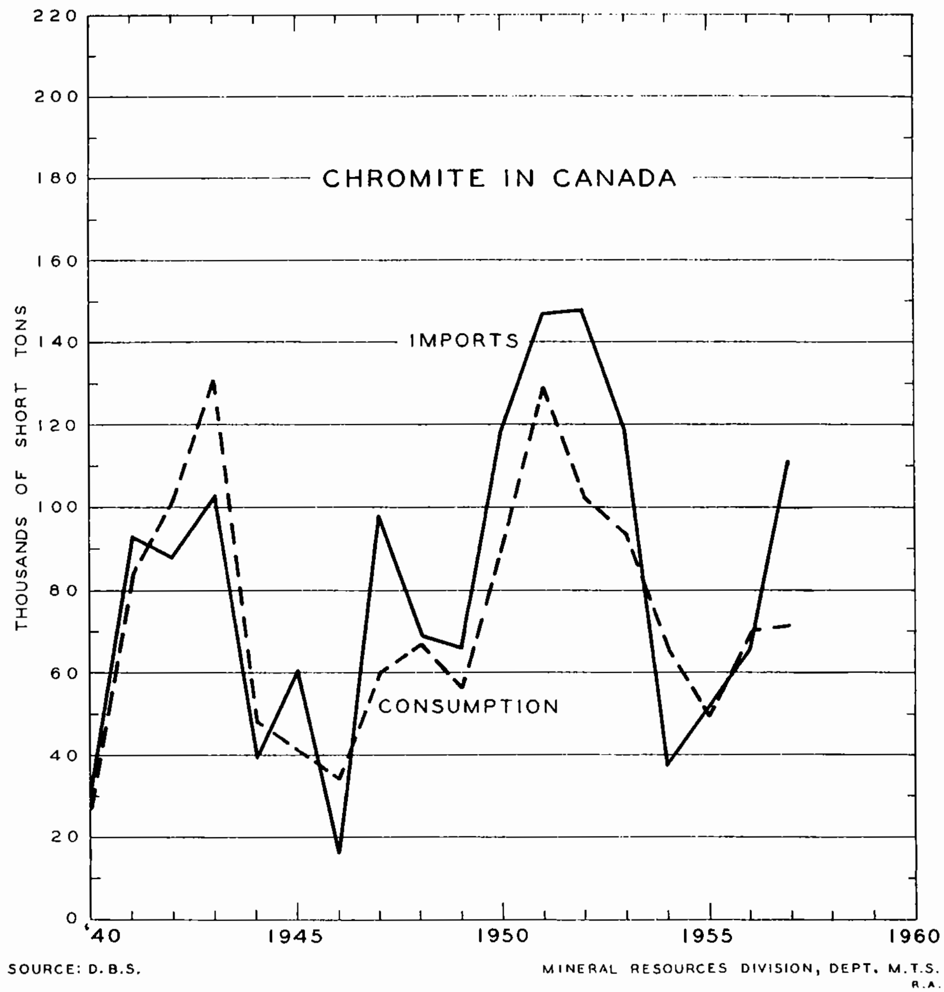
For the manufacture of refractories, specifications call for a 57-per-cent minimum of combined chromic oxide and alumina with as little iron and silica as possible, usually around 10 and 5 per cent, respectively. The chromium-iron ratio is of no consequence in this grade but the ore must be hard and lumpy, not under 10-mesh. Fine ore is suitable for the manufacture of brick cement or in the chrome-magnesite brick industry.

Refractory-grade chromite is manufactured into bricks for use as a neutral lining for 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, between the silica bricks of the roof and the top of the sides and the dolomite or magnesite bricks of the hearth and sides below the slag line. Other chrome refractories are used for patching brickwork and in making ramming mixtures for furnace bottoms.

Chemical-grade Chromite

For chemical consumption, specifications are not as rigid as in the 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 to 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

According to E & M J Metal and Mineral Markets of December 26, 1957, United States prices were as follows:

Chrome Ore - per long ton, dry basis, subject to penalties if guarantees are not met, f.o.b. cars, Atlantic ports:

Rhodesian	
48% Cr_2O_3, 3 to 1 ratio, lumps	\$47 to \$49
48% Cr_2O_3, 2.8 to 1 ratio	44 to 46
48% Cr_2O_3, no ratio, all long-term contracts	37 to 39

Chromite

South African (Transvaal)		
48% Cr_2O_3, no ratio	$36	to $37
44% Cr_2O_3, no ratio	26	to 26.50
Turkish		
48% Cr_2O_3, 3-to-1 ratio, lump and concentrates	$55	to $57
46% Cr_2O_3, 3-to-1 ratio, lump and concentrates	52	to 54
Pakistan (Baluchistan)		
48% Cr_2O_3, 3 -to-1 ratio	$52	to $53

<u>Ferrochrome</u> - per lb of Cr:

High carbon (4 to 9% C), 65 to 70% Cr, lumps, carloads, f.o.b. destination continental U.S.	22 3/4¢
Low carbon (0.10% C)	38 1/2¢

<u>Chromium metal</u> - per lb:

97% grade, 0.5% C	$ 1.29
Electrolytic chromium, commercial grade, 99% min., delivered	1.29

Tariffs

<u>Canadian</u>

Chrome ore	free
Chromium metal	free
Ferrochromium	
British preferential	free
Most favoured nation	5% ad valorem
General	5% ad valorem

<u>United States</u>

Chrome ore	free
Chromium metal	11% ad valorem
Ferrochrome	
3% or more carbon on Cr content	5/8¢ per lb
Less than 3% carbon on Cr content	11% ad valorem

COBALT

by
R.J. Jones

Cobalt production was the highest ever recorded in Canada. Derived from ores of Canadian origin and represented by shipments of metal, oxides, and matte and exports of concentrates, it increased to 3,922,649 pounds from the 3,516,670 pounds turned out in 1956. The increase arose from the continued expansion of the nickel industry, which produces cobalt as a by-product.

Consumption of cobalt decreased from 435,732 pounds in 1956 to 215,352 pounds in 1957.

Production

Ontario

Sudbury Area

Cobalt occurs in minor amounts in nickel-copper ores of the Sudbury area and is recovered as cobalt oxide or electrolytic cobalt from residues obtained in the refining of nickel.

The International Nickel Company of Canada Limited recovers cobalt oxide from the electrolyte at its nickel refinery at Port Colborne, Ontario. The cobalt is separated by precipitation and is shipped as an impure cobalt oxide to the Mond Nickel Co. Ltd. at Clydach, Wales, for the production of black and grey oxides and an extensive range of cobalt salts. In October 1954, International Nickel began the first production in Canada of high-purity electrolytic cobalt at its Port Colborne refinery. Recovery of the cobalt content of nickel matte produced by International Nickel began in 1940 at Clydach, but this cobalt has never been included as Canadian production in Canadian Government statistics. In 1957, deliveries of cobalt in all forms rose to a new high of 2,400,000 pounds from the 1,540,000 pounds delivered in 1956.

Falconbridge Nickel Mines Limited produces electrolytic cobalt from nickel-copper matte exported to its nickel refinery at Kristiansand, Norway. Deliveries of metal by Falconbridge increased in 1957 to 777,000 pounds, a new high compared with the company's 1956 total of 543,012 pounds.

Cobalt - Production, Trade and Consumption

	1957		1956	
	Pounds	$	Pounds	$
Production (shipments)(1) from Canadian ores (cobalt contained in metals, alloys, oxides, salts and concentrates)	3,922,649	7,784,423	3,516,670	9,065,493
Exports				
Cobalt in ores and concentrates				
United States	15,100	16,477	5,800	2,890
West Germany	-	-	10,200	12,202
Total	15,100	16,477	16,000	15,092
Cobalt metal				
United States	2,075,931	3,956,046	1,432,884	3,546,025
Brazil	25,942	50,068	-	-
Other countries	53,869	96,097	-	-
Total	2,155,742	4,102,211	1,432,884	3,546,025
Cobalt alloys(2)				
France	11,685	50,098	5,150	24,717
United States	424	678	5,615	10,905
Other countries	291	3,044	578	4,464
Total	12,400	53,820	11,343	40,086
Cobalt oxides and salts(2)				
United Kingdom	618,842	1,101,082	1,283,745	2,310,741
Other countries	1,200	1,820	5,400	4,400
Total	620,042	1,102,902	1,289,145	2,315,141
Imports				
Cobalt concentrates(2)				
United States	800	563	1,900	1,031
Oxides(2)				
United States	8,340	16,830	10,905	26,327
United Kingdom	2,000	2,764	448	798
Total	10,340	19,594	11,353	27,125
Consumption(3)	215,352		435,732	

(1) Excludes cobalt content of nickel matte shipped to the United Kingdom by International Nickel but includes the cobalt content of Falconbridge shipments of nickel-copper matte to Norway.

(2) Gross weight.

(3) Producers' domestic shipments of metal, oxides and salts.

Cobalt - Production, Trade and Consumption, 1947-57
(pounds)

	Production(1)	Exports				Imports		Consumption(3)
	All Forms	Cobalt in Ore and Concentrates	Metallic Cobalt	Cobalt Alloys	Cobalt Oxides and Salts	Cobalt Ore	Cobalt Oxide	Metal
1947	572,673	89,300	40,366	59,728	837,405	-	740	118,000
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

(1) Metallic cobalt from Canadian ores and cobalt content of oxides and salts sold and ores and concentrates exported.

(2) Includes shipments from stockpiled ores which were mined in earlier years.

(3) Producers' domestic shipments.

Cobalt-Gowganda Area

Cobalt ore shipments from the Cobalt-Gowganda area ceased during the first quarter of the year when the objective of the Canadian Government's premium-price plan on behalf of the United States Government was reached. Prices quoted by custom smelters after the first quarter were not attractive enough to warrant production. Shipments made by Cobalt Consolidated Mining Corporation Limited and Silver Crater Mines Limited via the Temiskaming Testing Laboratories during the first quarter contained 161,149 pounds of cobalt.

The effect of the discontinuance of the premium-price plan is seen when this figure is compared with the 571,244 pounds and the 1,293,500 pounds shipped in 1956 and 1955 respectively.

Silver ore shipments made in 1957 via the Temiskaming Testing Laboratories contained 380,001 pounds of cobalt; those made in 1956 contained 209,857 pounds. The more important shippers were Cobalt Consolidated Mining Corporation Limited, Silver-Miller Mines Limited, Nipissing-O'Brien Mines Limited and Langis Silver & Cobalt Mining Company, Limited.

Cobalt

These ores and concentrates were shipped mainly to the Deloro Smelting and Refining Co. Ltd., which refined the cobalt ores on a toll basis for the United States Government and purchased the cobalt content of silver ores on its own account.

Certain lower-grade silver concentrates containing copper and cobalt were shipped to the smelter of Noranda Mines Limited, at Noranda, Quebec, but the cobalt content was not recovered.

Manitoba

Production of cobalt by Sherritt Gordon Mines Limited from its Lynn Lake nickel-copper ores was 172,053 pounds in 1957 and 107,414 in 1956. Production of refined cobalt began in June 1955 at the company's nickel refinery at Fort Saskatchewan, Alberta. The annual capacity of the refinery was raised in 1957 from 20 million pounds to 27,500,000 pounds of nickel metal. Hence an eventual increase in cobalt production may be expected from this source.

World Mine Production

According to the American Bureau of Metal Statistics, the main producers in 1957 were: the Belgian Congo (17,890,329 pounds); the United States (4,137,297); Canada (3,922,649); Northern Rhodesia (3,166,000); and French Morocco (992,070). The United States Bureau of Mines estimates production at 15,500 tons for 1957.

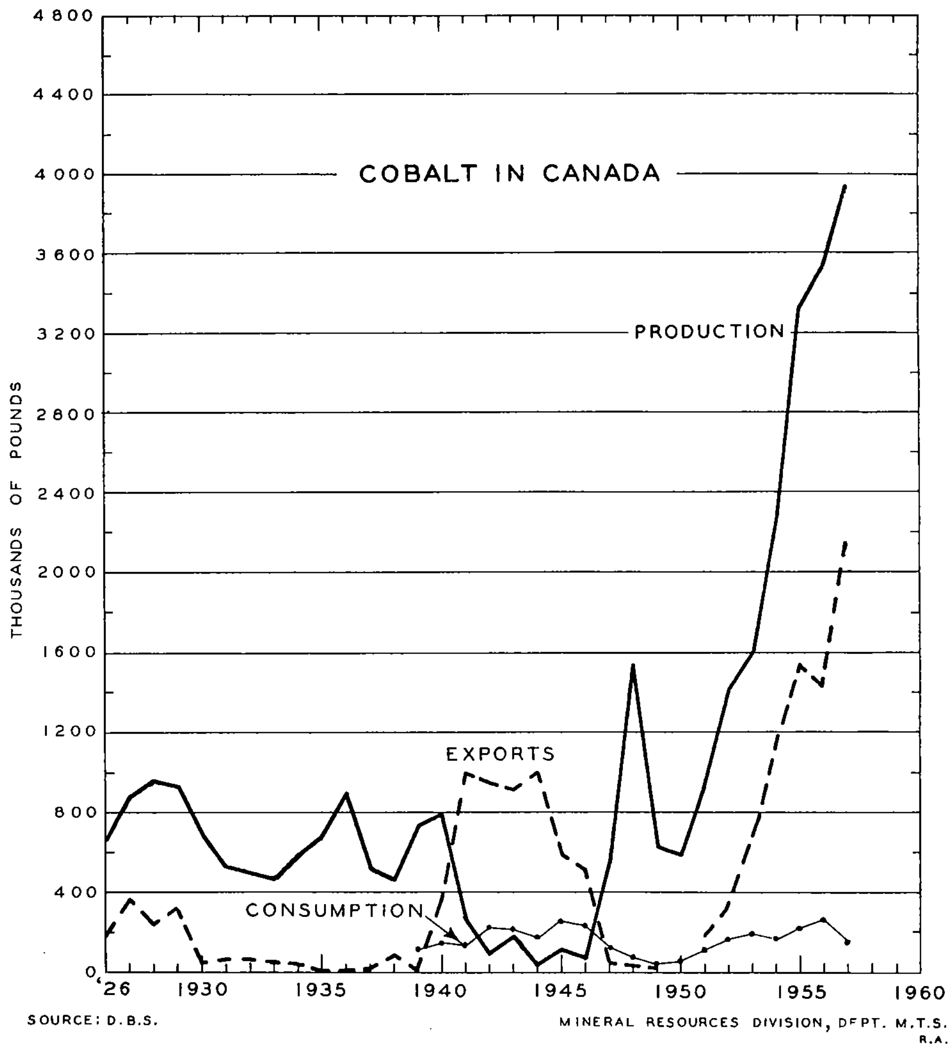
Production in the Belgian Congo is derived from the mines of Union Miniere du Haut-Katanga, the world's largest producer.

Production of recoverable cobalt in the United States was 1,649 short tons in 1957, but consumption declined to 4,578 tons, or 5 per cent below the 1952-56 average. The main producers were Calera Mining Company, National Lead Company and Pyrites Co.

Production in French Morocco is derived from the Mines of La Societe Miniere 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. The first stage of Chibuluma's new plant for the production of cobalt matte began operation in 1957. The matte is refined on toll into cobalt metal in Belgium. In the first year of operation Chibuluma produced 1,962,000 pounds of recoverable cobalt.

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 metal. Construction of a concentrating plant in Cuba and a refinery in Louisiana, U.S.A., was carried on according to schedule by the Cuban American Nickel Company, a subsidiary of Freeport Sulphur Company.



Uses and Consumption

World consumption of cobalt is not keeping pace with the large increase in mine production. Less cobalt is being used in all its main applications except in magnet alloys, but the reduction in demand for the high-temperature alloys is having the more serious effect.

About 90 per cent of the cobalt consumed is in the form of metal, marketed as rondelles, granules, shot and powder. The remaining 10 per cent comprises black and grey oxide, inorganic salts such as the acetate, carbonate and sulphate, and organic compounds such as linoleates, naphthenates and resinates.

Cobalt

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 also 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.

The greatest use for cobalt oxide is in the making of ground-coat frit to make fired enamel adhere to the metal base to which it is applied. It is also used in ceramics and glass manufacture.

Cobalt organic salts are used as driers in paint, varnish, enamel, ink, etc.; and the use of inorganic salts such as cobalt sulphate is increasing in animal-feed nutrition, especially in mountainous areas where the salt is sprayed by aircraft.

The more important Canadian consumers of cobalt are: Deloro Smelting and Refining Co. Ltd., Deloro, Ontario; Canadian General Electric Company Limited and Nuodex Products of Canada, Limited (driers), both of Toronto, Ontario; Ferro Enamels (Canada), Limited, Oakville, Ontario; Atlas Steels, Limited, Welland, Ontario; Dominion Glass Company, Limited, Montreal, Quebec; and Canadian Hanson and Van Winkle Co. Limited (electroplating equipment), Toronto, Ontario.

Prices

The first price reduction in cobalt metal was made on December 1, 1956, when the price was reduced from $2.60 U.S. to $2.35 U.S., after a steady rise in price over a 20-year period. On February 1, 1957, the price was further reduced to $2 U.S.

Prices at the end of 1957, according to the E & M J Metal and Mineral Markets, were as follows:

Cobalt metal

In rondelles or granules, 500-to-600-lb containers, ex docks or store New York, N.Y.	$2.00 lb
In 100-lb containers	2.02 lb
In containers of less than 100 lb	2.07 lb

Cobalt metal fines

Standard 650-lb package f.o.b. New York, N.Y., cobalt contained	$2.00 lb

Cobalt oxide

Ceramic grade, 72 1/2 to 73 1/2% cobalt, 350-lb containers:

East of Mississippi	$1.52 lb
West of Mississippi	1.55 lb

Tariffs

Canada

Ore	free
Cobalt metal	
British preferential	free
Most favoured nation	10% ad valorem
General	25% ad valorem
Cobalt oxide	
British preferential	free
Most favoured nation	10% ad valorem
General	10% ad valorem

United States

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

COPPER

by
R. J. Jones

Canadian production of copper in all forms was above the 1956 record level by 4,249 tons, or more than 1 per cent. In value, production dropped by $86,060,103, or 29 per cent. Exports of refined copper shapes increased, mainly owing to larger shipments to the United Kingdom and overseas.

The surplus world-supply condition which developed in 1956 was further accentuated during 1957 by higher world production. The high prices that prevailed in 1955 and early 1956 stimulated the establishment of new low-grade copper production and the expansion of the operations of established producers. The United States Defense Production Act also brought forth a large additional tonnage by such inducements as low-interest loans, accelerated depreciation and floor-price contracts. According to Copper Institute data, stocks held by fabricators decreased while producer stocks increased compared with those of the previous year. Depressed conditions in the automobile, electrical-appliance and building industries did not require heavy purchases of copper.

Toward the end of the year, the world producers were taking steps to curtail output. Low prices forced low-grade producers to suspend operations. However, these cutbacks were not sufficient to offset the effect of increased output from new mines brought into production.

Domestic Smelter and Refinery Production*

The 323,540 tons of refined copper produced in 1957 came from the two Canadian copper refineries, one operated by The International Nickel Company of Canada Limited at Copper Cliff, Ontario, and the other by Canadian Copper Refiners Limited at Montreal East, Quebec, a subsidiary of Noranda Mines, Limited.

Six smelters for the reduction of copper and copper-nickel ore were operated in Canada. The International Nickel Company of Canada Limited operated two smelters, one at Copper Cliff, Ontario, and the other at Coniston, Ontario, both of which operated on the company's ores. Noranda Mines, Limited, operated its smelter on ores and concentrates from its Horne mine and from concentrates of most of the copper mines in eastern Canada. In 1957

* See map on page 76 for location

(text continued on page 73)

Copper - Production, Exports and Consumption

	1957		1956	
	Short Tons	$	Short Tons	$
Production				
All forms				
Ontario	171,704	98,488,877	156,271	128,552,450
Quebec	112,409	65,084,941	122,300	101,288,640
Saskatchewan	30,597	17,715,571	33,116	27,426,903
Manitoba	18,551	10,686,798	17,973	14,890,139
British Columbia	15,410	8,877,743	21,682	17,885,709
New Brunswick	5,738	3,322,400	6	5,272
Newfoundland	4,535	2,625,986	3,108	2,574,274
Northwest Territories	165	95,672	-	-
Nova Scotia	-	-	404	334,704
Total	359,109	206,897,988	354,860	292,958,091
Refined	323,540		328,458	
Exports				
In ingots, bars, slabs, etc.				
United States	86,300	50,409,325	96,746	75,798,864
United Kingdom	84,672	57,644,005	63,990	53,857,357
France	12,502	7,492,252	9,860	8,547,324
India	3,968	2,803,617	3,972	3,336,404
Sweden	3,381	1,902,816	-	-
Other countries	7,971	4,689,459	276	227,154
Total	198,794	124,941,474	174,844	141,767,103
In rods, strips, sheets, plates and tubing				
Switzerland	4,372	2,740,825	4,570	4,267,453
United States	2,381	2,156,201	2,350	2,691,313
United Kingdom	2,411	1,344,643	1,730	1,692,393
Cuba	882	958,538	861	1,188,051
New Zealand	470	494,123	483	613,630
Other countries	1,277	1,344,870	1,921	2,232,832
Total	11,793	9,039,200	11,915	12,685,672

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Copper

	1957		1956	
	Short Tons	$	Short Tons	$
Exports (cont'd)				
In ore and matte				
United States	30,481	15,853,508	25,354	19,160,692
Norway	13,818	7,197,273	13,373	10,276,798
United Kingdom.....	1,103	570,659	1,175	898,466
Belgium...........	456	233,686	398	280,739
West Germany......	343	175,464	692	511,940
Mexico............	286	131,915	-	-
Netherlands	61	39,117	-	-
Other countries.....	-	-	1	725
Total	46,548	24,201,622	40,993	31,129,360
Scrap, slag and skimmings				
Japan..............	4,085	2,553,105	7,881	6,609,075
United States	3,917	1,529,110	1,333	731,007
West Germany......	2,158	1,104,806	3,452	2,564,927
Other countries.....	2,121	1,134,868	1,927	1,448,697
Total	12,281	6,321,889	14,593	11,353,706
Copper wire and cable, copper screening and copper manufactures				
United States		1,682,816		4,210,549
Venezuela..........		822,139		1,003,499
Philippines.........		630,200		437,653
Colombia...........		341,405		937,570
Cuba...............		256,808		607,182
Dominican Republic .		196,602		404,463
Jamaica............		162,900		246,319
Other countries.....		621,069		716,605
Total		4,713,939		8,563,840
Consumption				
Refined............	118,225		145,286	

Copper - Production, Trade and Consumption, 1947-57
(short tons)

	Production		Exports			Imports	Consumption
	All[1] Forms	Refined	In Ore and Matte	Refined	Total Primary	Refined	Refined
1947	225,862	202,425	29,094	87,478	116,572	-	109,210
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	40,994	174,844	215,838	2,541	145,286
1957	359,109	323,540	46,548	198,794	245,342	4,175	118,225

(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.

the smelter treated 1,303,800 tons of ore, concentrate, and secondary materials such as refinery slag and scrap copper and brass, from which 113,855 tons of anodes were produced. Included in the total tonnage were 647,800 tons of material treated for custom shippers on a toll basis. In its smelter at Murdochville, Quebec, Gaspe Copper Mines Limited treated 92,684 tons of concentrate, fluxing ores and scrap, from which 18,734 tons of anodes were produced and shipped to Canadian Copper Refiners Limited. This smelter treated concentrate from Maritimes Mining Corporation Limited at Tilt Cove, Newfoundland. Hudson Bay Mining and Smelting Co. Limited operated the smelter at Flin Flon, Manitoba, on concentrates from the company's mines and shipped blister copper containing 44,569 tons of copper. Falconbridge Nickel Mines Limited, at Falconbridge, Ontario, operated its smelter and treated 643,588 tons of ores and concentrates and shipped the resultant nickel-copper matte to its refinery at Kristiansand, Norway.

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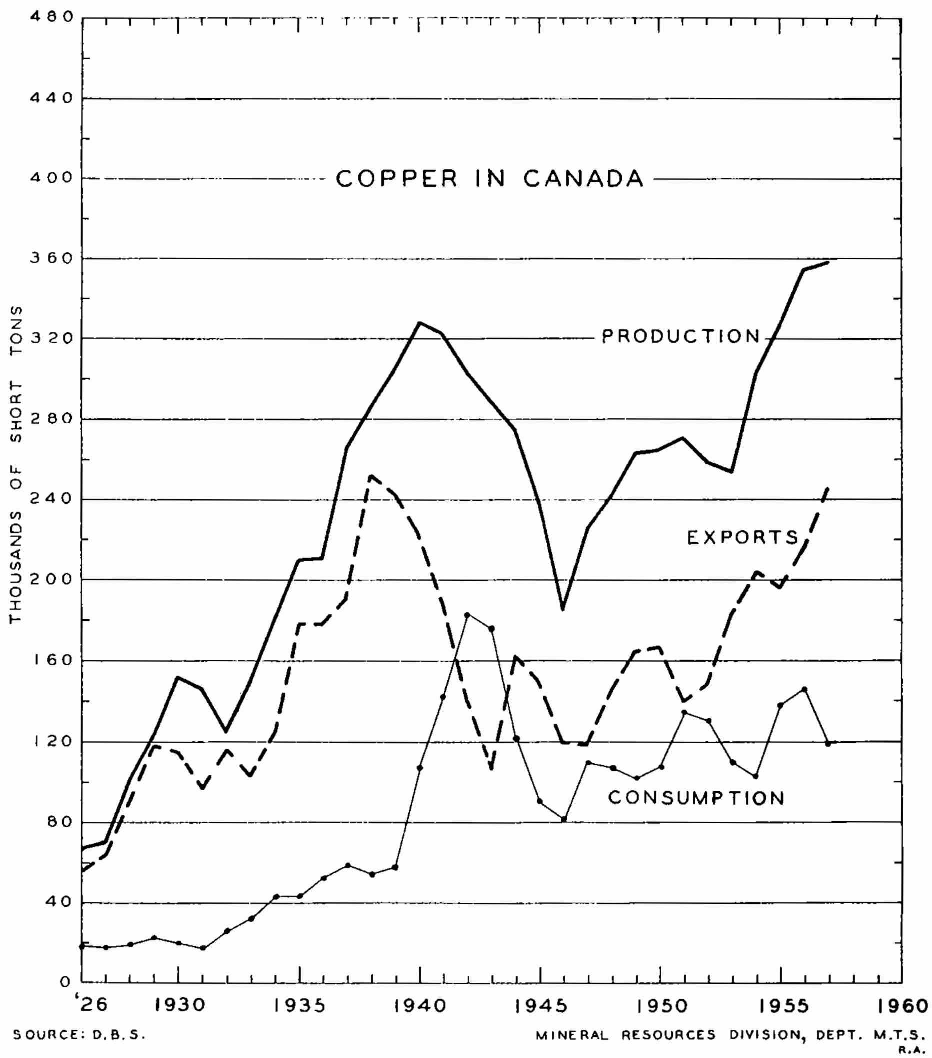
Copper



Copper production at the Montreal East refinery was 175,000 tons, or 6 per cent below 1956 output, owing to reduced receipts of anodes from Gaspe Copper Mines Limited. The latest addition to the refinery and a 28-per-cent increase in tank-house capacity have raised annual production capacity to some 220,000 tons of copper plus some 500,000 ounces of gold, 7 million ounces of silver and 260,000 pounds of selenium.

Domestic Mine Production

Ontario

Nearly all of the 168,976 tons of copper produced by Ontario mines during 1957 came from the Sudbury area.

The International Nickel Company of Canada Limited continued large-scale operations at its five producing mines - Frood-Stobie, Murray, Garson, Creighton and Levack. The amount of ore produced from these mines exceeded 16 million tons for the first time. The increase in underground production was mainly from the Frood-Stobie and Levack mines. At the end of 1957 the company's proven ore reserves stood at a high of 264,495,000 tons with a nickel-copper content of 7,956,600 tons.

Deliveries of refined copper amounting to 140,405 tons, or about 41 per cent of Canadian mine production, put the company in first place among Canadian producers in 1957. Deliveries in 1956 amounted to 135,650 tons.

Falconbridge Nickel Mines Limited operated six producing mines in the Sudbury area, namely, the East Mine, Falconbridge, McKim, Hardy, Longvack and Mount Nickel. The Mount Nickel mine closed down in November because of depletion of the ore reserves. For the first time in the company's history, production of ore in 1957 exceeded 2 million tons, of which 43 per cent was derived from mines in the Onaping area.

Continuing an expansion program designed to increase production capacity to 55 million pounds of nickel a year, the company built a new smelter, and the new blast furnace was blown in in January 1958.

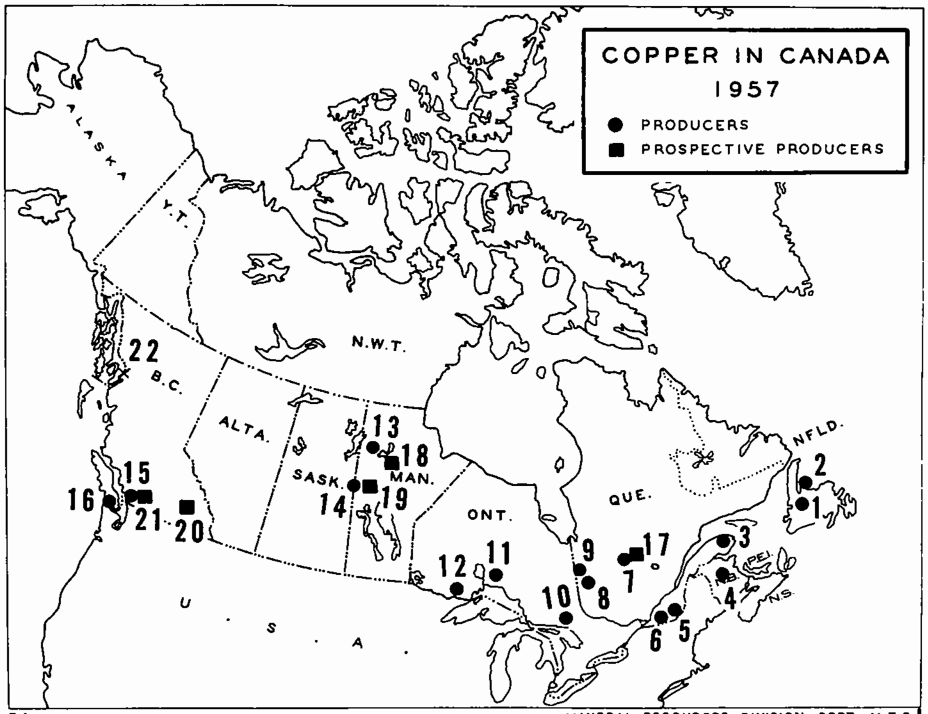
At the end of 1957, developed and indicated ore reserves totalled 45,775,900 tons with a grade averaging 1.44 per cent nickel and 0.79 per cent copper. Deliveries of copper during 1957 amounted to 12,614 tons.

Nickel Rim Mines Limited, 6 miles north of Falconbridge, milled 342,565 tons, from which 570 tons of copper concentrate were produced and shipped to the Noranda smelter. Reserves at the end of the year were 2,184,000 tons averaging 0.6 per cent nickel and 0.24 per cent copper.

Consolidated Bi-Ore Mines, Limited, at Cobre Lake, north of Thessalon, operated a sink-and-float plant over a short period and shipped copper concentrate. The mine was shut down at the approach of winter.

Geco Mines, Limited, began production of copper and zinc concentrates in September at the rate of about 1,800 tons of ore a day, which was steadily increased until December, when an average of 3,670 tons was reached. The mine and mill are in the Manitouwadge area. Copper concentrate produced amounted

Copper



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

Producers

1. Buchans Mining Company Limited
2. Maritimes Mining Corporation 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.
   Chibougamau Explorers Ltd.
8. Rainville Mines Limited
   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, 1 refinery, 2 smelters)
    Falconbridge Nickel Mines Limited (5 mines, 1 smelter)
    Nickel Rim Mines Limited
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
15. Britannia Mining and Smelting Company Ltd.
16. Cowichan Copper Co. Ltd.

Prospective Producers

17. Copper Rand Chibougamau Mines Ltd.
18. The International Nickel Company of Canada Limited (smelter)
19. Hudson Bay Mining and Smelting Co. Limited (Chisel Lake)
20. The Granby Consolidated Mining, Smelting and Power Company Limited
    Bethlehem Copper Corp. Ltd.
21. Western Nickel Limited
22. Granduc Mines, Limited

to 27,889 dry tons averaging 28.26 per cent copper, 14.27 ounces of silver and 0.06 ounce of gold. Copper production amounted to 7,881 tons. Ore reserves are reported at 14,806,200 tons containing 1.76 per cent copper, 3.75 per cent zinc, 1.74 ounces of silver per ton and 13.22 per cent pyrite.

Willroy Mines, Limited, which adjoins the Geco mine, commenced the shipment of concentrate during July from its 1,000-ton-a-day concentrator. In 1957 some 113,835 tons of ore were milled to produce 4,123 tons of concentrate containing 1,005 tons of copper. Ore reserves at the end of the year were 2,601,952 tons averaging 1.09 per cent copper, 6.49 per cent zinc, 0.25 per cent lead and 2.34 ounces of silver per ton.

Coldstream Copper Mines, Limited, started production of copper concentrate on June 22 from its mine, about 9 miles from a point on the railroad near Kashabowie, which is 70 miles west of Port Arthur. The milling plant is rated at 1,000 tons a day. The operation was closed in February 1958 because of low copper prices.

In 1957, the company milled some 86,000 tons of ore, from which it produced 7,453 tons of copper concentrate containing 1,834 tons of copper. Ore reserves at the end of 1957 were 1,588,355 tons averaging 2.23 per cent copper.

Silver-Miller Mines Limited discontinued the production of copper concentrate at its 250-ton LaRose mill in the Cobalt area and changed to the concentration of silver ores.

Quebec

The decrease in the copper production of Quebec mines to 103,835 tons from the 122,300 tons produced in 1956 was due mainly to reduced production at Gaspe Copper Mines Limited and to the closing down of several of the smaller mines.

Noranda Mines, Limited, operated the Horne Mine at Noranda and hoisted 1,336,434 tons of ore, of which 516,632 tons averaging 2.18 per cent copper were direct-smelting ore and 819,802 tons averaging 2.03 per cent copper were concentrating ore. The new, third reverberatory furnace was put into service on October 1 in anticipation of receipts of concentrates from Geco Mines, Limited. The 25,968 tons of copper produced from the Horne mine made the company the third ranking producer in Canada. Sulphide ore reserves in the Horne mine at the end of the year amounted to 10,758,000 tons averaging 2.26 per cent copper and 0.188 ounce of gold per ton.

Gaspe Copper Mines Limited at Murdochville, mined some 967,000 tons of ore and milled 941,000 tons averaging 1.94 per cent copper. Concentrate production amounted to 61,193 tons averaging 28.96 per cent copper. Copper recovery was 17,693 tons of copper in anodes containing also 2,800 ounces of gold and 304,700 ounces of silver.

Copper

Operations at the mine and smelter were suspended on March 10 owing to a strike. Smelting was resumed on August 5, and on October 7 the union discontinued the strike. Year-end ore reserves, proven by surface diamond-drilling and underground development, amounted to 64,434,000 tons containing 1.30 per cent copper.

Waite Amulet Mines Limited, near Noranda, milled 289,617 tons averaging 3.64 per cent copper, this ore originating from the company mine and Amulet Dufault Mines Ltd. Production of copper concentrate amounted to 42,350 tons containing 9,939 tons of copper, 6,204 ounces of gold and 182,842 ounces of silver. Combined ore reserves of Waite Amulet and Amulet Dufault were reduced by 140,000 tons to a total of 846,000 tons during the year.

Lyndhurst Mining Company Limited, 24 miles north of Noranda, operated until September 30 and milled 96,322 tons of copper ore in the mill of Beattie-Duquesne Mines Limited, 20 miles northwest of Noranda. Some 6,048 tons of copper concentrate containing 1,671 tons of copper were produced during the period of operation. Reserves at the end of 1957 amounted to 65,000 tons averaging 2 per cent copper.

Beattie-Duquesne Mines Limited, at Duparquet, 20 miles northwest of Noranda, suspended milling operations at the end of September. The mill was treating ore from the company's Hunter mine eight miles northeast of Duparquet.

Quemont Mining Corporation Limited, at Noranda, treated 837,231 tons of ore and produced 65,572 tons of copper concentrate averaging 17.29 per cent copper. Copper production amounted to 11,334 tons. Indicated ore reserves amounted to 7,430,000 tons at the end of the year containing 1.33 per cent copper, 2.77 per cent zinc, 0.176 ounce of gold per ton, 1.12 ounces of silver per ton and 51 per cent pyrite.

Normetal Mining Corporation, Limited, 55 miles northwest of Noranda, milled 378,283 tons of ore and produced 37,700 tons of copper concentrate containing 21.67 per cent copper. Copper production was 8,168 tons. Ore reserves at the end of the year were 2,377,600 tons averaging 3.51 per cent copper and 5.02 per cent zinc plus some gold and silver, of which 181,900 tons were high-grade zinc ore containing 19.03 per cent zinc and 0.37 per cent copper.

East Sullivan Mines, Limited, 3 miles east of Val d'Or, milled 905,241 tons of ore to produce 36,200 tons of copper concentrate containing 7,897 tons of copper. Ore reserves at the end of 1957 were 3,104,000 tons averaging 1.18 per cent copper and 0.74 per cent zinc plus some silver and gold.

Golden Manitou Mines Limited, 9 miles east of Val d'Or, milled 297,565 tons of copper ore and 171,870 tons of zinc ore and produced 10,397 tons of concentrate containing 2,788 tons of copper plus silver and gold. The reserves at the end of 1957 were 687,800 tons of zinc ore and 576,200 tons of copper ore, the latter averaging 1.2 per cent copper, as well as 0.02 ounce of gold and 0.42 ounce of silver per ton.

Rainville Mines Limited, 16 miles east of Val d'Or, which commenced production in May 1956, closed its mine in March 1958. During 1957, 161,572 tons averaging 1.47 per cent copper were milled and produced 7,768 tons of copper concentrate containing 2,234 tons of copper plus silver and gold. Reserves at the end of the year stood at 617,200 tons containing 1.46 per cent copper.

Campbell Chibougamau Mines Ltd. on Merrill Island in Lake Chibougamau milled 618,485 tons of 2.379-per-cent copper ore in the year ended June 30, 1957, and produced 62,209 tons of concentrate averaging 22.32 per cent copper. Production during this period was 13,883 tons of copper, 35,940 ounces of gold and 163,481 ounces of silver. Production during the last six months of the year from 283,848 tons of ore milled was 5,636 tons of copper, 16,265 ounces of gold and 53,691 ounces of silver.

Shipments from the Cedar Bay mine, 6 miles from the main plant on the north shore of Dore Lake, commenced during March 1958, and it is expected that a rate of 500 tons a day will be reached late in 1958.

Opemiska Copper Mines (Quebec) Limited milled 240,422 tons at its property 25 miles west of Chibougamau and produced 35,265 tons of concentrates containing 8,555 tons of copper. Ore reserves at the end of the year were 4,743,000 tons containing 3.21 per cent copper.

Anacon Lead Mines Limited, formerly Chibougamau Explorers Ltd., which commenced production at its copper-gold property 26 miles south of Chibougamau in February 1956, milled 170,628 tons of ore to produce 3,248 tons of concentrate containing 942 tons of copper.

Merrill Island Mining Corporation, Ltd., became the Chibougamau area's newest copper-gold producer when the 650-ton mill began operations in February 1958 on ore from its Dore Lake property. The copper content of the ore reserves averages slightly more than 2 per cent.

Quebec Copper Corporation Limited, near Eastman, Bolton township, milled 307,360 tons of ore, from which were produced 10,011 tons of concentrate containing 2,333 tons of copper. Reserves at the end of the year totalled 850,000 tons with a copper content averaging 0.88 per cent.

Copper

Weedon Pyrite & Copper Corporation Limited milled 107,418 tons of copper-zinc-pyrite ore at its property 75 miles south of Quebec City. Concentrate containing 1,771 tons of copper was produced. Reserves at the end of the year totalled 290,115 tons averaging 2.15 per cent copper, 29.66 per cent sulphur and 1.09 per cent zinc.

Manitoba-Saskatchewan

Hudson Bay Mining and Smelting Co. Limited operated its copper-zinc mine, concentrator, copper smelter and zinc plant at Flin Flon on the Manitoba-Saskatchewan boundary and also four smaller mines near Flin Flon. The mill treated 1,644,367 tons of ore, of which 83.8 per cent was hoisted from the Flin Flon mine, 4.5 per cent from the Schist Lake mine (3 1/2 miles southeast of Flin Flon), 6.5 per cent from the North Star mine (12 miles east of Flin Flon), 2 per cent from the Don Jon mine (1,600 feet east of the North Star) and 3.2 per cent from the Birch Lake mine (9 1/2 miles southwest of Flin Flon). Production from the Birch Lake mine commenced in August when ore was trucked to the Coronation mine (13 1/2 miles southwest of Flin Flon) and hauled by company railroad to Flin Flon for treatment. Operations at the Don Jon mine ended in August after the mining out of the orebody.

The average grade of all the ore milled was 2.93 per cent copper and 4.3 per cent zinc. From this ore the company produced 326,543 tons of copper concentrate averaging 13.82 per cent copper, as well as 3.35 ounces of silver and 0.22 ounce of gold per ton. At the copper smelter, 429,793 tons of material were treated to produce blister copper. Production, which amounted to 44,344 tons of copper, 97,486 ounces of gold, 1,528,295 ounces of silver and 98,500 pounds of selenium, made the company Canada's second largest copper producer of 1957. Ore reserves of the company's mines in the Flin Flon area and near Snow Lake, Manitoba, totalled 19,461,000 tons averaging 2.71 per cent copper and 5 per cent zinc, as well as 1.11 ounces of silver and 0.063 ounce of gold per ton.

Sherritt Gordon Mines Limited operated two producing nickel-copper mines and a concentrator at Lynn Lake, Manitoba, and a chemical-metallurgical refinery for treating nickel concentrates at Fort Saskatchewan, Alberta. A total of 833,443 tons of ore was mined and milled to produce a copper concentrate containing 4,748 tons of accountable copper. Ore reserves were higher, amounting to 13,640,000 tons averaging 1.064 per cent nickel and 0.561 per cent copper.

British Columbia

Production of copper from British Columbia mines in 1957, at 14,879 tons, was lower than in 1956 owing to the closing of several large mines. These mines accounted for more than 80 per cent of the production.

The Granby Consolidated Mining, Smelting and Power Company, Limited, shipped the last ore from the Copper Mountain mine on April 29, 1957, and operations were terminated with the exhaustion of the developed ore reserve. During the four months the plant operated, 567,951 tons of ore averaging 0.82 per cent copper were treated, and 3,582 tons of copper were obtained from concentrates produced at the Allenby concentrator. Equipment from the mine and mill was being sold to other mining companies such as Western Nickel Limited and Phoenix Copper Company, Limited.

Tulsequah Mines Limited, a subsidiary of The Consolidated Mining and Smelting Company of Canada Limited, milled 142,537 tons of copper-zinc-lead ore at its property in northwestern British Columbia. The property was closed at the end of August because of low metal prices.

Cowichan Copper Co. Ltd. continued underground exploration of its property on Vancouver Island, 45 miles northwest of Victoria on Lake Cowichan. Production began near the end of the year when the company entered into an agreement with Japanese buyers for the sale of copper concentrates over a 3-year period. Reserves of 500,000 tons with copper content averaging 2 per cent are indicated.

Britannia Mining and Smelting Company Ltd., at Howe Sound, announced that it would close its mine at the end of 1957 owing to low copper and zinc prices. Milling operations ceased on March 31, 1958. From the 849,212 tons of ore milled during 1957, production amounted to 28,444 tons of copper concentrate containing 8,373 tons of copper.

Mid-West Copper and Uranium Mines Ltd. moved the old Whitewater mill to the Velvet mine at Rossland and commenced production of copper-gold concentrates early in 1957. Operations were suspended at mid-year.

Woodgreen Copper Mines Limited operated a 1,000-ton concentrator at the Motherlode mine, a former copper producer near Greenwood. The mine was closed at mid-year and the company went into bankruptcy.

Northwest Territories

North Rankin Nickel Mines Limited commenced production of nickel-copper concentrate during May at its mine at Rankin Inlet. Production during 1957 came to some 7,474 tons of concentrate containing 979 tons of nickel and 265 tons of copper. The concentrate was shipped to the Falconbridge smelter. Reserves at the end of 1957 were 447,481 tons with nickel content averaging 3.2 per cent and copper content 0.93 per cent.

Copper

Newfoundland

Buchans Mining Company, Limited, in central Newfoundland, milled 371,000 tons of zinc-lead-copper ore, from which concentrates containing 4,149 tons of copper were produced. These concentrates were shipped to the smelters of the parent company, American Smelting and Refining Company, in the United States. The new MacLean shaft, a circular, concrete-lined structure which reached a depth of 276 feet by the end of 1957, will permit the mining of the deep-seated orebody situated on the extension of the Rothermere ore zone.

Maritimes Mining Corporation, Limited, began production in its 2,000-ton mill at Tilt Cove, and the initial shipment of copper concentrate went to the Murdochville, Quebec, smelter in September. The concentrate is landed at Gaspe and trucked to Murdochville. During 1957, the company milled some 188,999 tons of ore, from which it produced 16,477 tons of concentrate containing 3,142 tons of copper.

New Brunswick

Heath Steele Mines Limited, a subsidiary of American Metal Climax, Inc., and The International Nickel Company of Canada Limited, commenced production in February at its property 35 miles northwest of Newcastle. Copper concentrates were shipped to the smelter of American Metal Climax, Inc., at Carteret, New Jersey, by way of the new 22-mile railway spur from Bartibog, New Brunswick. The mine and plant has a rated capacity of 1,500 tons of ore a day. In February 1958, the company announced that operations were being curtailed to less than 500 tons a day. Proven ore reserves are estimated at 7,200,000 tons grading 5.6 per cent zinc, 2.2 per cent lead, 1.2 per cent copper and 2.7 ounces of silver per ton to a depth of 600 feet.

Exploration and Development

British Columbia

Granduc Mines, Limited, 25 miles northwest of Stewart, completed an internal shaft to a depth of 625 feet below the 3,250-foot level in the footwall of the deposits, and a crosscut was driven from the shaft. The deposits were traced to depth by diamond-drilling. Reserves remained at 25,600,000 tons with copper content averaging 1.62 per cent. All work was stopped at the property early in 1958, pending new financial arrangements.

Phoenix Copper Company, Limited, completed construction of a 700-ton milling plant near Phoenix. In July it was decided to delay completion of the project owing to copper prices. Some 54,000 tons of waste were stripped from the top of the orebody, which will eventually be mined by an open pit.

Granisle Copper Limited carried out a small amount of diamond-drilling on its property on an island in Babine Lake. No further work is planned until copper prices improve. Indicated are 22 million tons with copper content averaging 0.56 per cent.

Western Nickel, Limited, constructed a mill on its property near Hope to produce nickel and copper concentrates early in 1958. The operation will be managed by The Granby Consolidated Mining, Smelting and Power Company, Limited. Reserves total some 1,300,000 tons with nickel content averaging 1.39 per cent and copper 0.5 per cent.

Canadian Exploration Limited carried out diamond-drilling on the property of Craigmont Mines,Ltd., near Merritt. These claims are adjacent to those of Bethlehem Copper Corporation Ltd. in the Highland Valley area, being drilled by American Smelting and Refining Company. Phelps Dodge Corporation and Kennecott Copper Corporation, two of the largest world producers, are also holders of properties in the Highland Valley.

Saskatchewan

Hudson Bay Mining and Smelting Co. Limited continued development work at the Coronation mine 13 1/2 miles southwest of Flin Flon. Crosscuts were driven to the orebody and to the service-shaft location on all levels from the 150-foot to the 1,050-foot level in the Coronation shaft, which is 1,452 feet deep. Diamond-drilling for the year amounted to 14,395 feet. Ore reserves are 825,000 tons with copper content averaging 5 per cent and zinc 0.4 per cent.

Manitoba

Hudson Bay Mining and Smelting Co. Limited, commenced development work at the Chisel Lake mine, 5 miles southwest of the town of Snow Lake and 70 miles east of Flin Flon. A surface plant was constructed and fully equipped and the 8 1/2-mile road from the Wekusko-Snow Lake highway to the property was completed. A 3-compartment shaft was sunk 487 feet below the surface. By 1960 the Canadian National Railways will have built a 55-mile branch line to the property for the movement of ore to Flin Flon.

No work was done during the year on the Ghost Lake mine, three quarters of a mile east of the Chisel Lake mine.

Development work was started on the Stall Lake mine, 4 miles southeast of the town of Snow Lake. Clearing of the plant site was completed and Stall Lake was drained.

Copper

Ore reserves on the company's properties near Snow Lake total 5,319,000 tons with copper content averaging 1.37 per cent, zinc 8.7 per cent, and lead 0.7 per cent. These reserves also contain some gold and silver.

The International Nickel Company of Canada Limited embarked on a major program to bring the Thompson and Moak Lake mines into production by mid-1960. On October 20, the 30-mile railway spur from Sipiwesk on the C.N.R.'s Hudson Bay line was completed to Thompson, Manitoba's newest mining town. A 1,057-foot development shaft was completed at the Thompson mine, and a production shaft to the 2,100-foot level was commenced. A 9,000-ton concentrator and other mine buildings were under construction. The ore contains low but recoverable amounts of copper.

New Manitoba Mining and Smelting Company, Limited, carried out underground development and constructed a 1,000-ton mill at its Cat Lake copper-nickel property. Copper concentrate and a nickel matte will be produced when production actually begins. Reserves are estimated at 2 million tons with nickel content averaging 0.33 per cent, copper 0.75 per cent, and cobalt 0.06 per cent.

Ontario

The Shield Development Company, Limited, which owns property adjoining Coldstream Copper Mines, Limited, in the Shebandowan area of northwestern Ontario, carried out surface drilling which indicated that the Coldstream ore extends into its property. These indications will be examined by drifting from the Coldstream workings.

The International Nickel Company of Canada Limited proceeded toward preparing the Crean Hill mine for production at a rate of 2,500 tons of ore a day. The mine is some 10 miles west of Creighton Mine. The new 6,000-ton-a-day mill at Levack was under construction and will produce a nickel and a copper concentrate; the former will be shipped to the Coniston smelter and the latter to the Copper Cliff smelter.

Falconbridge Nickel Mines Limited carried out extensive development at its Onaping, Fecunis and Boundary mines in the Onaping area. The new 2,000-ton mill at the Fecunis mine was completed early in the year and went into production in May at partial capacity, treating development ore from the Fecunis mine and ore from the Longvack mine. One level at the Fecunis mine was turned over to International Nickel in preparing for operation under an agreement for joint mining of the deposit, which is partly within the latter company's Levack mine property. Each company will treat the ore derived from within its own property.

Norduna Mines Limited prepared its small orebody for production in 1958. The property is a short distance northeast of Falconbridge. The ore will be purchased by the Falconbridge smelter.

Kenbridge Nickel Mines Limited ceased operations in June on its nickel-copper property on Populus Lake, 55 miles southeast of Kenora. A shaft was completed to a depth of 2,042 feet and some lateral work was completed. The company decided to close down because the indicated grade and tonnage were not sufficient to justify further expenditure under present market conditions.

Temagami Mining Co. Limited continued development at its property on Timagami Island, mainly on the 400-foot and 525-foot levels.

Min-Ore Mines, Limited, shipped some copper concentrate from its property near Matachewan, but later ceased operations.

Eastern Mining & Smelting Corporation Ltd. carried out development work on its property near Werner Lake. No. 2 shaft was completed to a depth of 1,295 feet with stations cut at 150-foot intervals.

Norpax Nickel Mines, Limited, also in the Werner Lake area, carried out lateral development work and the shaft was completed to a depth of 400 feet.

Consolidated Sudbury Basin Mines, Limited, suspended operations in mid-year at its copper-zinc-lead property 15 miles northwest of Sudbury. The mill buildings were constructed and much of the mill equipment is in place.

Quebec

The Mattagami Syndicate located a large zinc-copper deposit on its Watson Lake property, south of Mattagami Lake. Thirty-seven holes totalling 21,000 feet of diamond-drilling have indicated in excess of 14 million tons averaging more than 10 per cent zinc and 0.77 per cent copper, plus some silver and gold.

The Ungava area across northern Quebec from Cape Smith on Hudson Bay to Wakeham Bay on Hudson Strait was the scene of intensive exploration. Work conducted by Asarco Nickel Company Limited, a subsidiary of American Smelting and Refining Company, on the original discovery of Le Moyne Ungava Mines Limited failed to indicate sufficient potential tonnage and grade to justify an integrated nickel operation. Raglan Nickel Mines Ltd. carried out some drilling on ground to the east of the discovery claims.

Copper

New Brunswick

Brunswick Mining and Smelting Corporation Limited, in Gloucester county near Bathurst, sank No. 2 production shaft to 800 feet during the year and carried out an extensive program of flotation research and roast-leaching of concentrate. The company decided, early in 1958, to suspend operations at the end of March. These large zinc-lead deposits are estimated to contain more than 58 million tons with a copper content of 0.5 per cent.

The Anaconda Company (Canada), Limited, Texas Gulf Sulphur Company, Nigadoo Mines Limited, Captain Mines Limited and Kennco Explorations (Canada) Limited also own favourable deposits with recoverable copper content in the same area.

World Mine Production

World mine production as reported by the Copper Institute reached an all-time peak of more than 2,900,000 tons as against 2,863,000 tons in 1956 and 2,614,000 tons in 1955. In the latter year, however, the industry was seriously affected by a series of strikes. These figures exclude production from Russia, Japan, Australia, Yugoslavia, Norway, Sweden, Finland and the Messina mine in South Africa.

World production in 1957, as reported by the American Bureau of Metal Statistics, was 3,861,996 tons, of which the United States produced 1,092,744 tons, Chile 533,855, Northern Rhodesia 480,313, Russia an estimated 465,000, Canada 359,109 and the Belgian Congo 267,026. World production in 1956 was 3,747,473 tons.

Domestic Consumption and Uses

Most of the 118,225 tons of refined copper consumed in Canada in 1957 was used by the rolling mills of Canada Wire and Cable Company, Limited, at Montreal East, and Phillips Electrical Company Limited at Brockville, Ontario, and by the brass mills of Anaconda American Brass Limited at New Toronto and Noranda Copper and Brass Limited at Montreal East. Other consumers are Canadian Arsenals Limited, the Royal Canadian Mint, Aluminum Company of Canada Limited and several foundries.

Calumet & Hecla of Canada Limited commenced the establishment of a copper- and brass-tube mill at London, Ontario. In the Vancouver area, Western Copper Mills Limited is constructing a brass- and copper-tube mill of 18,000 tons capacity. The London plant went into operation in March 1958 and the Vancouver plant is expected to do so about the end of the year. These new plants will materially increase the Canadian capacity for consumption of copper.

The following table gives a partial breakdown by industrial uses of the 118,225 tons of copper consumed in 1957.

	As Metal	As Component of Brass and Bronze	As Component of Nickel -Silver	Total
Ammunition	24	4,231	-	4,255
Automotive equipment	3,725	3,975	4	7,704
Hardware	2,881	944	21	3,846
Plumbing and heating equipment	9,339	4,461	-	13,800
Screw machine products	50	2,516	2	2,568
Silverware	149	-	463	612
Wire and cable	63,997	3,574	-	67,571
Electrical products (exclusive of wire,etc.)	5,514	3,203	18	8,735
Industrial equipment	1,118	1,401	49	2,568
Other uses	1,987	4,289	290	6,566
Total	88,784	28,594	847	118,225

Prices

Domestic shipments by Canadian producers were priced at the United States producers' level converted into Canadian funds. The premium on the Canadian dollar in relation to the United States dollar, which reached a high of 6 per cent during the year, also adversely affected Canadian producers. The price on domestic shipments was 34.74 cents a pound at the beginning of the year and 26.5 cents a pound at the end of the year.

The United States producers' price remained higher than all others quoted during the year. It was lowered in successive steps from 36 cents a pound at the beginning of the year to 34 cents on January 31, to 32 cents on February 18, to 29.25 cents on June 19, to 28.5 cents on August 6 and, finally, to 27 cents on September 3.

The London Metal Exchange prices, which form the pricing basis on overseas shipments and which had reached a high of 54 1/2 cents in April 1956, dropped to the equivalent of less than 22 cents a pound, the lowest price since free trading was resumed on August 5, 1953.

87875-1—7

Copper

Tariffs

Copper in bars, rods, wire, semi-fabricated 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 import tax, which stood at 2 cents a pound, has been suspended until June 30, 1958, with the provision that it will be restored if the average price for June 1958 is less than 24 cents a pound, delivered Connecticut Valley. Under the General Agreement on Tariffs and Trade, the tariff has been subject to 5 per cent reductions effective June 30, 1956, and June 30, 1957, and is now 1.8 cents. A further reduction of 5 per cent is due on July 30, 1958.

Consequently, if the suspension of the import tax is discontinued on July 1, 1958, and if, at that time, the price has averaged 24 cents or more, the three GATT reductions will be effective and the reimposed tariff will be 1.7 cents. But if, when suspension is discontinued, the price has averaged less than 24 cents, none of the GATT reductions will be effective, and the import tax will again be 2 cents a pound.

GOLD

by
T.W. Verity

The adverse conditions facing the gold-mining industry at the end of 1956 continued into 1957. By the year-end, however, the outlook was brighter.

Most of the gold mines instituted a change from the 48-hour to the 44-hour work week during 1956 with no loss in weekly labour earnings. The full impact of this change was felt during 1957 and was sufficient to increase labour costs in many mines by between 9 and 10 per cent. Another result of the shorter work week was a tendency toward a reduction in milled tonnage. In addition, an acute labour shortage developed in several mining districts, but it was offset somewhat, in some areas, by the employment of immigrants who had recently arrived from Great Britain and Europe. The premium on the Canadian dollar in relation to the United States dollar continued its adverse effect on the Mint price of gold, which is pegged at $35 an ounce in United States funds. The price dropped from $33.57 an ounce at the end of 1956 to a low of only $33.06 during the week of August 19 to 23, 1957.

To offset the adverse conditions, many gold mines mined a higher grade of ore during 1957 and this, plus the discovery of new high-grade ore in a few mines, increased the year's gold production to 4,433,894 fine ounces valued at $148,757,143. The final production figures for 1956 showed 4,383,863 ounces valued at $151,024,080.

By mid-1957, depressed metal prices in the base-metal industry had caused cutbacks in production and released many skilled miners for employment in the gold-mining industry. The Canadian and the United States dollar moved closer to parity, and the Mint price of gold increased to $34.42 an ounce by the year-end. The average price for the whole of 1957 was, however, only $33.55, while it was $34.45 in 1956 and $34.52 in 1955.

In spite of adverse conditions, no gold mines closed during 1957. On the other hand, no new mines came into production.

(text continued on page 93)

87875-1—7½

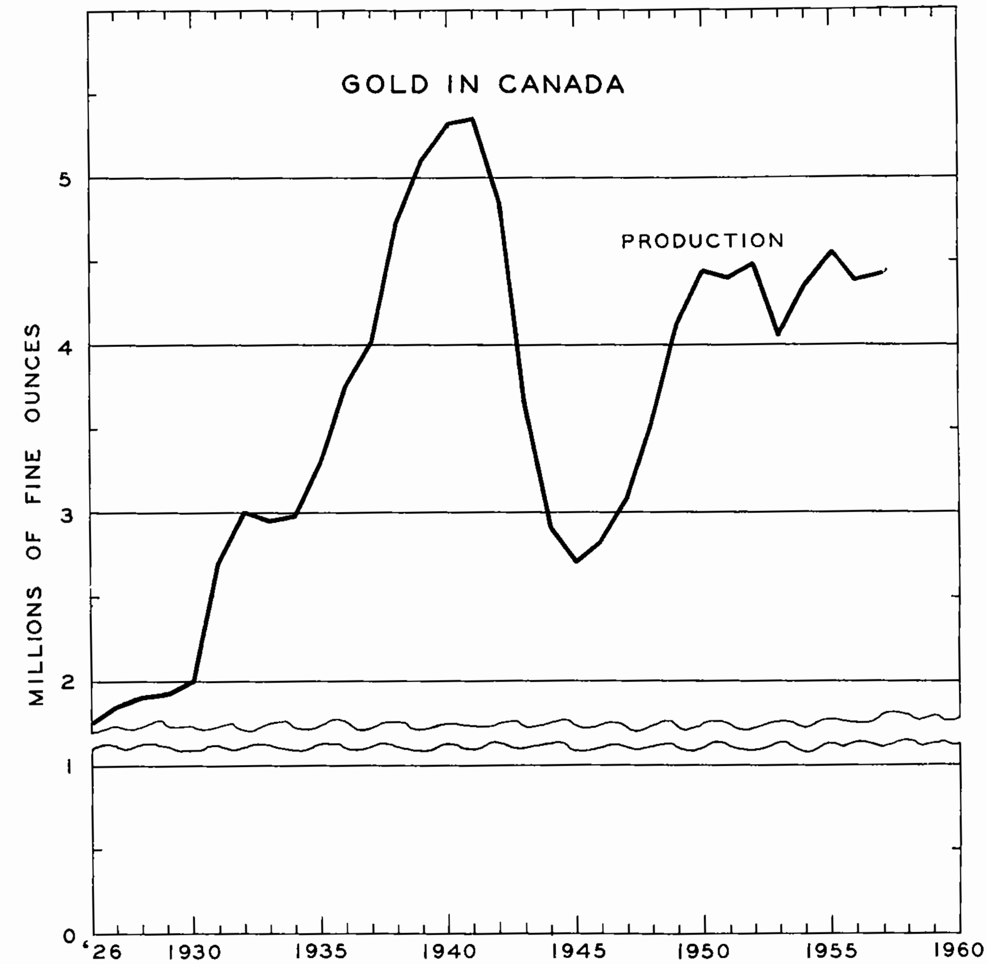
Production of Gold
(fine ounces)

		1957	1956
Yukon	Placer operations	73,709	71,736
	Base-metal mines	253	265
	Total	73,962	72,001
N.W.T.	Auriferous quartz	339,945	352,567
	Placer operations	73	102
	Total	340,018	352,669
B.C.	Auriferous quartz	186,495	158,029
	Placer operations	2,105	2,962
	Base-metal mines	40,513	35,701
	Total	229,113	196,692
Alta.	Placer operations	416	119
Sask.	Placer operations	-	-
	Base-metal mines	75,236	82,687
	Total	75,236	82,687
Man.	Auriferous quartz	97,156	97,445
	Base-metal mines	22,852	22,787
	Total	120,008	120,232
Ont.	Auriferous quartz		
	Porcupine	1,060,038	1,067,735
	Larder Lake	519,486	473,235
	Patricia Portion	456,571	419,646
	Kirkland Lake	361,284	369,394
	Thunder Bay	103,312	101,223
	Sudbury	31,276	33,288
	Matachewan	176	3,388
	Miscellaneous	19	673
	Total	2,532,162	2,468,582
	Base-metal mines	46,044	45,330
	Total	2,578,206	2,513,912
Que.	Auriferous quartz		
	Cadillac-Malartic	293,911	290,643
	Bourlamaque-Louvicourt	230,470	246,175
	Noranda-Duparquet-Belleterre	86,101	91,344
	Miscellaneous	-	-
	Total	610,482	628,162
	Base-metal mines	396,413	407,897
	Total	1,006,895	1,036,059
N.B.	Base-metal mines	240	-
N.S.	Auriferous quartz	45	85
	Base-metal mines	-	1,194
	Total	45	1,279
Nfld.	Base-metal mines	9,755	8,213

Production of Gold (cont'd)

(fine ounces)

		1957	1956
Canada	Auriferous quartz	3,766,285	3,704,870
	Placer operations	76,303	74,919
	Base-metal mines	591,306	604,074
	Total	4,433,894	4,383,863
Canada	Total value	$148,757,143	$151,024,080
	Average value per ounce	$33.55	$34.45



SOURCE: D.B.S.

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

Summary of Gold Production, 1947-57
(fine ounces)

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
1947	2,707,302	88.2	53,519	1.7	309,400	10.1	3,070,221	107,457,735	35.00	16.7
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

Gold continued to hold fifth place in value among minerals produced in Canada, following crude petroleum, nickel, copper and iron ore. In Free World output, Canada retained second place, following the Union of South Africa.

Continuing as the principal producer, Ontario turned out 58 per cent of Canada's output. Quebec followed with 23 per cent, Northwest Territories with 8 per cent and British Columbia with 5 per cent.

The contribution of Canada's base-metal mines to the country's gold production is important, but there is no record of gold production from these sources for the years prior to 1938. The 555,139 ounces recovered that year from base-metal mines made up 11.7 per cent of total gold production. In 1945, 475,197 ounces, or 17.6 per cent, came from base-metal mines. With 604,074 ounces, or 13.8 per cent of production, a peak was reached in 1956.

On January 7, 1958, the Minister of Mines and Technical Surveys announced in the House of Commons that the Government intended to extend the operation of The Emergency Gold Mining Assistance Act beyond the calendar year 1958 to the end of the calendar year 1960. Cost assistance paid to high-cost gold mines since the Act first came into force in 1948 was more than $106 million by the end of 1957.

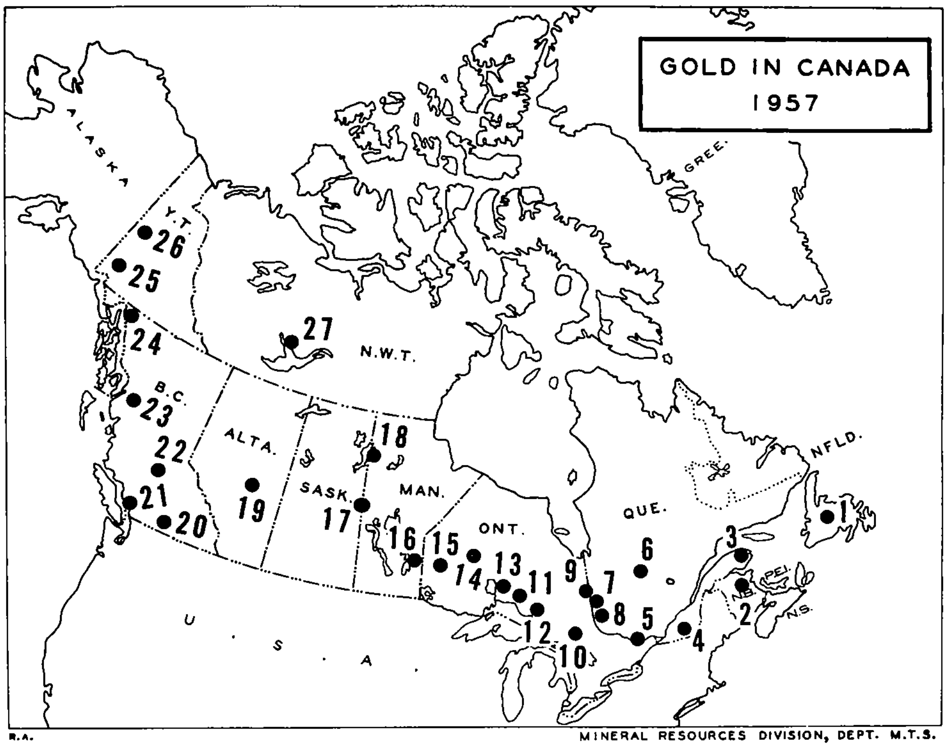
The graph on page 91 shows that since 1926 Canada's gold production has increased some two and a half times - from 1,754,228 to 4,433,894 fine ounces. Production reached a peak of 5,345,179 ounces in 1941, dropped to a low of 2,696,727 ounces in 1945 and then rose to 4,441,227 ounces in 1950. Since that date production has tended to level off at 4,400,000 ounces.

Operations at Producing Mines*

Yukon

The Yukon Consolidated Gold Corporation Limited, Yukon's chief gold producer, operates seven large dredges in the Dawson area. Favourable weather during the 1957 operating season gave this company an increase in production. Production from the smaller operators was, however, considerably lower, but over-all gold recovery increased 3 per cent. Yukon Gold Placers Limited, formerly the third largest gold producer, ceased operations in 1956, and its assets were acquired in June 1957 by Nighthawk Gold Mines Limited.

* See map on page 94.



Producers and Prospective Producers

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

1. Buchans Mining Co. Ltd. *
2. Bathurst District
   (Brunswick Mining and Smelting Corp. Ltd. *)
   Heath Steele Mines Ltd. *

Quebec

3. Gaspe Copper Mines Ltd. *
4. Quebec Copper Corp. Ltd. *
   Weedon Pyrite & Copper Corp. Ltd. *
   (Chaudière River Placers***)
5. New Calumet Mines Ltd. *
6. Chibougamau District
   Campbell Chibougamau Mines Ltd. *
   Chibougamau Explorers Ltd. *
   (Copper Rand Chibougamau Mines Ltd. *)
   Opemiska Copper Mines (Quebec) 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. **
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. **
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. **
(Heath Gold Mines Ltd. **)
(McFinley Red Lake Gold Mines Ltd. **)
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. *
19. Placer operations on Saskatchewan River***
20. Consolidated Mining and Smelting Co. of Canada Ltd., The (Kimberley)*
Sunshine Lardeau Mines Ltd. (Revelstoke)*
Granby Consolidated Mining, Smelting and Power Co. Ltd., The (Copper Mountain)*
21. Britannia Mining and Smelting Co. Ltd. *
22. Pioneer Gold Mines of B.C. Ltd. **
Bralorne Mines Ltd. **
Cariboo Gold Quartz Mining Co. Ltd., The **
Small placer operations ***
23. Silver Standard Mines Ltd. *
24. Tulsequah Mines Ltd. *
Noland Mines Ltd. ***
Enterprise Placers, etc. ***
25. Burwash Mining Co. Ltd. ***
Other smaller operations ***
26. Yukon Gold Placers Ltd. ***
Yukon Consolidated Gold Corp. Ltd., The ***

(continued on page 96)

Gold

Yukon Explorations Ltd.***
Other smaller operations***
27. Consolidated Mining and Smelting Co. of Canada Ltd., The
(Con and Rycon mines**)
Giant Yellowknife Gold Mines Ltd.**
Consolidated Discovery Yellowknife Mines Ltd. **
(Akaitcho Yellowknife Gold Mines Ltd.**)
(Taurcanis Mines Ltd.**)

Northwest Territories

Northwest Territories gold production, which had been growing rapidly, dropped by nearly 3.6 per cent in 1957.

The chief producers - Giant Yellowknife Gold Mines Limited and the Con and Rycon mines of The Consolidated Mining and Smelting Company of Canada Limited, all in the Yellowknife area - showed a decline of 8 per cent. On the other hand, Consolidated Discovery Yellowknife Mines Limited, Canada's highest-grade gold mine, in the Giaugue Lake area, some 65 air miles north of Yellowknife, had the greatest gold production in its history, with more than a 15-per-cent increase.

British Columbia

The steady decline shown in British Columbia's gold production since 1948 was reversed in 1957, and a 16 1/2-per-cent increase was realized. This increase was due entirely to a 40-per-cent increase from Bralorne Mines Limited, in the Bridge River area.

Bralorne Mines Limited, the province's leading gold mine, continued to sink its Queen shaft and developed high-grade ore in its No. 77 and No. 79 veins at depth. A much higher grade of ore mined increased gold production by more than 25,441 ounces. The other two gold mines in British Columbia - Pioneer Gold Mines of B. C. Limited in the Bridge River area and The Cariboo Gold Quartz Mining Company Limited in the Wells area - had a small drop in output.

Production of gold as a by-product from base-metal mines increased in total by 4,812 ounces but dropped in percentage of total gold production from 18.2 to 17.7 per cent. Lower base-metal prices during the second half of 1957 caused cutbacks in production at several base-metal mines, and gold production from this source will likely drop in 1958.

Placer-gold production continued to decline and in 1957 represented less than 1 per cent of the total. The main producer, Noland Mines Limited, an underground gold placer mine in the Atlin area, closed at the end of the 1957 season.

Alberta

As in previous years, a small amount of placer gold was recovered from the gravels of the North Saskatchewan River near Edmonton. Small amounts of placer gold have been recovered intermittently from this source since 1887.

Saskatchewan

All gold production comes as a by-product from the Saskatchewan part of the copper-zinc mines of Hudson Bay Mining and Smelting Co. Limited at Flin Flon on the Manitoba-Saskatchewan border. Gold production dropped by 9 per cent in 1957.

Manitoba

Gold production comes from both auriferous quartz and base-metal mines. Production in 1957 was down slightly.

The mine of Nor-Acme Gold Mines Limited at Snow Lake, under lease by Britannia Mining and Smelting Company Ltd., is the chief producer of the auriferous quartz mines; output in 1957 was almost the same as in 1956. The mine is, however, on a salvage basis and is expected to close in the summer of 1958. Production from San Antonio Gold Mines Limited and its subsidiary, Forty-Four Mines Limited, in the Rice Lake area, was down slightly, owing mainly to a labour shortage. By-product gold from the 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 small increase. By-product gold represented 19 per cent of gold output of the province in 1957.

Ontario

Ontario's contribution of nearly 58 per cent to Canada's 1957 gold production came from the province's 30 operating gold mines. Tons milled dropped slightly, but an increase in the average grade of ore milled, from 0.276 to 0.282 ounce gold per ton, gave an increase in production of nearly 64,294 ounces, or 2.6 per cent.

The increase was due to greater output from Larder Lake, Patricia Portion and Thunder Bay districts. Production was down in the older Porcupine, Kirkland Lake, Sudbury and Matachewan districts.

Gold

Porcupine District

There were 13 auriferous quartz mines operating in the Porcupine district, the leading gold-producing area of the province. The chief producer, Hollinger Consolidated Gold Mines, Limited, maintained the grade of milled ore, but a drop in milled tons resulted in a 1 1/2-per-cent drop in gold output. On the other hand, the second largest producer, McIntyre Porcupine Mines Limited, increased milled tonnage by 4 per cent with a slightly lower mill grade, and obtained a 2 1/2-per-cent increase in gold recovery. Dome, the third largest producer, milled less tonnage at a higher grade, which gave only slightly less than the 1956 total.

Among the smaller operators, Aunor Gold Mines Limited increased its mill rate and planned to increase mill tonnage 50 per cent by mid-1958. A lower grade of ore milled gave only a slight increase in gold output in 1957. Preston East Dome Mines, Limited, also milled a higher tonnage at a lower average grade, which gave a decrease in production. Broulan Reef Mines Limited continued a major development program at depth both on its own property and the adjoining property of Hugh-Pam Porcupine Mines Limited. Both mines increased tons milled, but a much lower grade of ore caused a large drop in gold output. Pamour Porcupine Mines Limited also increased milled tons while maintaining its ore grade, which at 0.082 ounce gold per ton is the lowest grade of any gold mined in Canada, and had a small increase in gold production. Coniaurum Mines Ltd., Delnite Mines Limited and Hallnor Mines Limited (the district's highest-grade gold mine) milled less ore and, in spite of a higher ore grade, produced slightly less gold. Delnite plans to deepen its No. 3 winze by 300 feet in 1958. Paymaster Consolidated Mines, Limited, milled less tonnage at a lower grade and had a large drop in gold output. The Hollinger-Ross mine at Holtyre, some 55 miles east of the town of Timmins, maintained production at the 1956 level.

Larder Lake District

This is the second largest gold-producing district in Ontario, and all production came from Canada's largest gold producer, Kerr-Addison Gold Mines Limited. This mine again topped its all-time high, established in 1956. Tons milled dropped by 13,000, but an increase in grade from 0.286 to 0.314 ounce gold per ton gave an increase of 46,251 ounces, or 9.8 per cent, in output.

Patricia Portion

This district, the third largest gold-producing area in the province, includes both the five mines in the Red Lake mining division and the mine of Pickle Crow Gold Mines Limited in the Patricia mining division. Its production rose by 36,925 ounces in 1957, an 8.8-per-cent increase. Milled tonnage increased by less than 2,000 tons, but the average grade milled rose from 0.421 to 0.455 ounce gold per ton.

The chief producer, Campbell Red Lake Mines Limited, milled almost the same tonnage as in 1956, but a higher grade of ore gave a 12,000-ounce, or 9-per-cent, increase in gold output. Madsen Red Lake Gold Mines Limited, the second largest producer, increased milled tonnage by 10,000 tons but a somewhat lower grade of ore gave only a small increase in gold output. New Dickenson Mines Limited and Cochenour Willans Gold Mines, Limited, had considerable success in finding new high-grade ore at depth, and an increase in tonnage and grade gave large increases of 19 and 32 per cent, respectively, in gold production. McKenzie Red Lake Gold Mines Limited, on the other hand, which adjoins Cochenour Willans, had little success in finding ore at depth and has been placed on a salvage basis; a lower grade of ore and a small increase in milled tonnage resulted in a 6-per-cent drop in output. Pickle Crow, in the Pickle Lake area, increased tonnage by 8 per cent, but a lower grade of ore gave only a 5-per-cent increase in gold production.

Kirkland Lake District

Production from the Kirkland Lake district continued its downward trend. Output from the seven gold mines in the district dropped by 2.2 per cent. Tonnage milled dropped by 38,000 tons, or 3 1/2 per cent, while the grade of ore milled improved from 0.324 to 0.328 ounce gold per ton.

Lake Shore Mines Limited was formerly the chief producer but was surpassed by Wright-Hargreaves Mines Limited in 1956 and 1957 and also by Macassa Mines Limited in 1957. Kirkland Minerals Corporation Limited and Teck-Hughes Gold Mines Limited, now on a salvage basis, and also Lake Shore and Sylvanite Gold Mines Limited reduced gold production while Macassa, Upper Canada Mines Limited and Wright-Hargreaves had increases from larger tonnages and a higher grade of ore worked.

Wright-Hargreaves closed its mill early in 1957 and trucked ore to the adjoining Lake Shore mill for treatment. Both mines are now controlled by Little Long Lac Gold Mines Limited. Increased gold production at Wright-Hargreaves was due mainly to clean-up gold recovered from the mill circuits. This mine also completed the sinking of its No. 6 internal shaft and was developing six new levels. Mining, carried out at a depth of 8,170 feet, was the deepest operation in Canada. Macassa was expanding its mill rate from 400 to 500 tons a day late in 1957. Upper Canada expects to deepen its No. 1 shaft from 3,625 to 4,375 feet during 1958 and open five new levels.

Thunder Bay District

The chief gold producer in the district is MacLeod-Cockshutt Gold Mines Limited. This mine increased milled tonnage by 2 per cent in 1957 while maintaining ore grade. The mine is now also under the control of Little Long Lac Gold Mines Limited. At the property of Leitch Gold Mines Limited, Ontario's highest-grade gold mine, tonnage was increased by 6 per cent, but a lower grade of ore gave only a 3 1/2-per-cent increase in production.

Gold

Sudbury District

At the property of Renabie Mines Limited, milled tonnage was increased by 9 per cent, but a drop in ore grade from 0.217 to 0.187 ounce per ton caused a 6-per-cent drop in gold output.

Matachewan District

The Young-Davidson Mines Limited closed at the end of 1955. Only a small amount of clean-up ore was treated in 1956 and no gold production was recorded from gold mines in the district in 1957.

Base-metal Mines

Production of gold as a by-product from base-metal mines showed a slight increase to 1.8 per cent of gold output in Ontario. The nickel-copper mines in the Sudbury Basin were the chief source. The coming into production of the copper mines of Geco Mines, Limited, Coldstream Copper Mines, Limited, and Willroy Mines, Limited, in the Thunder Bay district, gives promise of increased production of by-product gold.

Quebec

Only 11 auriferous-quartz mines were producing in Quebec during 1957 and gold output was down by 2.8 per cent. Milled tonnage dropped by 5 1/2 per cent, but mill grade increased from 0.160 to 0.164 ounce gold per ton.

Cadillac-Malartic District

The main gold-producing part of Quebec is in the Malartic area, with four mines in production. East Malartic Mines Limited, now Quebec's second largest gold mine, milled a lower tonnage, but an increase in ore grade from 0.165 to 0.198 ounce gold per ton gave an increase of 19,000 ounces of gold, or 21 per cent. The company is now controlled by Little Long Lac Gold Mines. The mine continued sinking its No. 4 inclined shaft and started development on three new levels. Malartic Gold Fields Limited, the leading gold mine in the area in 1956, dropped in tonnage milled while maintaining ore grade and had a 3-per-cent drop in production. Exploration at this mine for new ore at depth has been disappointing. This company, also, is now under the control of Little Long Lac Gold Mines Limited. Canadian Malartic Gold Mines, Limited, dropped in milled tonnage, but ore grade rose from 0.089 to 0.106 ounce gold per ton, giving a 15-per-cent increase in output. Barnat Mines Ltd. dropped in tonnage milled with a small increase in ore grade and had a 9 per cent drop in output, but is having some success in developing new ore zones in the upper part of the mine.

Bourlamaque-Louvicourt District

The closing of the mine of Sullivan Consolidated Mines Limited in 1956 reduced tonnage from this district in 1957 and gold output dropped by 6.4 per cent. At the property of Lamaque Gold Mines Limited, Quebec's largest gold mine, located in the district, production was increased by 3 per cent. Sigma Mines (Quebec) Limited had a drop of 11,000 tons milled and gold output decreased by 3 per cent. Bevcon Mines Limited increased mill tonnage and mined a higher grade of ore, obtaining a 17-per-cent increase in production. This mine had some encouraging results in the development of its four new lower levels.

Noranda-Duparquet-Belleterre Districts

Elder Mines Limited and Eldrich Mines Limited in the Noranda area continued to ship gold ore to the smelter of the Noranda Mines, Limited, to be used as a flux ore. Eldrich officially came into production as a new mine on December 1, 1956, and shipped an average of some 8,600 tons a month to the Noranda smelter in 1957. Stadacona Mines (1944) Limited had a drop of 11 per cent in gold production owing to the mining of a lower grade of ore. A possible new low-grade ore zone was indicated below its bottom level by diamond-drilling. Beattie-Duquesne Mines Limited, in the Duparquet area, closed as a gold mine in 1956 and had no gold production during 1957. In the Belleterre area, Belleterre Quebec Mines Limited, a subsidiary of McIntyre Porcupine Mines Limited, is now on a salvage basis and had a drop both in tons milled and in grade of ore worked.

Base-metal Mines

Base-metal mines continued to contribute a large share of the gold production. Most of Quebec's copper mines ship concentrates to the Noranda smelter for treatment, and gold is recovered as a by-product. Total gold recovered as a by-product from base-metal mines was lower, at 396,413 ounces compared with 407,897 ounces in 1956, and the percentage of gold recovered as a by-product in the province was 39.4.

Maritime Provinces

The closing of the Mindamar Metals Corporation Limited base-metal mine in Richmond county, Nova Scotia, in 1956 removed the province's principal gold producer and only 45 ounces of gold were shown as being recovered in the province during 1957.

Gold

No gold was recovered in New Brunswick, but the expansion of base-metal mining in the Bathurst area gives promise of some by-product gold in the future.

Newfoundland

Gold is recovered as a by-product from the silver-lead-zinc mine of Buchans Mining Company Limited, in the Red Indian Lake district. Output increased by more than 18 per cent in 1957.

Developments at Other Properties in Canada

British Columbia

French Mines Limited, a subsidiary of Cariboo Gold Quartz, moved part of the old Island Mountain Mines Company Limited mill equipment to Hedley in southern British Columbia and started treating ore mined from a portion of the old Kelowna Mines Hedley Limited (French mine) in August 1957.

Northwest Territories

Taurcanis Mines Limited, at Matthew Lake, 150 miles north of Yellowknife, sank a 3-compartment shaft to 325 feet during 1957 and carried out lateral development on two levels. It was planned to develop an airstrip at the property in the summer of 1958.

Ontario

McFinley Red Lake Gold Mines Ltd. in the Red Lake division completed underground development at the property but did not develop any orebodies that could be considered of importance under present economic conditions in the gold-mining industry.

Consolidated Mosher Mines Limited, adjoining MacLeod-Cockshutt Gold Mines Limited, in the Thunder Bay district, collared a production shaft during 1957 but has deferred further shaft-sinking until economic conditions improve. Negotiations were under way, early in 1958, to have Consolidated Mosher ore treated in the MacLeod-Cockshutt mill.

Quebec

Late in 1957, renewed interest was aroused in the gold possibilities of the Chaudière River Valley near Beauceville in the Eastern Townships, and staking took place all along the river valley. The first discovery of gold in

Canada was made in this district in 1823, when placer gold was recognized on the Gilbert River, a tributary of the Chaudière. Some $3 million in placer gold was estimated to have been recovered from the gravels of the Chaudière River Valley up to 1913, but none has been recorded since. Plans are underway to recover gold once again in the district by means of gold-dredging equipment similar to that used in Yukon Territory.

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INDIUM

by
D.B. Fraser

Indium, one of the rarer metals, 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 or 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 per cent) indium anode slime. The anode slime is then treated chemically to give a crude (99 per cent) indium metal, which is refined electrolytically to produce a standard grade (99.97 per cent) of indium or a high-purity grade which approximates 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 is shown in the following table:

Year	Troy Ounces	Value ($)
1942	437	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

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 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. As in the case of tin, a rod of indium will emit a high-pitched sound if bent quickly. The metal has an atomic weight of 114.8; its specific gravity at room temperature is 7.31, which is about the same as that of iron.

Indium forms alloys with silver, gold, platinum and 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 per cent) 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 the electronics field, 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 is a photoconductor, with potential application in electrophotographic plates.

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Indium

In the field of nuclear energy, since artificial radioactivity is easily induced in indium by neutrons of low energy, it 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

Since 1946 the price of indium quoted in E & M J Metal and Mineral Markets has been $2.25 a troy ounce of 99.9+ purity.

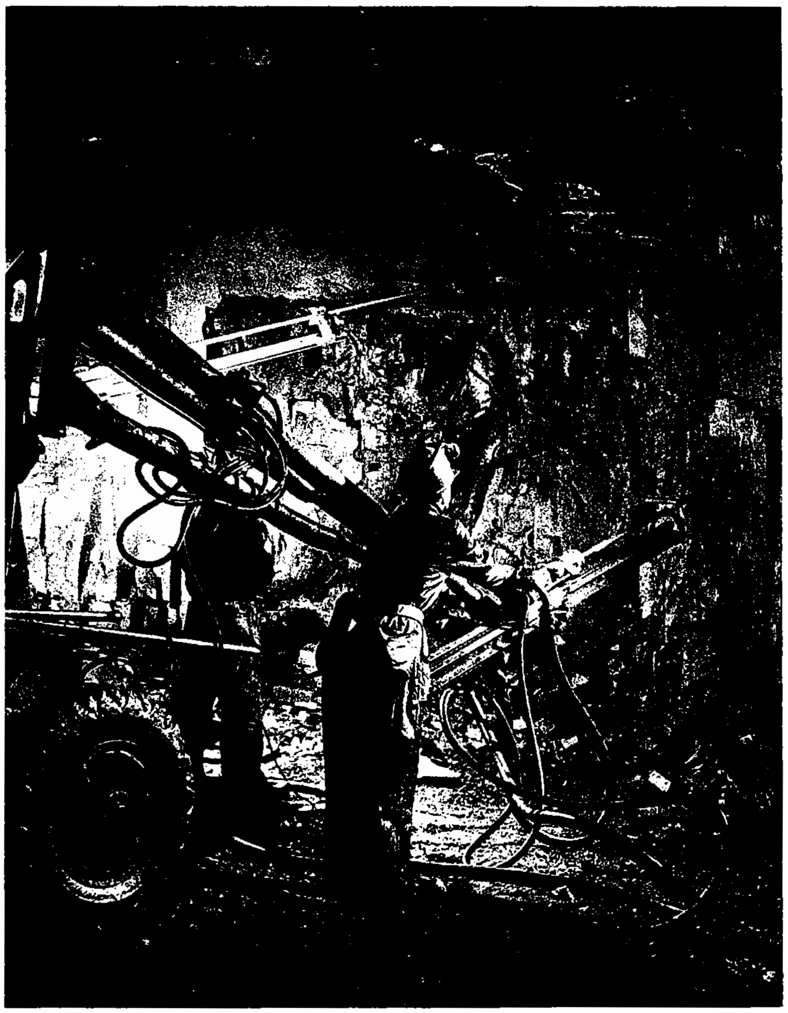

Photo: 3863, George Hunter

Drill Jumbo at Wabana
Mine, Bell Island, Nfld.

IRON ORE

by

T. H. Janes

Considerable uncertainty exists in the iron-ore industry concerning the market potential for 1958 owing to a continuing low rate of steel production in the United States. Throughout the first half of 1957, the steel-production rate of Canada's largest customer remained near an all-time high of 90 per cent of capacity. A slackening in production, beginning in July, continued throughout the remainder of the year. In December, production had declined to about 55 per cent of the January 1, 1957, capacity of 133.5 million net tons and has remained at approximately the same level during January and February of 1958.

Despite the decreased tempo of activity during the latter part of 1957, forecasts of steel-ingot and castings production in the United States for 1958 have ranged from 100 to 110 million net tons. Production in 1957 totalled 113 million tons, only slightly below the all-time high output of 117 million tons in 1955. However, stocks of ore on hand at steel plants and ore docks in the United States and Canada had risen to 67,119,050 gross (long) tons at the end of 1957 from 58,187,162 tons a year earlier. This 9-million-ton increase in stocks, coupled with the low steel-operating rate in effect at the beginning of 1958, does not bode well for increased iron-ore production during the current year. Total consumption of iron ore in the two countries in 1957 amounted to 139,233,430 tons* compared with 128,561,951 tons the previous year.

Offsetting a reduction of shipments to the United States, from 13,737,467 tons in 1956 to 12,613,121 tons in 1957, was an increase of shipments to the United Kingdom and western European countries to 5,023,219 tons from the 4,052,143 tons shipped in 1956. Steel-ingot and castings production in these countries increased to about 90 million net tons in 1957 from the previous year's 85 million net tons, thus gaining by about 6 per cent. This trend of increased shipments to European customers is expected to continue and to amount to at least 8 million tons annually by 1961.

Shipments from Quebec mines were higher during the year, but a decline in shipments from mines in Ontario and Labrador left the total about the same as in 1956. In 1957, the value of shipments increased to $167,221,425 from the $160,362,118 recorded for 1956. The amount of ore imported for domestic consumption was slightly lower than the 4,525,768 tons recorded in 1956.

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

Iron Ore

World Production

Canada continued in fourth place among the world producers of iron ore in 1957 and will probably remain there, following the United States, Russia and France, for many years. The annual statistical report of the American Iron and Steel Institute estimates world production of iron ore in 1957 at 476,728,928 net tons, with the countries listed in the following table contributing the major portion.

Production of Iron Ore by Countries

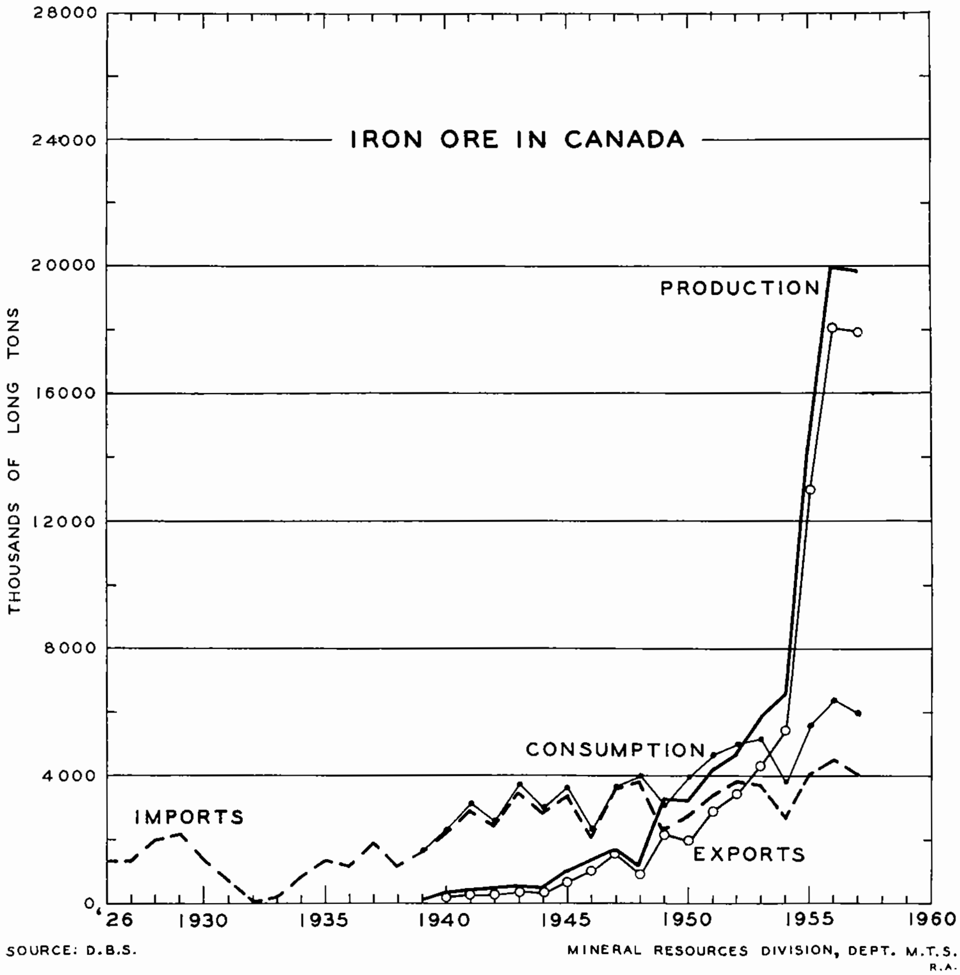
(thousands of net tons)

Country	1957	1956	Approximate Average Grade*
United States	118,886	109,592	50
U.S.S.R.	92,858	85,979	60
France	63,678	58,072	35
Canada	22,272	22,348	55
Sweden	22,024	21,012	60
West Germany	20,699	18,654	30
China	20,395	22,042	45
United Kingdom	18,930	18,194	30
Venezuela	16,951	12,142	65

* As estimated in Monthly Bulletin of Statistics, United Nations, New York.

Canadian Production and Trade

Canadian iron-ore production and trade are expected to remain at about the same levels during 1958 as in 1957. Any reduction in 'merchant ore' shipments from producers will probably be balanced by shipments from four plants being prepared for initial production in the first half of 1958. Two of the four plants are subsidiary operations of established steel companies.



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 world's largest consumer of iron ores, its incentive taxation policies, its stable political climate and its immense reserves of iron ore together with 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 Limited and Iron Ore Company of Canada 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

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 need of blending ores from different sources for blast-furnace feed by steel makers also contributes to the need for imports. Ores from Brazil and Liberia are used as open-hearth lump-ore feed.

Iron ore - Production, Trade and Consumption, 1947-57

(long tons)

	Production (1)	Imports	Exports	Indicated Consumption (2)
1947	1,713,720	3,521,920	1,562,479	3,673,161
1948	1,193,968	3,839,431	955,604	4,077,795
1949	3,281,336	2,247,531	2,277,053	3,158,777
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	5,582,506
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

(1) Producers' shipments.

(2) Producers' shipments plus imports less exports.

Canada's modern iron-ore industry had its beginning 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 1939 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 at a very rapid rate. An annual production of 46 to 60 million tons is forecast for 1965, and a further rise is expected, perhaps to 96 million tons by 1980.

The shipments of iron-ore sinter by Noranda Mines Limited from Port Robinson, of iron ore pellets by The International Nickel Company of Canada Limited from Copper Cliff, both in Ontario, and of 'remelt iron' by Quebec Iron and Titanium Corporation from its Sorel, Quebec, smelter, are not included in the main production table on page 113. Shipments for 1956 and 1957, in long tons, from these sources were:

	1957	1956
International Nickel pellets	113,099	71,000
Noranda sinter	40,952	48,200
QIT 'remelt iron' (Sorelmetal)	187,529	142,745

Iron ore - Production, Trade and Consumption

	1957		1956	
	Long Tons	$	Long Tons	$
Production (shipments)				
Quebec	7,922,275	65,805,057	7,104,062	58,373,270
Newfoundland	7,298,910	57,898,102	7,556,761	55,620,755
Ontario	4,345,630	41,317,629	4,962,681	44,177,246
British Columbia	319,055	2,200,637	330,316	2,190,847
Total	19,885,870	167,221,425	19,953,820	160,362,118
Imports				
United States	3,778,140	32,593,452	4,362,070	36,556,207
Brazil	264,192	3,685,845	132,979	1,790,853
Chile	10,367	107,128	-	-
Sweden	5	363	-	-
Liberia	-	-	30,710	374,191
United Kingdom	-	-	9	852
Total	4,052,704	36,386,788	4,525,768	38,722,103
Exports				
United States	12,613,121	110,179,709	13,737,467	113,516,437
United Kingdom	3,047,029	24,283,931	2,504,847	18,506,953
West Germany	1,097,105	8,294,106	1,088,506	6,858,962
Netherlands	545,687	4,455,135	438,290	3,322,051
Japan	336,429	2,342,738	304,470	2,075,500
Other countries	333,398	2,725,775	20,500	162,647
Total	17,972,769	152,281,394	18,094,080	144,442,550
Indicated consumption*	5,965,805		6,385,508	

* Indicated consumption = production (shipments) plus imports minus exports.

Iron Ore Production in 1957, by Company

Company and Location*	Type of Ore	Product Shipped	Iron Ore Shipments (long tons)
Dominion Wabana Ore Ltd., Wabana, Bell Island, Nfld.	hematite	heavy-media concentrates	2,879,019
Quebec Iron and Titanium Corporation Allard Lake, Que. (mine) Sorel, Que. (smelter)	ilmenite-hematite	desulphurized iron	187,529 (remelt iron)
Iron Ore Company of Canada, Labrador-New Que., near Schefferville, Que.	goethite and hematite	direct-shipping ore	12,435,712
Noranda Mines Ltd., Noranda area, Que. (mines); Port Robinson, Ont. (sinter plant)	by-product pyrite flotation concentrate	iron-oxide sinter	40,952
Marmoraton Mining Co. Ltd. (Bethlehem Steel Co.), Marmora, Ont.	magnetite	pelletized magnetite concentrate	452,710
Clarken Development Ltd., Lake Township, Hastings County eastern Ont. 16 m. west of Millbridge Stn.	magnetite	magnetite concentrate	41
Algoma Ore Properties Ltd., mines and sinter plant near Jamestown, Ont.	siderite	iron-oxide sinter	1,600,630
Steep Rock Iron Mines Ltd., Steep Rock Lake, Ont., near Atikokan	goethite	direct-shipping ore	2,370,770
The International Nickel Co. of Canada, Ltd., mines in the Sudbury area and plant at Copper Cliff, Ont.	pyrrhotite flotation concentrates	iron-oxide pellets	113,099
Texada Mines Ltd., Texada Island, B.C.	magnetite	magnetite concentrate	178,572
Argonaut Mine Division of Utah Co. of the Americas(1), Quinsam Lake near Campbell River, Vancouver Island, B.C.	magnetite	magnetite concentrate	70,929
Empire Development Co. Ltd. (formerly Quatsino Copper-Gold Mines Ltd.)(2), Elk River deposit near N end of Vancouver Island, B.C.	magnetite	magnetite concentrate	75,000 (est.)

* See map on page 122.

(1) Shipped from stocks in 1957. Mine closed December 1956.

(2) First shipments in October 1957.

Sources of Production

About one quarter of the iron ore production of the past few years has come from underground operations, and the remainder from open pits. Three underground mining methods are being used for ore extraction - room and pillar at Wabana, sublevel stoping at Algoma, and block-caving at Steep Rock. In each of these mines ore is brought to surface by conveyor belts. At Algoma's Helen mine in the Michipicoten area of Ontario, it is planned to bring the ore from the lower block of levels, currently under development, to surface by a continuous aerial ropeway on a 22-degree incline in 3-ton buckets for 5,000 feet, and then on surface for two miles to the sinter plant.

In 1957, seven companies contributed to Canada's shipments of iron ore from properties operated solely for the production of iron ore. Two of these produced direct-shipping ore; two, magnetite concentrates; one, sinter; one, pelletized magnetite concentrates; and one, heavy-media concentrates. In addition to these, one company produced iron-oxide sinter from pyrite as a co-product of sulphur dioxide and elemental sulphur, another produced iron-oxide pellets as a co-product of nickel from nickeliferous pyrrhotite, and another made 'remelt iron' and titanium-dioxide slag from ilmenite. One company reported production of 41 tons of finely ground, high-grade magnetite concentrate valued at $2,000, probably for use in heavy-media separation.

Developments

Several companies were in various stages of developing their properties for early production. Four of them were in the plant-construction stage for production in the first half of 1958. Two other companies were engaged in the earlier stages of property development for large-scale production to commence in 1959 or 1960 on orebodies proved by diamond-drilling to contain large reserves of iron ore.

In addition to the companies with properties in production and being developed for production, there are many companies holding iron-ore properties in Canada that are of possible economic importance. The accompanying table provides information on the companies in this group that have indicated by diamond-drilling, geological reconnaissance and surface examination large deposits of iron-bearing material ranging from 25 to 35 per cent recoverable iron. In the aggregate, the reserves on these properties might run to several billion tons of concentrating-grade iron ore.

Companies under Development with Announced Plans of Production

Company	Property Location	Type of Ore	Product to Be Shipped
The Hilton Mines (early in 1958)	Near Bristol, Que. 40 miles NW of Ottawa	beneficiating-grade magnetite	iron-oxide pellets
Noranda Mines Ltd. (early in 1958)	Noranda area, Que. (mine) Cutler, Ont. (sinter plant)	by-product pyrite and pyrrhotite flotation concentrate	iron-oxide sinter
Lowphos Ore Ltd. (May 1958)	Near Milnet, Ont. 10 miles N of Capreol	beneficiating-grade magnetite	magnetic iron-oxide concentrates
Canadian Charleson Ltd. (May 1958)	Near Atikokan, Ont. S of Steep Rock Lake	hematite-bearing gravels	washed and sized hematite
Caland Ore Co. Ltd. (1959-60)	Steep Rock Lake, Ont.	goethite-hematite	direct-shipping ore
Quebec Cartier Mining Co. (1960-61)	Mt. Reed and Mt. Wright areas, Que., 150 and 210 miles N of Shelter Bay	beneficiating-grade specular hematite and magnetite	iron-oxide concentrates

Some Companies with Large Reserves of Concentrating-grade Iron Ore

Company	Property Location	Ownership	Type of Ore
Albanel Minerals Ltd.	Lake Albanel, Quebec, 100 miles NE of Chibougamau	Cleveland-Cliffs Iron Co. and M. J. O'Brien	magnetite
Anaconda Iron Ore Co. Ltd.	32 miles N of Nakina, northern Ontario	The Anaconda Co. of New York, N. Y.	magnetite
Belcher Mining Corporation Ltd.	Belcher Islands in Hudson Bay	Public stock company	magnetite
Bellechasse Mining Co.	Mt. Wright area, Que.	Optioned to Pickands Mather & Co.	magnetite

Company	Property Location	Ownership	Iron Ore Type of Ore
Canadian Javelin Ltd.	Wabush Lake area, 224 miles N of Seven Islands, Que.	Public stock company (see Julian Iron Corporation and Wabush Iron Co. Ltd.)	magnetite specular hematite
Iron Bay Mines Ltd.	30 miles S of Red Lake, Ont.	Public stock company	magnetite
Julian Iron Corporation Ltd.	Wabush Lake area	Canadian Javelin Ltd.	magnetite
Mattagami Mining Co. Ltd.	35 miles N of Kapuskasing, Ont.	The Steel Co. of Canada and Interlake Iron Corporation	magnetite
Oceanic Iron Ore of Canada Ltd.	West of Ungava Bay, northern Quebec	Controlled by Rio Tinto Mining Co. of Canada Ltd.	magnetite
Quebec Cobalt and Exploration Ltd.*	Mt. Wright area	Optioned to Jones & Laughlin Steel Corporation	magnetite
Wabush Iron Co. Ltd.	Wabush Lake, Que., 224 miles N of Seven Islands	Owned by Canadian Javelin --optioned to Pickands Mather & Co. and The Steel Co. of Canada	magnetite and specular hematite
Ungava Iron Ores (formed to bring properties of Atlantic Iron Ores Ltd. and International Iron Ores Ltd. into production)	West of Ungava Bay, northern Quebec	Development company formed by Cyrus Eaton and West German interests	magnetite

* Option exercised in February 1958.

Iron Ore

The following section deals in more detail with those 1957 developments of immediate or major consequence.

Quebec

Iron Ore Company of Canada began construction, late in 1957, of a 500,000-ton storage-transfer dock at Rotterdam, Holland, to permit quick unloading of large 30,000-ton ore carriers. The transfer facilities will be similar to those the company operates at Contrecoeur, Quebec, and will permit it to provide better service to its European and United Kingdom customers. The company announced, also late in the year, that it had indicated, by diamond-drilling on its holdings in the Wabush Lake area of Labrador, a minimum of 1 billion tons of concentrating-grade iron ore averaging perhaps 35 per cent iron. Eventual production from these deposits could reach 10 million tons of high-grade shipping product annually, when market conditions would warrant such production, possibly by the late 1960's.

Quebec Cartier Mining Company completed 160 miles of its 200-mile truck access road northward from Shelter Bay to its property holdings in the Mount Reed area, some 60 miles southwest of Mount Wright. Final reading, by the Quebec Legislative Assembly early in 1958, was given to a bill for the incorporation of the company's 265-mile railroad to the Mount Wright area (Cartier Railway Company). The various phases of engineering design (docks, loading facilities, mining towns, railroad, hydro-power, concentrator, etc.) are progressing on schedule, and actual construction is beginning on some projects during 1958. Initial production is planned for 1960-61 at an annual rate of 8 million tons of concentrate grading about 66 per cent iron.

Jones & Laughlin Steel Corporation, in association with The Cleveland-Cliffs Iron Company, in February 1958 exercised its option to lease, for 99 years, the property of Quebec Cobalt and Exploration Limited. This property is about 5 miles north of the Mount Wright holdings of Quebec Cartier Mining Company and 40 miles west of the Quebec North Shore and Labrador Railway. A minimum of 1 billion tons of concentrating-grade hematite-magnetite ore was indicated on the property during the period of the two-year examining option.

Ungava iron-ore interests continued discussions with West German and other interests on means of financing the large deposits to production.

The Hilton Mines neared the production stage, and some of the mill equipment was turned over in December on test runs.

Quebec Iron and Titanium Corporation, enjoying another record year, completed and put into operation its sixth electric furnace at Sorel. Two additional furnaces, bringing the total to eight, will be completed during 1958 and 1959.

The huge tonnages of concentrating iron ore (magnetite and specular hematite) envisaged for several years in the Wabush Lake area come much closer to reality and production with the announcement by the Iron Ore Company of Canada, as previously outlined.

Ontario

Caland Ore Company Limited continued its dredging of Falls Bay, Steep Rock Lake, and began sinking its large production shaft on the east side of the bay. It is expected that open-pit ores will be produced in 1959 and that ore from underground operations will be available the following year.

Steep Rock Iron Mines Limited continued dredging the silt overlying the middle (G) orebody and produced ore from the Hogarth open-pit and Errington underground operations. The company is building two concentrators to recover lower-grade ores in the walls of the pits and to treat underground ore before shipment.

Canadian Charleson Limited started construction of its gravity separation plant to treat hematite-bearing gravels that it holds under lease a short distance south of Steep Rock Lake.

Algoma Ore Properties Limited in the Michipicoten area, completed installation of its sixth sintering machine in August to bring plant capacity up to 2 million long tons of sinter annually. The company expects first ore production from its new Sir James mine late in the spring of 1958, and continued its underground development program to bring three new, deeper levels into production in its Helen and Victoria mines, which adjoin each other.

Lowphos Ore Limited, north of Capreol, expects to begin production of high-grade magnetic concentrates in May 1958 and eventually to produce 600,000 tons annually.

Anaconda Iron Ore Company Limited was formed in November by Anaconda Company of New York to exercise an option to purchase the iron-ore claims of Lake Superior Iron Limited and others, about 32 miles north of Nakina.

British Columbia

The British Columbia Legislature, on October 30, 1957, approved Bill 87, Mineral Property Taxation Act, passed at the 1957 spring session of the Legislature, to tax all 1957 shipments of iron ore for export. The operative provisions of this Mineral Property Taxation Act are similar to those contained in the Mineral Taxation Acts of Saskatchewan and Manitoba, of which the former was upheld by a decision of the Supreme Court of Canada. The new Act provides for a tax on ore in the ground that is based, in reality, on the amount of ore exported from the property in a 12-month period. Roughly, the tax appears to

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work out to about 50 cents per ton of ore shipped, half of which may be remitted if sufficient exploratory work is done during the tax year.

Order-in-Council 138 of January 22, 1958, reserved one half of all iron ore in the five coastal mining divisions to the Crown. Bill 91, passed toward the close of 1957, changed the issuance of Crown grants on mining properties with full title, to a system of 5-year retention leases or 21-year production leases. The leases are renewable at the discretion of the British Columbia government.

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

Empire Development Company Limited began shipments of magnetite concentrates to Japan in October from its Elk River deposit near the north end of Vancouver Island. After shipping about 75,000 tons of concentrate, the company suspended all operations.

Argonaut Mine Division of Utah Company of the Americas, whose operations near Campbell River on the east coast of Vancouver Island were suspended in December 1956, shipped from stockpile during 1957.

The Consolidated Mining and Smelting Company of Canada Limited early in 1957 announced plans to study the feasibility of producing pig iron and steel from its large accumulation of pyrrhotite tailings at its Kimberley concentrator. The company reported in April 1957 that the daily output contains about 900 tons of iron and 600 tons of sulphur, and that research work has shown the possibility of turning out, by electric-furnace methods, commercial products suitable for a variety of uses.

Prices

Because most iron-ore shipments are made to ports on Lake Erie, a system of ore prices has been evolved which has come to be known as the Lake Erie Price. This is the price paid per gross ton of 2,240 pounds for ore delivered at the rail of the vessel at the Lower Lake ports. The buyer pays, in addition to the Lake Erie Price, all costs incurred in moving the ore from the rail of the vessel to its ultimate destination. The producer receives the Lake Erie Price less all freight, insurance, shipping, loading and unloading charges from the mine to the rail of the vessel at the Lower Lake ports.

The E & M J Metal and Mineral Markets of December 26, 1957, lists the following prices per long ton, basis 51.5 per cent iron, Lower Lake ports:

Lake Superior Ore (price effective as at January 30, 1957):

		$
Mesabi non-Bessemer	-	11.45

		$
Mesabi Bessemer	-	11.60
Old range non-Bessemer	-	11.70

These prices are expected to remain firm during the 1958 lake-shipping season, the merchant ore companies absorbing any increases in rail and lake freight charges.

Swedish Iron Ore, c.i.f. Atlantic ports, 60 to 68 per cent minimum: per short-ton unit* 25¢ +, according to grade.

Brazilian Iron Ore, f.o.b. Brazilian port, 68 1/2 per cent: per long ton $14 + 60¢ premium for low phosphorus.

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* One short-ton unit is equivalent to 1 per cent, or to each 20 pounds of iron content.

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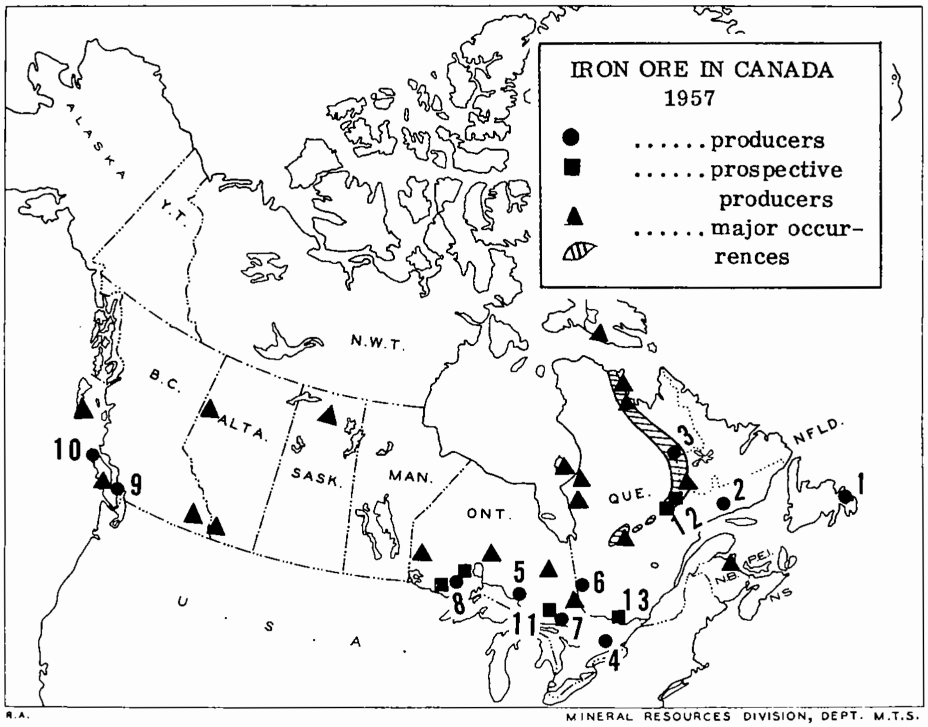


Producers in 1957

1. Dominion Wabana Ore Limited
2. Quebec Iron and Titanium Corporation
3. Iron Ore Company of Canada
4. Marmoraton Mining Company Limited
   Clarken Development Limited
5. Algoma Ore Properties Limited
6. Noranda Mines Limited
7. The International Nickel Company of Canada, Limited
8. Steep Rock Iron Mines Limited
9. Texada Mines Limited
10. Empire Development Company Limited

Prospective Producers by 1960

8. Caland Ore Company Limited
   Canadian Charleson Limited
11. Lowphos Ore Limited
12. Quebec Cartier Mining Company
13. The Hilton Mines

LEAD

by
D. B. Fraser

Canada's production of lead in 1957 amounted to 181,484 tons, or 7,370 tons less than in 1956. The value of production decreased by more than $7 million, or 13 per cent, owing to a decline of 3 1/4 cents a pound in the price of lead during the year. The refined lead turned out by The Consolidated Mining and Smelting Company of Canada Limited (Cominco), operator of Canada's only lead smelter, at Trail, British Columbia, decreased to 142,935 tons in 1957 from the 147,865 tons produced in 1956. Exports of primary lead,which totalled 129,191 tons,were almost unchanged from the previous year. The United States received 41 per cent of these exports, the United Kingdom 35 per cent, Belgium 9 per cent, Japan 7 per cent and West Germany 6 per cent, while the remaining 2 per cent went in small shipments to 12 other countries. Canada ranks fifth in world mine production of lead, after Australia, the United States, Russia and Mexico.

Production from British Columbia mines was 7,607 tons less than in 1956 owing chiefly to mine closures, and there was a slight decline in output from Yukon. The relatively minor production from Quebec and Ontario was also less than in 1956. Offsetting these decreases were the 1,724 tons gained by Buchans Mining Company Limited in Newfoundland, and an increase of 696 tons in New Brunswick, where Heath Steele Mines Limited opened a new copper-lead-zinc concentrator near Newcastle.

Lead output, exports and consumption since 1926 are shown graphically on page127. 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. After 1950 there was a moderate increase owing to the addition of Newfoundland's output after that province entered Confederation and the reopening of silver-lead-zinc mines in Yukon.

Besides the Sullivan mine, the main sources of current supply are Cominco's Bluebell mine at Riondel, British Columbia, the Buchans deposit in Newfoundland and the mines of United Keno Hill Mines Limited in Yukon. Large deposits of lead-bearing ore have been outlined at Pine Point on the south shore of Great Slave Lake, and in the Pelly River and Hyland River areas of Yukon, but no production has come from these deposits yet. First production from the major base-metals deposits of northern New Brunswick began in 1957.

(text continued on page126)

Lead - Production, Trade and Consumption

	1957 Short Tons	1957 $	1956 Short Tons	1956 $
Production				
All forms				
British Columbia.....	140,094	39,114,378	147,701	45,816,877
Newfoundland	24,512	6,843,665	22,788	7,068,813
Yukon...............	12,493	3,488,023	12,802	3,971,215
New Brunswick.......	1,170	326,663	474	147,204
Quebec..............	2,709	756,324	2,873	891,145
Ontario	506	141,354	1,505	466,876
Nova Scotia..........	-	-	711	220,521
Total	181,484	50,670,407	188,854	58,582,651
Refined..............	142,935		147,865	
Exports				
In ore and concentrates				
United States.........	23,421	5,889,327	29,997	8,269,305
Belgium.............	11,108	2,486,192	12,154	3,251,479
West Germany	8,383	1,888,308	7,823	2,027,066
Mexico..............	1,250	228,153	-	-
Netherlands..........	5	1,022	-	-
Total	44,167	10,493,002	49,974	13,547,850
Refined				
United Kingdom	45,676	9,359,656	50,281	13,437,728
United States.........	28,623	6,926,035	15,801	4,381,788
Japan	9,232	2,308,601	12,541	3,358,770
Other countries	1,010	268,031	1,010	273,620
Total...............	84,541	18,862,323	79,633	21,451,906
Scrap				
United States.........	143	20,989	162	25,514
United Kingdom	153	12,536	-	-
Other countries	45	7,500	-	-
Total	341	41,025	162	25,514
Lead pipe and tubing and lead manufactures				
United States		11,570		5,612
Colombia............		5,464		7,296
Cuba...............		4,500		4,934
Other countries		13,984		3,142
Total		35,518		20,984

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

	1957		1956	
	Short Tons	$	Short Tons	$
Imports				
Lead and lead products				
Compounds of tetraethyl lead		2,373,402		13,348,923
Lead in pigs and blocks		378,854		37,790
Lead in bars and sheets		13,338		29,680
Litharge		383,620		383,575
Lead manufactures		259,412		275,020
Miscellaneous lead products		272,180		282,663
Total		3,680,806		14,357,651
Consumption refined lead				
By uses (primary and secondary)				
Ammunition	4,106		4,991	
Foil and tubes	611		659	
Heat treating	523		618	
Oxides, paints and pigments	6,547		7,495	
Solders	2,476		2,665	
Babbitt	402		339	
Type metal	119		193	
For antimonial lead	2,476		3,934	
Cable covering	9,213		15,062	
Pipes, sheets, traps and bends	3,733		4,036	
Block for caulking	3,302		4,117	
Brass and bronze	684		722	
Batteries	30,455		29,145	
Other uses	9,936		1,906	
Total	74,583		75,882	
By source				
Primary material	60,083		65,676	
Secondary material	14,500		10,206	
Total	74,583		75,882	
Scrap material	6,600		9,545	
Total	81,183		85,427	

Lead - Production, Trade and Consumption, 1947-57
(short tons)

	Production		Exports			Imports	Domestic Consumption
	All Forms(1)	Refined	In Ore and Concentrates	Refined	Total	Refined(2)	Refined
1947	161,668	162,000	6,726	124,965	131,691	7	64,131
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	74,583

(1) Primary lead in base bullion produced, plus recoverable lead in ores exported.

(2) Lead pigs and blocks.

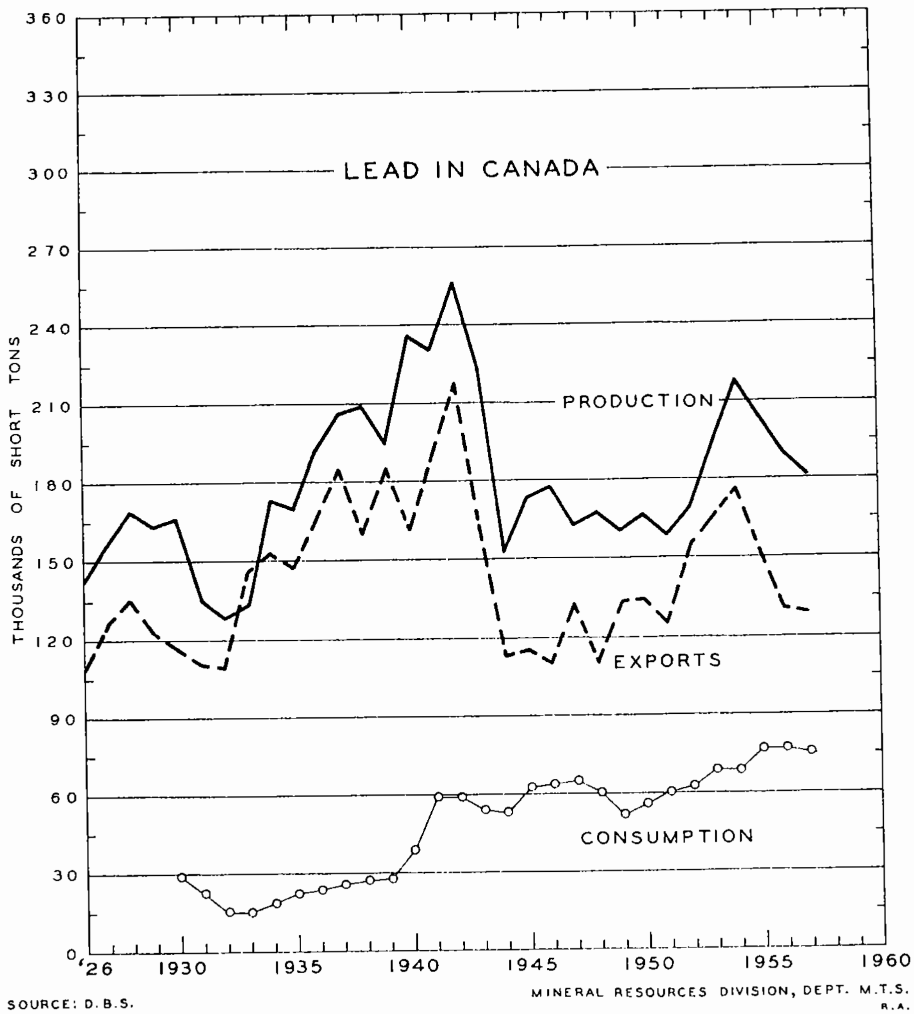
Consumption of refined lead in 1957 was 74,583 tons; in 1956 it was 75,882. The amount used in cable sheathing declined substantially; somewhat more lead was used for battery-manufacturing than in 1956. The value of lead imports dropped from $14,357,651 in 1956 to $3,680,806 in 1957, owing principally to a large reduction in imports of tetraethyl lead, which is now manufactured in Sarnia, Ontario, by Ethyl Corporation of Canada Limited.

Developments at Producing Properties*

British Columbia

The Consolidated Mining and Smelting Company of Canada Limited mined 2,423,577 tons of ore from its Sullivan mine at Kimberley; in 1956 the total was 2,769,177 tons. The decrease resulted from the closing of the low-grade open-pit operation on the southern extremity of the orebody in May, because of a sharp decline in lead and zinc prices. The pit had been in continuous opera-

* See sketch map, page 129.



tion since December 1951. A 100-ton pilot flotation mill within the main 11,000-ton concentrator was completed and put in operation during the latter part of the year to assist in testing circuit revisions and reagent use.

Production at the company's Bluebell mine at Riondel increased to 256,118 tons of ore from the 252,523 tons taken out in 1956; and at the H. B. mine near Salmo the output for 1957 rose to 451,381 tons from the 435,305 tons of the preceding year. The copper-zinc-lead property of Tulsequah Mines Limited on the northwest coast was closed at the end of August because of low metal prices. Production dropped to 142,537 tons from the 203,688 tons produced in 1956. The Tulsequah operation commenced production in 1951.

Lead

All lead concentrates produced at Cominco's four mines were treated at the Trail smelter together with custom concentrates from other mines in British Columbia and Yukon and from foreign shippers. Purchased ores and concentrates of all types totalled 68,663 tons, obtained principally from domestic sources; the comparable total for 1956 was 71,435 tons. Total lead production at Trail was 144,017 tons; in the previous year it was 149,262 tons.

Giant Mascot Mines Limited closed its Silver Giant lead-zinc mine near Spillimacheen in June, when commercial ore was exhausted. Before closure the nearby Rothschild and Lead Mountain claims were thoroughly explored, but without success. The Silver Giant property was discovered in 1886 and was worked intermittently thereafter, but its main productive period began with the opening of a 600-ton mill in February 1951. From then until the end of 1956, 849,619 tons were milled, from which 30,631 tons of lead, 3,122 tons of zinc and 584,575 ounces of silver were produced in lead and zinc concentrates.

Canadian Exploration, Limited, operating the Jersey mine near Salmo, milled about 35,000 tons a month of zinc-lead ore with mill heads averaging 1.4 per cent lead and 4 per cent zinc. Most of the tonnage was mined by underground trackless methods.

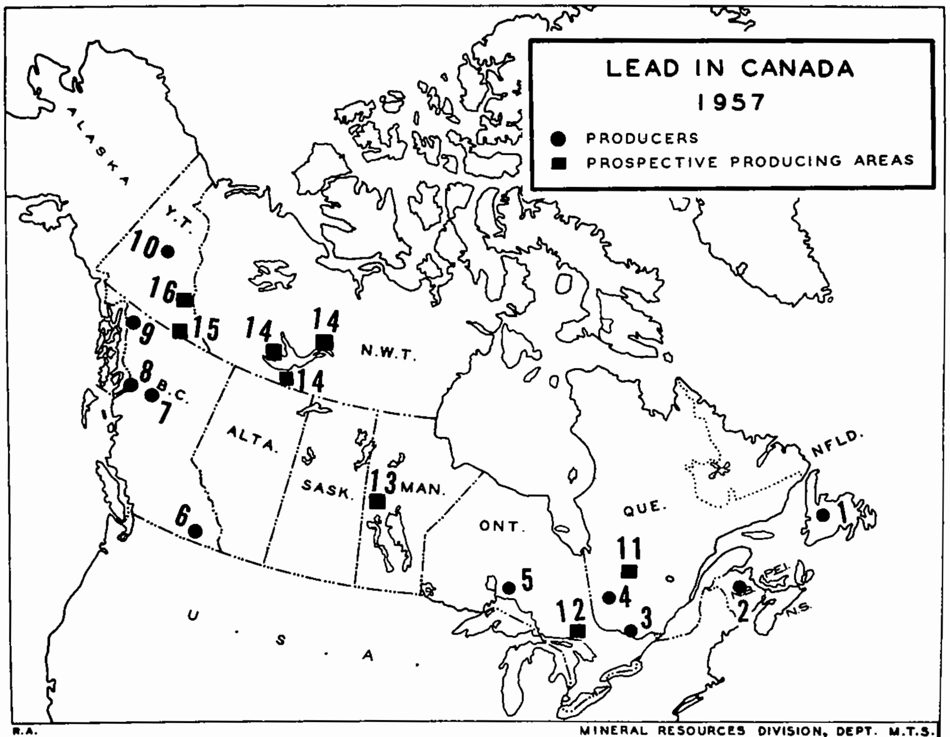
Reeves MacDonald Mines Limited, 12 miles south of Salmo, treated 405,531 tons of zinc-lead ore and produced lead concentrates containing 3,961 tons of lead, about the same as in 1956. The shaft was extended 503 feet in the footwall of the main orebody to develop deep-level ore for production.

Yale Lead and Zinc Mines Limited, at Ainsworth, milled about 180 tons of ore a day averaging 5 1/2 per cent lead, 1 1/2 per cent zinc, and 1 3/4 ounces of silver per ton, from which lead and zinc concentrates were produced.

ViolaMac Mines Limited mined an average of 1,700 tons a month from the Victor mine near Sandon. The ore was trucked to Silverton and custom-milled by Western Exploration Co. Ltd. which treated its own ore from the Mammoth mine at the rate of 80 tons a day, and ViolaMac's ore on a week-about basis.

Sheep Creek Mines Limited operated the Mineral King mine and mill, 22 miles southwest of Windermere, at 500 tons a day, mill heads averaging about 1 per cent lead and 4 1/2 per cent zinc. Exploration continued between the third and seventh levels, where new ore was located in 1956. No work was done at the Paradise mine, 10 miles to the northeast.

Sunshine Lardeau Mines Ltd., near Camborne, milled 28,176 tons averaging 7.4 per cent lead, 9.3 per cent zinc and 9.7 ounces of silver per ton in the fiscal year ended October 31, 1957, and shipped 331 tons of high-grade direct-smelting ore. Ore reserves at this date were 12,000 tons.



Producers

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

Prospective Producing Areas

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

Other producers of lead concentrate included Silver Standard Mines Limited, near Hazelton; Torbrit Silver Mines Limited, near Alice Arm; and Highland-Bell Limited, at Beaverdell, all of which produced mainly silver. Also included were New Cronin Babine Mines Limited, near Smithers; Slocan Van Roi Mines Limited,at Silverton; and Carnegie Mines Limited, near Sandon.

Ontario

Jardun Mines Limited, 18 miles northeast of Sault Ste. Marie, ceased production in April. Reserves at the time of closure were about 36,000 tons grading 4.2 per cent lead and 3.1 per cent zinc.

Willroy Mines Limited, whose zinc-copper ore contains about 0.4 per cent lead, opened a 1,000-ton mill at Manitouwadge in August, and operated for the rest of the year at a rate of 800 tons a day, producing concentrates of zinc, copper and lead.

Quebec

Lead concentrates were produced by three mines, the most important being New Calumet Mines Limited, on Calumet Island, 60 miles west of Ottawa. In the fiscal year ended September 30, 1957, 142,324 tons of zinc-lead-silver ore were treated, and from this 1,979 tons of lead were produced in concentrates. In August the milling rate was reduced from 550 to 340 tons a day owing to low metal prices, and mining was concentrated in the higher-grade No. 4 shaft area. Ore reserves in September were 165,800 tons grading 7.2 per cent zinc, 1.7 per cent lead, and 3.25 ounces per ton of silver.

Golden Manitou Mines Limited, Abitibi East county, produced 1,907 tons of lead concentrate containing 954 tons of lead from ores mined primarily for their zinc and copper content.

Barvue Mines Limited, in Abitibi East county, primarily a zinc producer, recovered 123 tons of lead concentrate containing 42 tons of lead. The mine was closed in September owing to the low price of zinc.

New Brunswick

Heath Steele Mines Limited, the only producer, opened a 1,500-ton mill in February at its copper-zinc-lead property 32 miles northwest of Newcastle. The mill was operated continuously on a tune-up basis throughout the year, producing concentrates of copper, lead and zinc. Mill feed was supplied from a copper and a zinc-lead pit. Ore treatment problems were unusually difficult, owing to the complexity of the ore and partial oxidation of open-pit mill feed. Underground development of the 'B' or easterly orebodies was continued in preparation for trackless mining. The new Canadian National

Railways branch line from Bartibog to the mill site was completed in November. On March 1, 1958, the scale of operations was reduced to less than 500 tons a day because of low metal prices, and metallurgical research continued on this scale.

Newfoundland

Buchans Mining Company Limited, Canada's second largest source of lead, produced concentrates of lead, zinc and copper and raised the total of its lead concentrates to 42,591 tons from the 39,415 tons of the previous year. The estimated recoverable lead content of all concentrates produced totalled 26,584 tons. The new concrete-lined circular MacLean shaft was collared and sunk to a depth of 276 feet at year-end, preparatory to opening up and mining the deep-seated orebody on the extension of the Rothermere ore zone.

Yukon

United Keno Hill Mines Limited, Mayo district, milled 159,885 tons in the fiscal year ended September 30, 1957; in 1956 it milled 155,702 tons. Mill heads averaged 7.56 per cent lead, slightly lower than the average of the previous year, 6.39 per cent zinc and 38.65 ounces of silver per ton. The lead recovered in concentrates was down to 11,285 tons from the 12,542 tons of the fiscal year 1956. The Hector mine supplied 49 per cent of the mill feed and the Calumet mine 44 per cent. The remainder was development ore from the Elsa and Jock mines. In September ore reserves excluding those of the Onek mine, 4 miles east of the Hector, amounted to 601,165 tons averaging 7.27 per cent lead, 6.05 per cent zinc and 36.78 ounces of silver per ton. At the Onek mine, reserves totalled 123,491 tons grading 4.4 per cent lead, 13 per cent zinc and 10.27 ounces of silver per ton.

Galkeno Mines Limited, adjoining United Keno's Galena Hill property, operated continuously until September, when operating losses forced the shut-down of the 220-ton mill. An underground water problem and declining metal prices were the chief reasons for the shut-down. A start was made in driving a low-level adit to drain off excess water, but in December all work was deferred until lead and zinc prices improve.

Other Developments

British Columbia

American Standard Mines Limited postponed development of the Jordan River lead-zinc deposit in the Revelstoke district until market conditions improve.

Silbak Premier Mines Limited, in the Portland Canal area, whose 600-ton mill was burned late in 1956, deferred rebuilding in view of low lead and zinc prices. Reserves of 75,250 tons grading 1.8 per cent lead, 2.7 per cent zinc and 2.8 ounces of silver per ton have been proven. The adjoining Premier Border deposit, which was to have been mined with Silbak Premier's ore, contains 74,000 tons averaging 4.3 per cent lead, 6.4 per cent zinc and 2 ounces of silver per ton.

Conwest Exploration Company Limited explored a silver-lead prospect 16 miles south of Mile 701 on the Alcan Highway in the Tootsee River area of northern British Columbia. Two adits were driven, but no commercial ore was found and development was discontinued.

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 was started on one of these, the Chisel Lake deposit, which contains 3,832,400 tons averaging 11 per cent zinc, 0.42 per cent copper and 0.91 per cent lead, with silver and gold. The surface plant was completed and a shaft sunk to 487 feet. No work was done on 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.

Ontario

Consolidated Sudbury Basin Mines Limited brought its zinc-copper-lead deposits 15 miles northwest of Sudbury to the production stage, but in September it put off production until base-metal prices improve. Total reserves at the company's Vermilion and Errington mines are 17,810,256 tons averaging 1.1 per cent lead, 3.9 per cent zinc, 1.1 per cent copper and 1.6 ounces of silver per ton. Initial production was to have been at a rate of 1,000 tons a day from the Vermilion mine.

Quebec

The Coniagas Mines Limited continued development of a zinc-silver-lead property at Bachelor Lake, about 100 miles east of Barraute, where 394,000 tons of ore were previously indicated. The shaft, originally scheduled to bottom at 850 feet, was deepened to 1,350 feet so that new ore discovered at the 1,000-foot horizon could be explored.

New Brunswick

Brunswick Mining and Smelting Corporation Limited continued pilot-mill testing of its complex zinc-lead-copper ores 12 miles southwest of Bathurst. Research was directed mainly toward improving the flowsheet for processing ore from the north section of No. 12 deposit. This project was completed successfully and the outline of a production program, with estimated costs, was drawn up. Its chief features were the construction of a 2,000-ton mill, to be enlarged after 3 1/2 years to 4,000-ton capacity, the construction of a lead smelter for pig-lead production, the provision of railway facilities to Bathurst from the mines, and the placing of dock installations and deepening of the harbour at Bathurst. The production shaft at No. 12 mine was sunk to 800 feet. Owing to the unfavourable market outlook for base metals, the production program was deferred early in 1958, and development stopped on March 31.

Nigadoo Mines Limited continued mine development 11 miles northwest of Bathurst. The shaft was sunk to 900 feet, two levels were established and detailed exploration of the complex ore structure was carried out. The 250-ton Keymet mill, idle since 1956, was acquired for metallurgical testing and eventual production.

Anacon Lead Mines Limited suspended underground development of the New Larder 'U' deposit 15 miles south of Bathurst in February. Since 1954, a shaft had been sunk to 1,450 feet and six levels established. Reserves at the time of closing totalled 1,428,000 tons averaging 2.35 per cent lead, 6.48 per cent zinc and 2.16 ounces of silver per ton.

Sturgeon River Mines Limited suspended mine development 12 miles west of Bathurst in August. A shaft was sunk to 550 feet in 1956, and lateral development on two levels, totalling 3,000 feet, was completed at the time of closure. Reserves are 518,000 tons averaging 2.58 per cent lead, 3.54 per cent zinc and 4.68 ounces of silver per ton.

Kennco Explorations (Canada) Limited continued exploration of the Murray group, 35 miles west of Bathurst. The Consolidated Mining and Smelting Company of Canada Limited diamond-drilled a deposit near Canoe Lake, 25 miles southwest of Bathurst.

Anaconda Company (Canada) Limited carried out detailed mapping and surface exploration of ground surrounding the extensive Caribou deposit, 30 miles west of Bathurst, which was diamond-drilled in 1956. No work except for assessment purposes was done on the Middle River deposit, held by Texas Gulf Sulphur Company and Conwest Exploration Company Limited and situated 12 miles west of the Heath Steele property.

Northwest Territories

No work was done by Pine Point Mines Limited, a Cominco subsidiary, on its large zinc-lead deposit south of Great Slave Lake, previous exploration having outlined adequate reserves.

Lead

Yukon

Prospectors Airways Company Limited carried out an electromagnetic survey in the immediate area of its Vangorda zinc-lead deposit 30 miles west of the Canol Road-Pelly River crossing, but no mineralization was indicated. Reserves of 9,400,000 tons averaging 3.2 per cent lead, 5 per cent zinc and 1.8 ounces of silver per ton remained unchanged.

Uses and Consumption

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.

In the field of atomic energy, there is a growing use for lead as shielding against radiation.

About one third of Canada's lead production is consumed in the domestic market. In addition to new and secondary refined lead, large quantities of various lead alloys, such as antimonial lead, are re-used for battery plates, bearing metal, solder, and type metal. In 1957, 21,100 tons of refined and alloy lead from scrap material were consumed.

Among the principal consumers of lead in Canada are: Electric Storage Battery Company (Canada) Limited; Prest-O-Lite Battery Co. Limited; Hart Battery Company (1957) Limited; The Canada Metal Co. Limited; Federated Metals Canada Limited; Ethyl Corporation of Canada Limited; Northern Electric Company, Limited; Canada Wire and Cable Company Limited; Carter White Lead Co., of Canada Limited; and McArthur Irwin (1957) Limited.

World Production of Lead

The following table from American Bureau of Metal Statistics gives world production on a mine basis for 1956 and 1957.

	1957	1956
	(short tons)	
Australia	350,880	315,067
United States	338,216	352,826
Russia	310,000	290,000
Mexico	236,858	220,030
Canada	181,484	188,854
Peru	151,183	142,279
French Morocco	101,287	93,875
Yugoslavia	99,304	96,258
South West Africa	93,063	87,480
West Germany	78,394	72,181
Spain	69,024	64,735
Italy	56,185	51,237
Other countries	374,812	338,494
Total	2,440,690	2,313,316

Prices and Tariffs

The Canadian price of lead was 15.5 cents a pound at the beginning of the year. In January the price was reduced to 15.25 cents a pound. A series of decreases began in May and continued until early December, when the price was 12.25 cents a pound. The average price for the year, according to the Dominion Bureau of Statistics, was 13.96 cents a pound.

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 semi-fabricated forms.

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

87875-1—10

MAGNESIUM

by

H. D. Worden

Material for Canadian magnesium production is currently derived from the minerals dolomite and brucite. Magnesite, $MgCO_3$, is also a potential source. Dolomite, $CaMg(CO_3)_2$, is mined and completely processed to metal at Haley's, Ontario, by Dominion Magnesium Limited. Brucite, $Mg(OH)_2$, is mined and processed at Wakefield, Quebec, by Magnesium Company of Canada Limited, a subsidiary of Aluminum Company of Canada Limited (ALCAN). Here, high-grade magnesia is produced and shipped to Arvida, Quebec, where it is reduced to magnesium metal. These two companies are the only producers in Canada.

There is no scarcity of magnesium minerals in Canada, but high production costs, owing to the small volume of trade, prevent new reduction plants from opening. In 1957 domestic consumption accounted for only 9 per cent of the 8,385 tons of metal produced; the remainder was exported. The small domestic consumption hampers expansion of existing wrought-product fabricating industries and discourages initial investment in sheet-rolling machinery. Despite the light consumer demand, however, Canadian companies, individually and collectively, through The Magnesium Association in New York, continually promote sales of magnesium in the hope that an increase in the number of its applications will eventually lead to improved volume and hence, through lower unit costs, to production economy.

Production

Dominion Magnesium Limited

Dominion Magnesium Limited uses a patented process developed by L. M. Pidgeon, in which dolomite is converted in a rotary kiln into dead-burnt dolomite. The latter is mixed with ferrosilicon and other ingredients and pressed into briquettes, which are charged into horizontal thermal reduction retorts. A vacuum is created in the retort as it is heated in a globar electric furnace, and magnesium sublimate, termed a crown, is deposited in a water-cooled head-section of the retort. The crowns are then melted down and the metal is poured into ingots.

In 1957 the company's production of magnesium crowns reached an all-time high, although magnesium sales were lower, as indicated in the accompanying production tabulation. The decline was due to unexpected cutbacks in export markets, and at the end of the year the outlook for sales of Dominion Magnesium's products was uncertain. Sales to the United States are subject to high tariffs and, in order to compete there, the company is sponsoring a subsidiary, to be owned jointly with Brooks and Perkins Incorporated of Detroit. The new plant will be built at Selma, Alabama, where ore is plentiful and natural gas is available for fuel. Financing arrangements for the new company, Alabama Metallurgical Corporation, have not been completed.

Magnesium Company of Canada Limited

Magnesium Company of Canada Limited calcines brucitic limestone, composed of $Mg(OH)_2$ and $CaCO_3$, and hydrates the calcined material so that finely divided hydrate of lime can be separated from the granular calcined brucite, which retains much of its natural form. Screening recovers the brucite, and this concentrate, which contains about 92 per cent magnesia, is shipped to Arvida, where it is converted to magnesium chloride and treated in electrolytic cells. The magnesium collects on steel cathodes; it coalesces into globules, rises to the surface of the molten bath and is ladled off. Total production of magnesium metal in Quebec dropped from 2,286 tons in 1956 to 793 tons in 1957, or to only 18 per cent of maximum plant capacity, which is 4,400 tons.

Uses

Magnesium, having a specific gravity of 1.74 is two thirds the density of aluminum and one quarter the density of steel. This physical property makes it especially useful for metal components in aircraft engines and frames and in motor-transport trailers. It also has advantages in many machine parts, manual tools and hardware items. The metal is particularly adaptable for cast shapes but it is also used in shapes formed by extruding, rolling, drawing and spinning. The latter magnesium shapes, however, are usually more costly to produce than similar aluminum shapes.

Light Alloys Limited, a subsidiary of Dominion Magnesium Limited at Haley's, operates the only extrusion plant in Canada and the largest foundry. The company produces Orenda jet-engine castings and a wide variety of shapes finished and assembled for industrial and household use. The sales value of its main product, aircraft-engine castings, was 20 per cent lower in 1957 that in 1956, representing a reduction of 23 per cent in pounds of castings. Another subsidiary company, Aerometal Products and Design Limited, opened a new fabricating plant at Toronto in November 1956 to handle an increasing demand for its products. Four smaller foundries in Ontario, one in Quebec and one in British Columbia also fabricate wrought magnesium products.

87875-1—10½

Magnesium

The special magnesium-base alloys developed impart a wide range of high-temperature strength and corrosive-resistant properties to finished magnesium products. Aluminum was one of the chief additives first used to give magnesium strength and ductility, and to make magnesium castings porosity-free. To improve the characterists of the metal, other elements - zinc, zirconium, thorium, beryllium, etc. - were tried. A popular magnesium alloy containing 3 per cent thorium and 0.7 per cent ziroconium shows high-temperature stability up to 600°F and has good forming properties and good creep characteristics. Beryllium is particularly useful in die-casting material. Researchers are experimenting with lithium to find a special light alloy, and with titanium, hafnium, rhenium and yttrium to improve high-temperature alloys.

Prices

The Canadian base price of magnesium metal is quoted in The Northern Miner of December 26, 1957, as follows:

20-lb ingot, 99.8%, f.o.b. Arvida, Quebec, per lb	33.5¢

United States prices of magnesium metal at the end of 1957, as quoted in the December 26 issue of E & M J Metal and Mineral Markets, were as follows:

10,000-lb lots, pig, ingot, 99.8%, per lb	35.25¢ to 36.65¢
Notched ingot, per lb	36 ¢ to 37.45¢

Tariffs

Canada

Alloys of magnesium, viz. ingots, pigs, sheets, plates, strips, bars, rods and tubes:

British preferential	5% ad valorem
Most favoured nation	10% " "
General	25% " "

Sheet or plate of magnesium or alloys of magnesium, plain, corrugated or pebbled for use in Canadian manufacture:

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

Magnesium scrap	free

United States

Magnesium alloys, powder, ribbons, sheets, tubing, wire and all other articles of magnesium:

Alloys, per lb on metallic magnesium content	20 ¢ and 10% ad valorem
Other, * per lb on metallic magnesium content	18 ¢ " 9% " "
Metallic magnesium, * per lb	14.3¢
Magnesium scrap	free

* Tariff to be reduced 5% on June 30, 1958, under the Geneva Agreement, which expires on June 30, 1959.

Magnesium - Production, Trade and Consumption

	1957		1956	
	Short Tons	$	Short Tons	$
Production				
Ontario	7,592	4,767,043	7,320	4,543,202
Quebec	793	487,853	2,286	1,536,688
Total	8,385	5,254,896	9,606	6,079,890
Imports, magnesium alloys				
United States		275,618		344,853
United Kingdom		1,124		21,984
Total		276,742		366,837
Exports, metal				
United Kingdom		1,795,875		1,798,469
Japan		1,654,891		3,021,384
France		362,581		27,202
Mexico		246,673		165,995
West Germany		131,375		10,310
United States		87,603		58,301
Other countries		256,572		71,848
Total		4,535,570		5,153,509

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

	1957 Short Tons	1957 $	1956 Short Tons	1956 $
Consumption (available data)				
In white metal alloy foundries	341		421	
In brass and bronze foundries	42		64	
In aluminum products.....	407		518	
Total	790		1,003	

Magnesium - Production, Trade and Consumption, 1947-57

	Production(1) (short tons)	Imports(2) ($)	Exports(3) ($)	Consumption (short tons)
1947		17,338		280
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	790

(1) Not available for publication 1947 to 1955 inclusive.
(2) Magnesium alloys.
(3) Not separately available 1947 to 1954 inclusive.

MANGANESE

by

R. J. Jones

Canadian consumption of manganese ore and alloys continued at a high level during 1957 until about the fourth quarter. Then, toward the end of the year, a decline in steel production adversely affected demand, with the result that total domestic requirements were somewhat lower than in 1956.

Sales of ferromanganese outside of Canada were mainly to the United States, although small quantities were shipped to South America. Contracts in the United States were completed in November and not renewed.

The first half of 1958 offers little prospect for improvement in the demand for manganese alloys and ore. Steel production in the United States, which was about 98 per cent of capacity at the beginning of 1957, was only 54 per cent at the end of the year.

Manganese prices moved upward early in 1957 under the influence of continued difficulties in the Middle East and labour and freight advances; but lower ore costs resulted in reductions during the fourth quarter.

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

The availability of abundant power has made possible the establishment of a modern ferromanganese plant at Welland, Ontario, in which high- and low-carbon ferromanganese and silicomanganese are manufactured in electric furnaces for domestic consumption and export. The plant is operated by Electro Metallurgical Company (Division of Union Carbide Canada Limited). Metallurgical-grade ore is also used by Chromium Mining and Smelting Corporation Limited, at Sault Ste. Marie, Ontario, to make manganese alloys.

Canadian Furnace Company, Limited, at Port Colborne, Ontario, produces silvery pig iron from low-grade manganiferous ores.

Canadian Occurrences and Developments

Strategic Materials Corporation

This corporation through a subsidiary, Stratmat Limited, owns a large low-grade manganese deposit a few miles northeast of Woodstock, New Brunswick. During the year, shipments of concentrates from the company's sink-float plant were made to the pilot plant of Strategic-Udy Metallurgical and Chemical Processes Limited at Niagara Falls, Ontario.

Manganese - Trade and Comsumption

	1957		1956	
	Short Tons	$	Short Tons	$
Imports				
Manganese ore				
Ghana	62,966	3,460,112	30,688	1,384,569
Belgian Congo	30,081	1,874,650	26,484	1,262,378
India	19,634	721,436	26,199	1,090,697
Brazil	9,798	673,282	-	-
Union of South Africa	4,838	227,699	3,350	148,380
United States*	3,763	526,499	94,019	4,105,351
United Kingdom	118	29,544	171	25,592
France	2	213	-	-
Other countries	118	6,311	27,067	1,120,311
Total	131,318	7,519,746	207,978	9,137,278
Ferromanganese under 1% silicon				
United States	518	170,179	2,078	759,768
United Kingdom	2	876	1	449
Other countries	223	66,049	112	37,869
Total	743	237,104	2,191	798,086
Silicomanganese over 1% silicon				
United States	1,039	455,520	956	404,173
Japan	1,163	378,715	174	55,243
France	55	20,074	-	-
Total	2,257	854,309	1,130	459,416
Exports				
Ferromanganese				
United States	46,689	7,726,202	59,355	10,208,367
Colombia	44	12,035	88	16,446
Mexico	-	-	2	301
Total	46,733	7,738,237	59,445	10,225,114
Consumption, ore				
Metallurgical-grade	192,473		216,475	
Battery-grade	2,615		2,666	
Total	195,088		219,141	

* Country of origin not known.

Manganese - Trade and Consumption 1947-57

(short tons)

	Imports			Exports	Consumption
		Manganese Alloys			
	Manganese Oxides	1% or Less Si	Above 1% Si	Ferro-manganese	Ore
1947	223,503	545	3	73,421	223,728
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	253	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	3,995	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

This plant is the result of test work carried out in 1955 in 50-kva and 250-kva electric furnaces at the Mines Branch, Ottawa. The Niagara Falls plant has a capacity of 50 tons of concentrate per day and produces pig iron, ferrosilicon-manganese and ferromanganese. The purpose of the Niagara Falls plant is to check the process on a semi-commercial scale and to obtain data in order to construct an electric smelter in New Brunswick with an initial capacity of 70,000 tons of ferromanganese and 60,000 tons of iron per year. The operating company in New Brunswick is Strategic Manganese Corporation Limited.

During the year this corporation and Koppers Company Inc. entered into an agreement whereby, in return for financial interest in the venture, the company would develop engineering designs and estimates of construction and operating costs for the electric smelter in New Brunswick.

Labrador Mining and Exploration Company Limited
Iron Ore Company of Canada
Hollinger North Shore Exploration Company Limited

Large reserves of manganiferous iron ore occur in the Labrador and New Quebec area. In Labrador, in 11 deposits, reserves amount to 13,321,000 long tons averaging 49.23 per cent iron and 7.45 per cent manganese. In Quebec, in 19 deposits, reserves amounted to 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 is in the vicinity of 20 per cent.

Manganese

Some test work has already been carried out on this manganiferous iron ore to determine the technical feasibility of making either manganese ore or ferromanganese from it.

Steep Rock Iron Mines Limited

During mining operations at Steep Rock Lake, 120 miles west of Port Arthur, Ontario, this company must remove considerable quantities of 'paint rock' which forms the footwall part of the ore zone. This waste material averages more than 2 per cent manganese, whereas the average manganese content of the ore itself is about 0.18 per cent. Inasmuch as this material must be mined and removed, it constitutes a potential source of manganese.

Some exploration work was carried out during 1957 on manganese occurrences in the New Ross area of Nova Scotia by Marpic Explorations Limited.

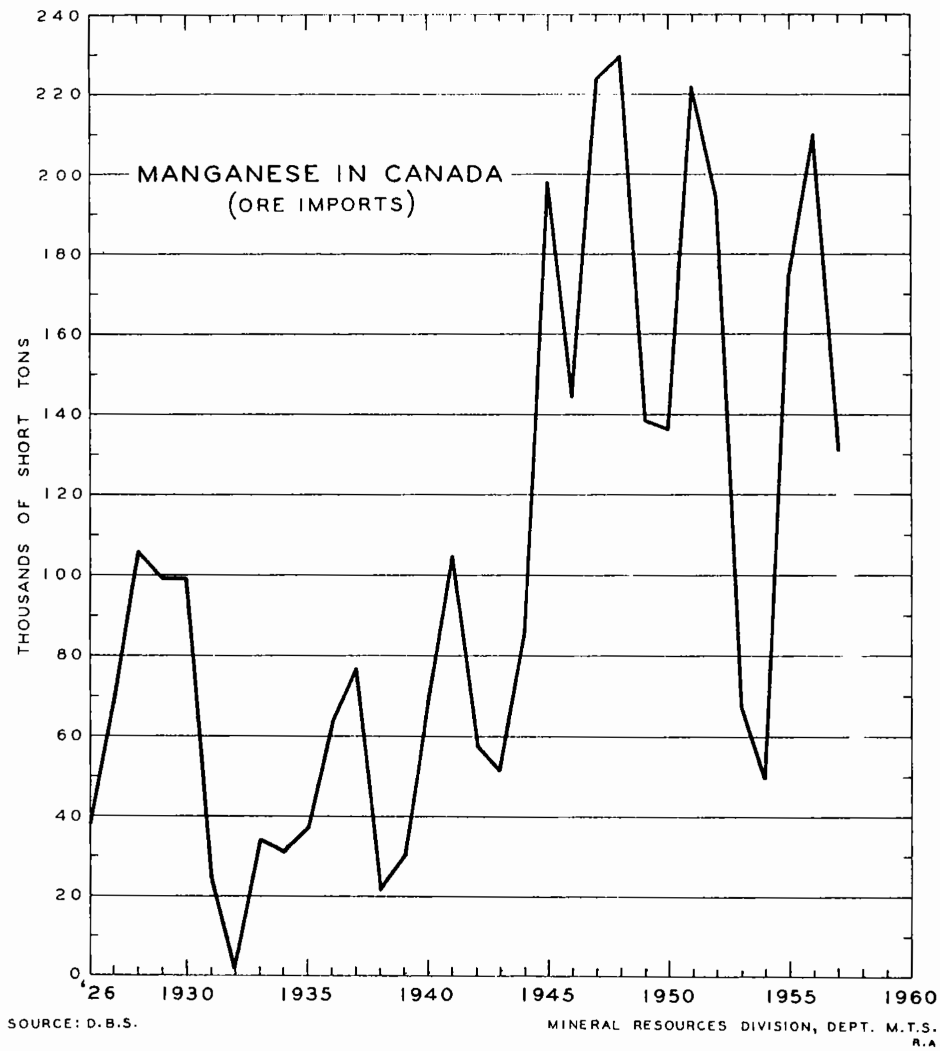
World Mine Production

World production of manganese ore in 1957 amounted to some 13 million tons. Of this it is estimated that Russia produced 5,467,500 tons, India 1,756,163, Brazil 879,717, and the Union of South Africa 787,878. The Free World supply comes mainly from India, the Union of South Africa, Brazil, Ghana, Cuba, the Belgian Congo and French Morocco.

The outstanding development in recent years was the bringing into production of the Amapá mine in Brazil. Initial shipments were made in 1956, and production in 1957 approached the million-ton mark. The deposit is situated about 120 miles from the port of Santana on the Amazon River. A railway connects the deposit and Santana. Amapá is owned by Brazilian interests and the Bethlehem Steel Corporation through a corporation called Icomi.

The output in Brazil during 1957 was consigned mainly to the United States Government in order to pay off the financial assistance granted by the Export-Import Bank to the enterprise. Indian and Cuban output is generally consigned to the United States while North African production is destined for European markets. The output of Ghana, the Belgian Congo, and the Union of South Africa goes to both markets. Production from Ghana, the Union of South Africa, Cuba and India is mostly of metallurgical grade, but Ghana also ships a large amount of battery and chemical grades. Of importance is the growing production in Brazil, Turkey, Mexico, Egypt and Japan.

The Government of India in August 1956 imposed an export tax which was equivalent to \$2.10, \$4.20 and \$6.30 per ton for 38-40%, 40-44% and 44+% ores, respectively.



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. In the production of a ton of steel ingot, an average of 13 pounds of manganese is needed to deoxidize and clean the steel and combine with the sulphur in it so that the ingot produced 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.

Manganese

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 ferromanganese 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: 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, Chromium Mining and Smelting Corporation, Limited, at Sault Ste. Marie and Canadian Furnace Company, Limited, at Port Colborne, all in 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 the 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 industry.

Prices

The December 26, 1957, issue of E & M J Metal and Mineral Markets quotes the following manganese prices in the United States:

Manganese ore

Indian ore	per long-ton unit of Mn, basis 46 to 48% Mn, c.i.f. U.S. ports, import duty extra:	
	export duty included	\$ 1.36 to \$ 1.39
	exclusive of export duty	\$ 1.225 to \$ 1.255
Manganese oxide	84% MnO_2, long tons, bulk, c.i.f. U.S. ports	\$ 110 to \$ 120
Chemical-grade manganese ore	per ton, coarse or fine, minimum 84% MnO_2, carload lots, f.o.b. Philadelphia:	
	paper bags	\$ 144.50
	burlap bags	\$ 148.00
	drums	\$ 152.50

Ferromanganese

Standard	per lb, carload lots, lump, bulk, f.o.b. shipping point, 74 to 76% Mn	12.25¢
Medium-carbon	per lb contained Mn, carload lots, lump, bulk, f.o.b. U.S., 80 to 85% Mn, 1 1/4 to 1 1/2% C	25.50¢
Low-carbon	basis as for medium carbon 85 to 90% Mn, max. 0.07% C	35.10¢

Silicomanganese

	per lb carload lots, lump, bulk, f.o.b. shipping point:	
	1.5% C max. 18-20% Si	12.80¢
	2% C " 15-17 1/2% Si	12.60¢
	3% C " 12-14 1/2% Si	12.40¢

Spiegeleisen

	per gross ton, carload lots, lump, bulk, f.o.b. Palmerton, Pa.:	
	3% Si max. 16-19% Mn	\$ 100.50
	3% Si " 19-21% Mn	\$ 102.50
	3% Si " 21-23% Mn	\$ 105.00

Manganese

Manganese metal	per lb delivered, 95.5% Mn, carloads:	
	bulk	45¢
	packed	45.75¢
	electrolytic, per lb f.o.b. Knoxville, Tenn., with freight allowed east of Mississippi, min. 99.9% Mn:	
	carloads	34¢
	ton lots	36¢

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	0.85¢ per lb on Mn content and 6 1/2% 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.

Spiegeleisen Not over 1% C	15/16¢ per lb on Mn content and 7 1/2% ad valorem
Over 1% C	75¢ per ton
Manganese metal	1 7/8¢ per lb on Mn content and 15% ad valorem

MERCURY

by
H.D. Worden

No mercury is being produced in Canada as production, at present, is uneconomical; enough, however, could be mined from large deposits grading 0.5 per cent mercury to meet national requirements during a crisis. The principal mercury mineral is cinnabar (HgS). As the element is volatile at 455°C, the relatively low temperature for magmatic mineral deposition restricts commercial mercury deposits to porous types of rocks capable of trapping and condensing mercury vapours. The essential geological formations are found in the mountainous Cordilleran region of British Columbia and Yukon. All mercury deposits in Canada are located in this region, in brecciated sedimentary rocks underlain by batholithic intrusives.

The largest known mercury deposit is located at Pinchi Lake, a few miles northwest of Fort St. James in central British Columbia. The mine, owned by The Consolidated Mining and Smelting Company of Canada Limited, produced more than 4 million pounds of mercury during the years 1940 to 1944. Eighty miles northwest of Pinchi Lake, along the same geological break, the Takla mercury mine owned by Bralorne Mines Limited has also produced small quantities of mercury, and recent prospecting in the general area between the two mines has exposed other occurrences. In southern British Columbia small mines east and north of Bralorne have sporadically yielded mercury, and intermittent mining in the vicinity of Kamloops Lake produced more than 11,000 pounds between 1895 and 1927.

World Production and Markets

The principal world mercury sources are in Italy, Spain, United States, Mexico, Yugoslavia, Chile and Peru, and small quantities are mined in many other countries. World production in 1957, excluding that of Russia, is estimated to be 245,000 flasks;* production in the United States increased to 34,625 from 24,177 flasks in 1956; and Mexican production in 1957 is estimated at 21,068 flasks. Italy and Spain produced 63,237 and 54,750 flasks, respectively, in 1957.

Mercury production in the United States is currently encouraged by special purchase programs authorized by the Office of Defense Mobilization through General Services Administration. The 1954 program, which was to be effective until December 31, 1957, and was extended to March 31, 1958, guaranteed purchase of 125,000 flasks from United States domestic mines and

* There are 76 pounds in one flask of mercury.

Mercury - Trade and Consumption

	1957 Pounds	1957 $	1956 Pounds	1956 $
Exports[1]				
Metal				
United States	1,425	3,749	5,953	18,518
Imports				
Metal				
Mexico	145,457	419,504	129,273	398,624
United Kingdom	97,628	253,402	1,015	2,646
United States	92,829	299,189	127,079	422,642
Spain	42,200	127,256	61,206	260,657
Italy	15,196	44,352	131,433	415,464
Peru	7,400	24,264	-	-
Total	400,710	1,167,967	450,006	1,500,033
Mercury salts				
United Kingdom		17,382		400
United States		6,843		1,419
Total		24,225		1,819
Consumption				
Heavy chemicals	194,636		159,524	
Pharmaceuticals and fine chemicals	4,560		35,720	
Electrical apparatus ..	12,312		13,680	
Gold recovery	3,000(e)		3,000(e)	
Miscellaneous	836		876	
Total[2]	215,344		212,800	

(1) Scrap mercury. During 1957, Montreal and Toronto scrap-metal dealers shipped scrap mercury to Eastern Smelting and Refining Company in Boston. In 1956, exports of virgin mercury not included above were 304 pounds valued at $996; in 1957 they were 4,306 pounds valued at $14,003.

(2) Since the total consumption of mercury is so much less than the amount imported, it might appear that the consumption figures were incomplete. The difference is explained, however, by industry's common practice of building large inventories when dependent upon imported commodities.

(e) Estimated.

75,000 from Mexican mines at $225 a flask. G. S. A. has since announced a new program, to end on December 31, 1958, for the purchase of 50,000 flasks of mercury at $225 each - 30,000 flasks from domestic mines and 20,000 from Mexican mines. This, however, has not been particularly attractive to Mexican producers for two reasons: the United States charges a duty of $19 a flask and

Mercury - Production, Trade and Consumption, 1947-57

(pounds)

	Production	Imports	Exports*	Consumption
1947	-	412,649	17,084	344,516
1948	-	803,878	175	522,216
1949	-	278,069	8	460,577
1950	-	614,005	8,100	166,716
1951	-	308,172	58,235	289,980
1952	-	144,439	1,500	280,632
1953	-	196,412	7,018	211,852
1954	-	244,783	6,310	203,756
1955	75	555,526	3,781	416,632
1956	-	450,006	5,953	212,800
1957	-	400,710	1,425	215,344

* Scrap mercury.

requires a new seamless flask costing $5 more than the older type plus about $8 for changing and refilling. Mexico has therefore preferred to sell on the London Metal Exchange for as low as £69 a flask.

The accumulation of surplus mercury stocks is the result of a general decrease in industrial consumption combined with increased mercury-mining in the United States. Moreover, the G. S. A. stockpiling program is certain to influence mercury-marketing, increasing mercury stocks and continuing, in all probability, to depress mercury prices.

Uses

Mercury is used in the production of heavy chemicals - chlorine, caustic soda, acetic acid and other basic chemicals; in pharmaceuticals, insecticides and fine chemicals. It is important to the amalgamation process for gold recovery and in laboratory work. In wartime, mercury has been used in large quantities in the production of explosive caps.

Other applications include gas gauges, flow meters, thermometers and a variety of control instruments.

Prices

According to E & M J Metal and Mineral Markets, the price of mercury f.o.b. New York in 1957 was $255 a flask (76 pounds) from January until June, inclusive. The price began to decline in July and at the end of the year was $225 a flask.

87875-1—11

MOLYBDENUM

by

R. J. Jones

Molybdenite Corporation of Canada Limited remained the sole producer of molybdenite (MoS_2) in 1957, operating from its mine at Lacorne, about 25 miles northwest of Val d'Or in northwestern Quebec. During the year all molybdenite concentrate was roasted to molybdic oxide (MoO_3) at the mine - in roasting plant, which commenced production in December 1956. From the 841,421 pounds shipped in 1956, the molybdenum content of Canadian shipments decreased to 783,739 pounds valued at $1,166,557.

The production of molybdic oxide, which can be consumed by Canadian steel plants, should ultimately lead to a decrease in the quantity imported. The company is already in a position to supply this material to the domestic steel industry, but during 1957 most of the output was exported to Japan and Italy.

In 1957 the company milled 169,601 tons of ore, or an average of 465 tons a day, containing 0.46 per cent molybdenum disulphide (MoS_2) and 0.041 per cent bismuth. Proven ore reserves at the end of the year were 180,983 tons averaging 0.43 per cent molybdenite.

The financial position of the company was improved during the year with the making of the final payment on the $540,000 loan from the Export-Import Bank.

Preissac Molybdenite Mines Limited carried out some 17,000 feet of surface diamond-drilling during 1957 on the property of Indian Molybdenum Ltd. about 20 miles northwest of the Lacorne mine in Preissac township. The company is planning the sinking of a shaft in 1958 and the construction of a 1,200-ton mill in 1959 for the production of molybdenite concentrates. The molybdenum content of the ore is higher than that of the Lacorne mine.

Sogemines Development Company Limited and Rio Canadian Exploration Ltd. are participating in a new company, Pidgeon Molybdenum Mines Limited, formed to take over some claims in Echo township, 20 miles southwest of Sioux Lookout, Ontario. Some drilling has been carried out, apparently with encouraging results. DeCoursey-Brewis Minerals Limited owns some adjacent ground and plans to do some exploration.

Quebec Metallurgical Industries Ltd. carried out diamond-drilling and continued to drive an adit and drifts at its Kirkham molybdenum prospect near Shawville, Quebec, some 40 miles northwest of Ottawa.

Climax Molybdenum Company continued to drill its prospect on Mount Boss, approximately 45 miles northeast of Lac La Hache, British Columbia.

Molybdenum - Production, Trade and Consumption

	1957		1956	
	Pounds	$	Pounds	$
Production (shipments)				
(Mo content)	783,739	1,166,557	841,421	955,828
Imports				
Molybdic oxide				
United States	477,304	401,928	955,308	705,400
Calcium molybdate (grouped with vanadium oxide and tungsten oxide for manufacture of steel)				
United States	249,608	410,762	322,295	367,194
West Germany.........	35,968	57,353	-	-
Total	285,576	468,115	322,295	367,194
Ferromolybdenum(1)				
United States	237,233	266,812	495,748	504,043
Exports				
Molybdic oxide				
United States	4,892,600(2)	3,870,185(2)	-	-
Japan	706,100	897,000	280,200	317,200
Italy	367,400	221,900	436,300	265,400
Other countries........	43,700	35,400	601,700	358,750
Total	6,009,800	5,024,485	1,318,200	941,350
Consumption				
(Mo content)				
Molybdic oxide	326,420		535,546	
Ferromolybdenum	322,366		255,919	
Calcium molybdate.....	13,248		13,688	
Sodium molybdate......	24,109		33,021	
Molybdenum metal	9,660		12,286	
Molybdenum wire	2,617		3,558	
Miscellaneous.........	-		1,450	
Total	698,420		855,468	

(1) Exports of ferromolybdenum to Canada reported by United States Exports of Domestic and Foreign Merchandise. This item is not reported separately in the official Canadian trade statistics.

(2) Exports of molybdic oxide from molybdenum concentrates imported from the United States for roasting in Canada.

87875-1—11½

Molybdenum - Production, Imports, Consumption, 1947-57
(short tons)

	Production	Imports			Consumption
		Calcium Molybdate	Molybdic Oxide	Ferro-molybdenum	
	(1)	(2)		(3)	(4)
1947	228	21	48		
1948	91	27	165		
1949	-	39	160		
1950	31	71	222	125	243
1951	114	31	283	158	331
1952	152	85	260	220	355
1953	97	99	179	101	274
1954	226	61	212	40	187
1955	417	65	329	87	317
1956	421	161	478	248	428
1957	392	143	239	119	349

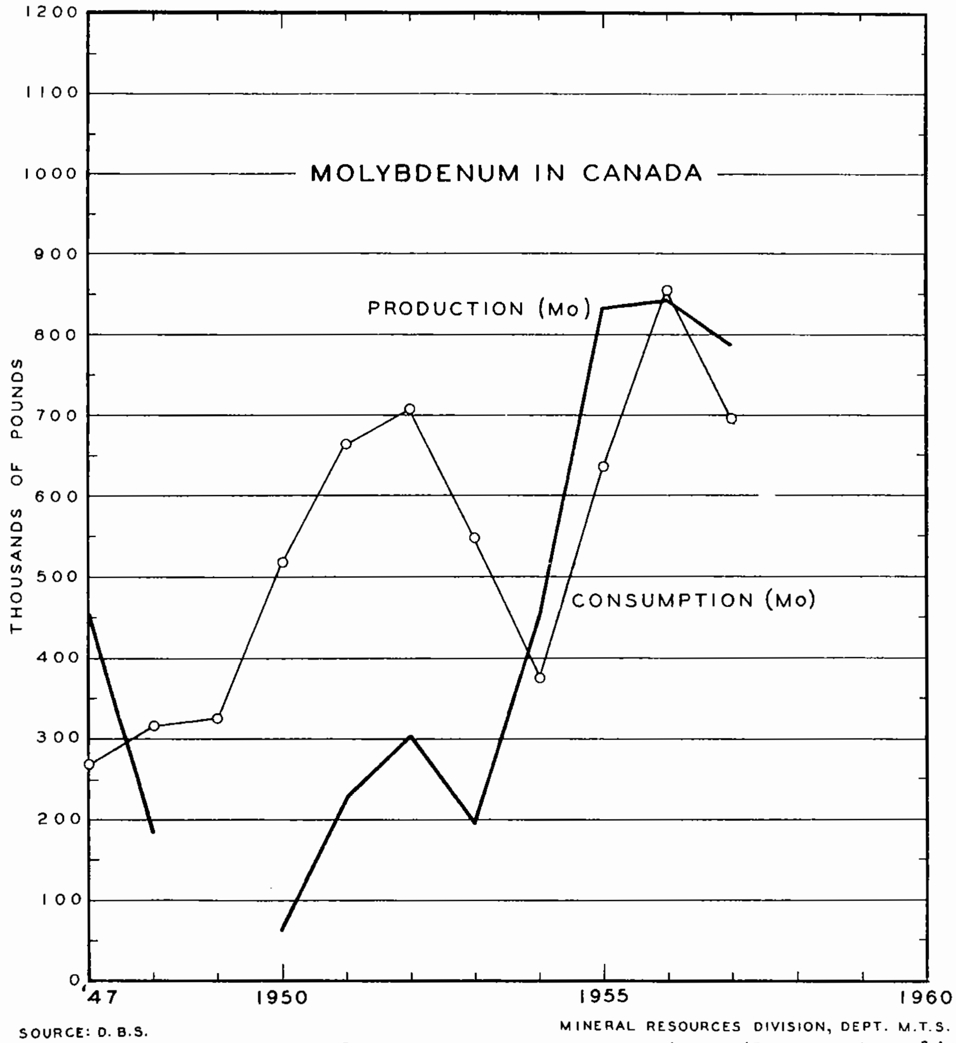
(1) Producers' shipments of molybdenum concentrates, Mo content.
(2) Including vanadium oxide and tungsten oxide.
(3) United States exports to Canada reported by United States Exports of Domestic and Foreign Merchandise.
(4) Molybdenum addition agents (Mo content) reported by consumers.

The occurrence consists of quartz diorite mineralized by molybdenite. This property was discovered during World War I and has been held by various mining companies, including The Consolidated Mining and Smelting Company of Canada Limited.

World Production

The United States Bureau of Mines has estimated that the molybdenite concentrates produced in the United States in 1957 contained 60,753,000 pounds of molybdenum, or 5.7 per cent more than in 1956. The United States accounted for about 91 per cent of world output in 1957.

The output of American Metal Climax, Inc., at Climax, Colorado, in 1957 was 42,466,000 pounds of molybdenum contained in concentrate from 10,552,000 tons of ore averaging 0.367 per cent molybdenum disulphide. This tonnage represents a new record for the company and is the largest ever obtained from an underground mine in North America. Although more than 100 million tons of ore have been mined at Climax in the past 40 years, proven



ore reserves are calculated at 418 million tons averaging 0.43 per cent molybdenum disulphide. The company's conversion plant at Langeloth, Pennsylvania, was affected by a strike from July to November, and during this time molybdenite concentrate was roasted at the previously idle roaster of Beattie-Duquesne Mines Limited at Duparquet, Quebec, and re-exported. The rest of United States production is derived from the molybdenite-bearing copper ores of Utah, New Mexico, Nevada and Arizona; the molybdenite mine of Molybdenum Corporation of America at Questa, New Mexico; and the tungsten mine of the US Vanadium Corp. at Bishop, California.

In Chile, molybdenite is recovered as a by-product in the milling of copper ores by Braden Copper Co., a subsidiary of Kennecott Copper Corp. During 1957 molybdenite production amounted to some 14,378 tons; in the previous year the output was 16,269 tons.

Molybdenum

Consumption and Uses

About 85 per cent of all the molybdenum used in the United States, by far the world's largest consumer, is in the form of ferromolybdenum, molybdic oxide and calcium molybdate - about 70 per cent in the making of steels and 15 per cent in cast-iron and malleable castings. The remainder is used in non-ferrous alloys, metallic molybdenum and compounds. In the production of low-molybdenum steels, molybdenum is generally used in the form of molybdic oxide. Ferromolybdenum is used where a higher molybdenum content is required, as in cast-iron and malleable castings.

A large amount of the molybdenum used in alloy steels goes into the making of gears and axles for the automobile, railroad and shipbuilding industries, shafts for mining and industrial machinery, and castings for pumps and valves. Titanium-base alloys being developed as frame and skin for supersonic aircraft contain from 1 to 6 per cent molybdenum.

Varying amounts of molybdenum are used in high-speed tool steels, high-temperature alloys and stainless steels. Molybdenum imparts increased strength and hardness and resistance to heat and corrosion.

Molybdenum wire and sheet are used in the electric-lamp, radio-valve, rectifier and resistance-wire industries. Molybdenum is used in conjunction with cobalt as a catalyst in hydroforming, desulphurization and hydrogenation.

Molybdenum salts are used as fertilizers and in pigments, mordants and welding-rod coatings. They have a limited use in the chemical field. Molybdenite is finding increasing use as a lubricant and as molybdenum disulphide in greases, oil dispersion, resin-bonded films and dry-power lubricants.

Molybdenum orange pigments for automobile finishes are popular.

Among the more important Canadian consumers of molybdenum primary products are: Atlas Steels, Limited; Algoma Steel Corporation Limited; The Steel Company of Canada, Limited; Sorel Industries, Ltd.; Shawinigan Chemicals, Ltd.; Canada Iron Foundries Ltd.; Welland Electric Steel Foundry, Limited; Dominion Engineering Works, Limited; Dominion Colour Corporation Limited; L'Air Liquide; Crane Limited; Eastern Electro-Casting Company Limited; and Dominion Brake Shoe Company, Limited.

Prices

With minor exceptions, the prices of molybdenum products have not changed since August 1956, when the price of molybdenum contained in concentrate was increased from $1.10 to $1.18 a pound and the prices of the majority of molybdenum products were increased an average of 7 per cent.

According to E & M J Metal and Mineral Markets of December 26, 1957, the prices of molybdenum in the United States were as follows:

Molybdenum metal, powder, carbon reduced, f.o.b. shipping point, per lb	$3.35
Ferromolydbenum, f.o.b. shipping point, per lb of contained Mo:	
58-64% Mo, powdered	$1.74
All other sizes	1.68
Calcium molybdate, f.o.b. shipping point, per lb of contained Mo	$1.42
Molybdic trioxide (MoO_3), f.o.b. shipping point, per lb of contained Mo:	
Bagged	$1.38
Canned	1.39
Briquettes	1.41
Molybdenum ore (molybdenite), f.o.b. Climax, Colo., per lb of contained Mo plus cost of containers	$1.18

Tariffs

Canada

	British Preferential	Most Favoured Nation	General
Calcium molybdate	free	free	5% ad valorem
Molybdic oxide	"	"	" "
Ferromolybdenum	"	5% ad valorem	" "
Molybdenum ore and concentrates	"	free	free

United States

Molybdenum ore and concentrate, per lb on Mo content	31.5¢
Calcium molybdate, ferromolybdenum, metallic molybdenum, molybdenum powder and all other alloys and compounds of molybdenum, per lb on Mo content	25 ¢ plus 7 1/2% ad valorem
Material containing more than 50% molybdenum:	
Bars, ingots, scrap and shot	23.5% ad valorem to June 30,1957 22.5% " " for the remainder of the year
Other forms	28.5% ad valorem to June 30,1957 27% " " for the remainder of the year

The tariff on molybdenite is to be reduced 5 per cent on June 30, 1958, under the Geneva Agreement.

NICKEL

by
R.J. Jones

Canadian production of nickel continued to increase for the seventh successive year. It rose to 187,958 short tons valued at $258,977,309. The Sudbury area of Ontario was the source of 94 per cent of Canadian production, the remainder being derived from Manitoba and the Northwest Territories.

In 1957 there was an increase in world supply. In addition, defence demand was reduced and the Office of Defense Mobilization released to industry the nickel scheduled for delivery to the United States stockpile. The result of these three factors was an increase in the stocks held by producers, consumers and the United States Government. The International Nickel Company of Canada Limited in March 1958 announced that production was being reduced by 10 per cent, or some 1,250 tons a month, because of poor market conditions. In April the company announced a further 10-per-cent cutback, to become effective during the first week of May.

When the nickel shortage ended, in 1957, the continual supply shortage that had come to a head at the beginning of the Korean War also ended, as did premium prices for nickel. The plans of prospective producers and the expansion programs of actual producers indicate that the production capacity of the Free World in 1961 will be 653 million pounds of nickel. Barring unforeseen circumstances, it is unlikely that nickel will again be in short supply for at least five years.

The development of a surplus supply of nickel and the disappearance of premium-price markets has had an adverse effect on the production and development plans of a number of marginal properties in Canada. Toward the end of 1957, several of these companies abandoned development and production plans, as financing could no longer be obtained, particularly from certain countries in Europe which had previously felt the nickel shortage most severely.

Nickel - Production, Trade and Consumption

	1957		1956	
	Short Tons	$	Short Tons	$
Production, all forms				
Ontario	177,396	243,518,138	167,576	208,099,454
Manitoba	10,034	14,725,014	10,939	14,105,406
Northwest Territories ..	528	734,157	-	-
Total	187,958	258,977,309	178,515	222,204,860
Exports				
Nickel in matte or speiss				
United Kingdom	28,710	38,502,055	28,296	34,485,212
Norway(1)	24,480	32,831,889	23,382	28,474,349
United States...........	18,391	24,649,619	19,036	23,153,053
Other countries	2,113	2,832,957	1	378
Total	73,694	98,816,520	70,715	86,112,992
Nickel in oxide				
United Kingdom	841	517,894	634	439,816
United States..........	801	955,845	1,052	1,192,398
Other countries	64	102,943	81	118,918
Total..................	1,706	1,576,682	1,767	1,751,132
Refined metal				
United States	90,581	127,265,463	92,905	119,166,952
United Kingdom	4,748	6,353,619	5,073	6,616,378
West Germany	3,013	5,101,754	2,823	4,133,666
Italy	1,572	2,920,928	908	1,306,778
Sweden................	964	1,739,585	834	1,174,301
Other countries	2,380	4,478,491	1,813	2,646,587
Total..................	103,258	147,859,840	104,356	135,044,662
Imports				
Semi-fabricated nickel(2)				
United States...........	1,955	3,560,185	2,495	4,690,414
United Kingdom	57	169,455	28	74,208
Norway................	78	111,334	31	39,539
West Germany	1	999	-	-
Total..................	2,091	3,841,973	2,554	4,804,161

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

Imports (cont'd)	1957 Short Tons	1957 $	1956 Short Tons	1956 $
Nickel manufactures				
United States...........		1,332,994		1,363,260
West Germany		245,472		226,896
United Kingdom		189,755		209,077
Others		101,379		143,053
Total..................		1,869,600		1,942,286
Consumption, domestic, refined metal (producers' domestic shipments)....	4,532		5,545	

(1) For refining and re-export.

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

Nickel - Production, Trade and Consumption, 1947-57

(short tons)

	Production(a)	Exports: In Matte or Speiss	Exports: In Oxide	Exports: Refined Metal	Exports: Total	Imports (b)	Consumption(c)
1947	118,626	39,767	6,535	70,756	117,058	1,376	1,670
1948	131,740	50,801	9,792	71,247	131,840	1,364	1,887
1949	128,690	56,902	1,151	69,088	127,141	1,448	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

(a) All forms refined metal plus content of oxide and matte exported.
(b) Nickel in semi-fabricated 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.

Domestic Mine Production*

Ontario

The International Nickel Company of Canada Limited operated at capacity for the eighth consecutive year. Approximating the all-time high, the company's deliveries of nickel in all forms amounted to 290,050,000 pounds. The corresponding total in the previous year was 286,140,000 pounds. Some 16,049,000 tons of ore were mined, of which 14,948,000 tons came from underground at the Creighton, Frood-Stobie, Garson, Levack and Murray mines, the rest from the Frood open pit. This tonnage was the largest yet obtained from the company's Sudbury mines. Ore reserves in the Sudbury area mines at December 31, 1957, were at a high of 264,495,000 tons containing 7,956,600 tons of nickel and copper.

The company's expansion program in Ontario and Manitoba will result in a production capacity of 385 million pounds in 1961. During 1957, a new process for the recovery of nickel by the direct electrolysis of nickel matte was developed at the company's refinery at Port Colborne, Ontario. The process also permits the recovery of cobalt and high-purity sulphur and selenium. The nickel-salts plant capacity at the Copper Cliff, Ontario, copper refinery was increased by 50 per cent.

Falconbridge Nickel Mines Limited extracted 2,005,439 tons from the company's Sudbury area mines, the highest amount on record. The ore was mined from the Falconbridge, East, Mount Nickel, McKim, Longvack and Hardy mines and, together with some development ore, from the Fecunis mine. Mining at Mount Nickel, a small orebody, was concluded in November.

The new 2,000-ton mill at the Fecunis mine was completed early in the year and in May it began to treat ore from the Longvack mine and development ore from the Fecunis mine.

The new smelter was constructed near the old smelter at Falconbridge, and the new furnace was blown in on January 16, 1958.

The company delivered 46,880,000 pounds of nickel in 1957 from its refinery at Kristiansand, Norway, a new high for the company. Developed and indicated ore reserves in the Sudbury area at the end of the year - 45,775,900 tons averaging 1.44 per cent nickel and 0.79 per cent copper - were the highest in the company's history.

Nickel Rim Mines Limited, on the east rim of the Sudbury Basin, milled 342,565 tons of nickel-copper ore, from which 18,511 tons of concentrate were produced. The nickel concentrate, containing 1,336 tons of nickel, was shipped to the refinery of Sherritt Gordon Mines Limited at Fort Saskatchewan, Alberta, for refining on a toll basis. Ore reserves at the end of 1957 were 2,184,000 tons averaging 0.60 per cent nickel and 0.24 per cent copper.

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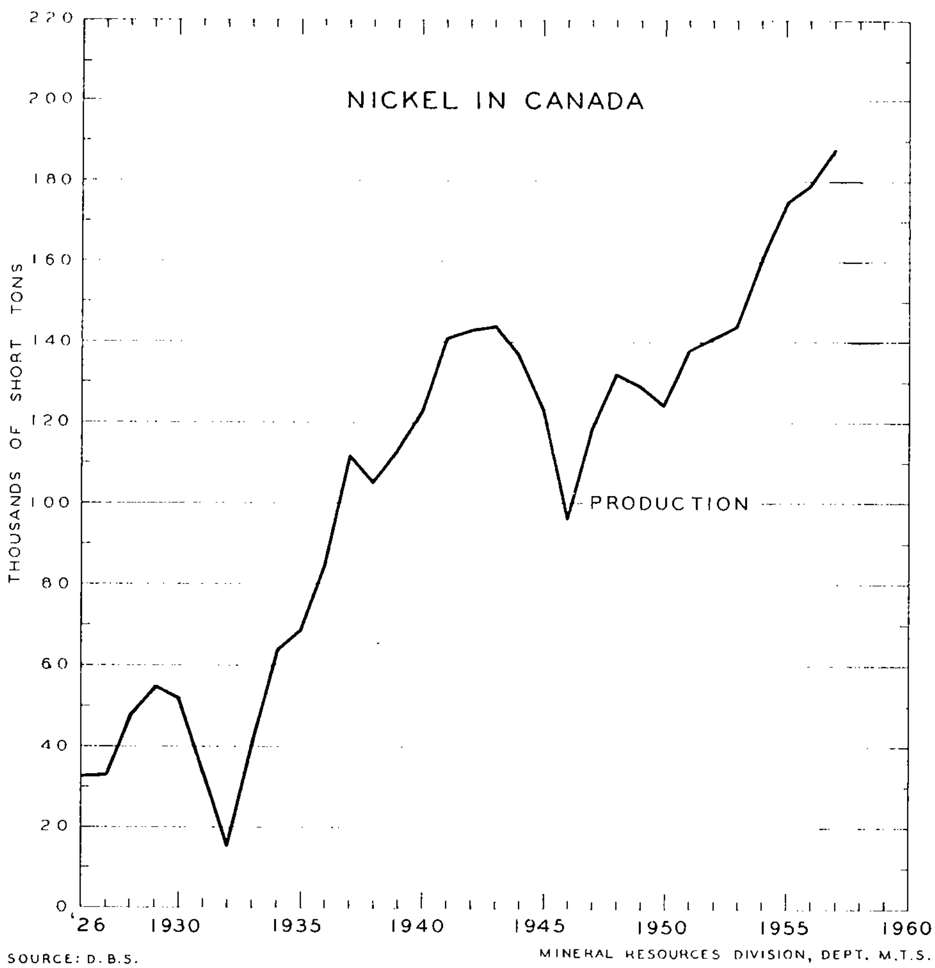
* See map on page 164.



Nickel Offsets Limited, a small shipper of concentrates to the Falconbridge smelter, closed its mine in the Sudbury area at the beginning of the year owing to exhaustion of reserves.

Deloro Smelting and Refining Co. Ltd. continued to recover nickel oxide from the cobalt-silver ores of the Cobalt-Gowganda area.

Manitoba

Sherritt Gordon Mines Limited operated two producing nickel-copper mines and a concentrator at Lynn Lake, Manitoba; and at Fort Saskatchewan, Alberta, the company operated a chemical-metallurgical refinery for treating nickel concentrate. A total of 833,443 tons of ore was mined and milled to produce concentrates containing 20,067,367 pounds of nickel. A new orebody located during the year and extensions to known orebodies resulted in a net increase that raised the ore reserve to 13,640,000 tons averaging 1.064 per cent nickel and 0.561 per cent copper. When the capacity of the refinery was raised from 20 million to 27,500,000 pounds of nickel a year, provision was made for the treatment of custom concentrate.

Northwest Territories

North Rankin Nickel Mines Limited commenced production of nickel-copper concentrates from its mine and 250-ton concentrator at Rankin Inlet some 320 miles north of Churchill, Manitoba. From the 46,120 tons of ore milled during 1957, 7,474 tons of concentrate containing 265 tons of copper and 979 tons of nickel were produced. The concentrate was shipped to the Falconbridge smelter. Ore reserves at the end of 1957 totalled 447,481 tons averaging 0.93 per cent copper and 3.20 per cent nickel.

Quebec

Canadian Copper Refiners Ltd. at Montreal East continued to recover nickel sulphate from the impure electrolyte produced during the refining of Noranda anodes.

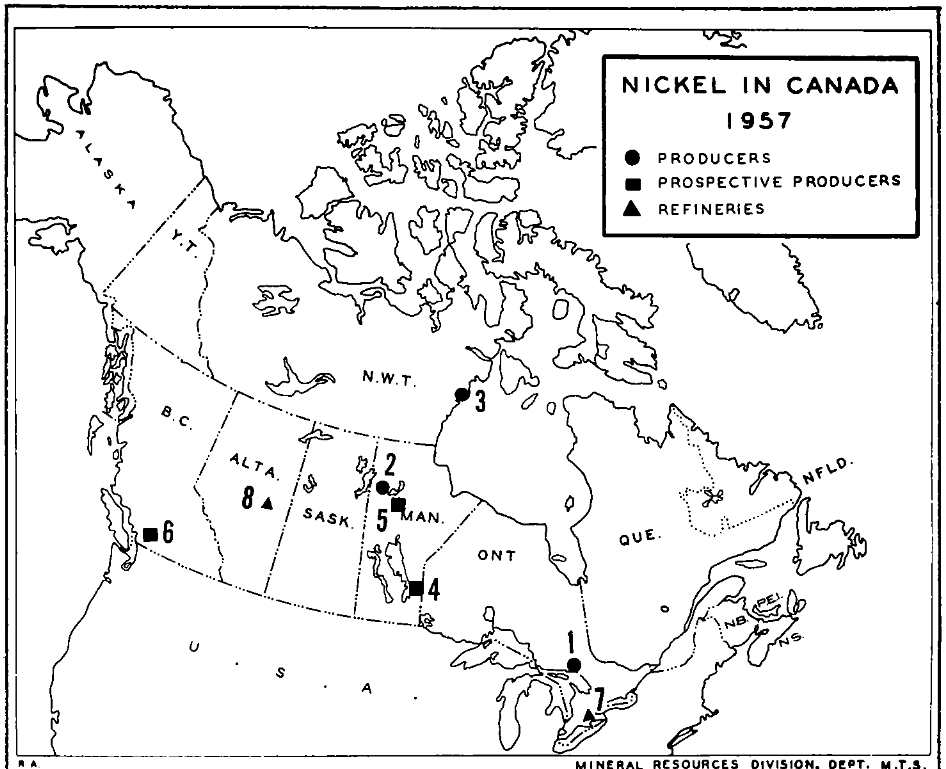
World Mine Production

Free World production in 1957 amounted to 258,500 tons, of which Canada produced 73 per cent.

Cuba produced an estimated 22,245 tons, or 9 per cent of Free World production. This production was the output of Nickel Processing Corporation at Nicaro, a plant owned by the United States Government. The capacity of the plant is now some 25,000 tons of nickel annually and represents an investment by the government of $85 million. The government announced that it intended to sell the plant to private industry. Some of the nickel oxide sinter from Cuba was refined to metal at Crum Lynne, Pennsylvania, by the National Lead Company.

Production of nickel metal by Cuban American Nickel Company, a subsidiary of Freeport Sulphur Company, is expected to begin in 1959 and to amount annually to 25,000 tons from ores mined and concentrated at Moa Bay. The concentrate will be shipped to Louisiana, where a refinery will produce nickel and cobalt by the Sherritt Gordon process.

The United States produced 10,000 tons in 1957, or 4 per cent of the Free World's output for the year. Hanna Nickel Smelting Company's nickel-smelting plant at Riddle, Oregon, which was in its first full year of capacity production, turned out more than 9,000 tons of nickel contained in ferronickel. The remainder of United States production came from the National Lead Company operation at Fredericktown, Missouri, the Howe Sound Company operation in Idaho and the purification of electrolyte at certain copper refineries.



Producers

1. - Sudbury Area

The International Nickel Company of Canada Limited (5 mines; 2 smelters)
Falconbridge Nickel Mines Limited (5 mines; 1 smelter)
Nickel Rim Mines Limited

2. - Sherritt Gordon Mines Limited
3. - North Rankin Nickel Mines Limited

Prospective Producers

4. - New Manitoba Mining and Smelting Company Limited
5. - The International Nickel Company of Canada Limited
6. - Western Nickel Limited

Refineries

7. - The International Nickel Company of Canada Limited
8. - Sherritt Gordon Mines Limited

Nickel produced in New Caledonia by the French company, Société Le Nickel, plus ores exported from there to Japan for refining, together with the output of Finland, Burma and South Africa, accounted for the remaining 14 per cent. Production from South Africa amounted to 4,562 tons of nickel, which is produced in the Rustenburg district by Matte Smelters (Pty.) Limited, a subsidiary of Rustenburg Platinum Mines Limited.

Exploration and Development in Canada

Ontario

Falconbridge Nickel Mines Limited carried out extensive pre-production development at its Onaping, Fecunis and Boundary mines in the Onaping area. At Fecunis the permanent system of ore-passing, of crushing, loading and hoisting and of conveying ore to the main storage bin was put in service in November. In preparation for mining, the first level was turned over to International Nickel under an agreement for the joint mining of the deposit, which is partly within the latter company's Levack mine property. Each company will treat the ore obtained on its own property.

The International Nickel Company of Canada Limited continued to prepare the Crean Hill mine for production at a rate of 2,500 tons of ore a day. The mine is situated some 10 miles west of Creighton Mine.

The new 6,000-ton-a-day mill at Levack was under construction during the year. It will be used for the handling of normal Levack ore and ore from the Fecunis Lake property. This mill will produce a nickel concentrate for the Coniston smelter and a copper concentrate for the Copper Cliff smelter.

Arcadia Nickel Corporation Limited carried out development work on its properties in Denison township, about 25 miles west of Sudbury. A mill was partly completed. Reserves are estimated at 786,000 tons averaging 0.755 per cent copper and 0.573 per cent nickel. The company also managed the adjoining properties of Aer Nickel Corporation Limited which also carried out development work. Operations were suspended before the end of the year.

Eastern Mining and Smelting Corporation Ltd. carried out underground development and exploration at its property near Werner Lake, 52 miles north of Kenora. A 21-mile road from Oiseau Lake, Manitoba, to the property of Norpax Nickel Mines Limited and this property was almost complete.

Norpax Nickel Mines Limited, which adjoins Eastern Mining and Smelting Corporation on the west, carried out underground development. Reserves based on surface diamond-drilling are estimated at 1,010,000 tons averaging 1.2 per cent nickel and 0.5 per cent copper.

Kenbridge Nickel Mines Limited, a subsidiary of Falconbridge Nickel Mines Limited, at Populus Lake, 55 miles southeast of Kenora, completed a 3-compartment shaft to 533 feet and carried out some lateral development. Operations ceased in June because the indicated tonnage and grade were deemed not sufficient to justify further expenditure under present market conditions.

Nickel

Manitoba

The International Nickel Company of Canada Limited embarked on its major development program to bring the Thompson and Moak Lake mines to the production stage. On October 20, the 30-mile railway spur from Sipiwesk on the Canadian National Railways' Hudson Bay line was completed to Thompson, Manitoba's newest mining town. A 1,057-foot development shaft was completed at the Thompson mine and a production shaft to the 2,100-foot level was commenced. A 9,000-ton concentrator and other mine buildings were under construction. The Thompson mine will be brought into production first, and the entire output - 75 million pounds of nickel a year by mid-1960 - will be obtained from it. The Moak Lake mine, 22 miles north of Thompson, will be brought into production later.

The combined average grade of the two deposits is reported to be more than 1 1/4 per cent nickel, which is the Sudbury mine grade, and to contain small amounts of copper, cobalt and platinum metals. A smelter is to be constructed to roast the concentrate, the calcine being smelted in electric furnaces to produce converter matte. It is probable that a refinery will also be built in the area.

This operation, combined with that at Sudbury, will increase the company's annual nickel production capacity to 385 million pounds by 1961.

New Manitoba Mining and Smelting Company Limited, southwest of Cat Lake, has outlined some 2 million tons of material averaging 0.33 per cent nickel, 0.75 per cent copper and 0.06 per cent cobalt to a depth of 425 feet. A 1,000-ton concentrator is being constructed, and the company is laying plans for electric smelting of nickel concentrates to matte.

Quebec

The Ungava area across northern Quebec from Cape Smith on Hudson Bay to Wakeham Bay on Hudson Strait was the scene of intense exploration. Asarco Nickel Company Limited, a subsidiary of American Smelting and Refining Company, diamond-drilled the original discovery of Le Moyne Ungava Mines Limited. The option was dropped when Asarco decided that results did not justify further expenditure. Raglan Nickel Mines Ltd. which adjoins the aforementioned property to the east, also carried out some drilling. Some high-grade drill intersections with lesser copper content were reported. About 20 other companies were engaged in surface prospecting, mapping and diamond-drilling.

Selco Exploration Company Limited did some diamond-drilling on the property of Lake Renzy Mines Limited in Pontiac county, 110 miles northwest of Ottawa, where about 1,138,000 tons of material averaging 0.67 per cent copper, 0.68 per cent nickel and 0.04 per cent cobalt had been indicated by diamond-drilling.

Marchant Mining Company Limited diamond-drilled a prospect held under option in La Motte township and indicated some 200,000 tons grading 2 per cent nickel.

Consolidated Regcourt Mines Limited suspended exploration work on a deposit in Blondeau township, 60 miles south of Noranda, where some 2,200,000 tons of material averaging 1.4 per cent nickel plus copper had been indicated.

British Columbia

Western Nickel Limited rehabilitated its nickel-copper property near Choate under the management of The Granby Consolidated Mining, Smelting and Power Company. Construction of a mill was well advanced and production was due to commence in 1958. The nickel concentrates will be shipped to Fort Saskatchewan, Alberta, for refining. The reserves total about 1,300,000 tons averaging 1.39 per cent nickel and 0.5 per cent copper.

Felpscan Mines Limited, a subsidiary of Phelps Dodge Corporation, leased and optioned the low-grade prospect of Colossus Nickel Development Ltd. at Colossus Mountain in the Bridge River district.

Consumption and Uses

Shipments of nickel to Canadian consumers amounted to 4,532 tons during 1957, or 2.4 per cent of Canadian production.

Consumption of nickel in the United States, the world's largest consumer, was 122,466 tons in 1957; in 1956 it amounted to 127,578 tons. Stocks of nickel held by consumers in the United States at the end of 1957 were the highest ever recorded, totalling 25,282 short tons. At the beginning of the year stocks had amounted to only 12,672 tons.

The steel industry, as a producer of stainless, alloy steel and cast iron, is the world's largest consumer of nickel. The second is in the non-ferrous alloy field, where nickel is alloyed with a multitude of other non-ferrous metals in the production of a wide variety of useful alloys. The third largest consumer uses nickel in plating anodes. Other outlets include high-temperature and electrical resistance alloys, catalysts, batteries, magnets and ceramics. Research in 1957 had to do with projects that promised important increases in the use of nickel. Noteworthy among the proposed products were new nickel steels for gears and heavy forgings, and high-nickel alloys for automotive gas turbines and atomic power plants.

Prices

The Canadian price of electrolytic nickel, f.o.b. Port Colborne, Ontario, was 70 cents a pound until the beginning of August, when it was reduced to 69 cents. It remained at this level for the rest of the year.

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Nickel

The United States price remained unchanged at 74 cents (U.S.) a pound, f.o.b. Port Colborne, including the 1 1/4 cent United States import duty. This price was established on December 6, 1956.

Tariffs

Canada

Tariffs varied on nickel manufactured products ready for consumption and on nickel products for use in the manufacture of finished products in Canada.

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, drawn or worked - 2 1/2% extra)	6 1/4% ad valorem

NIOBIUM AND TANTALUM

by

R. J. Jones

As in 1956, no commercial production of niobium or tantalum ores was recorded in 1957. During 1955, a small quantity of niobium pentoxide and tantalum pentoxide was produced by Boreal Rare Metals Limited at its refinery at Cap de la Madeleine, Quebec, from concentrates originating from a lithium-tantalum-niobium property 70 miles east of Yellowknife, Northwest Territories.

Quebec Metallurgical Industries Limited continued to produce niobium pentoxide, ferroniobium and niobium sponge at its laboratory at Billings Bridge, near Ottawa, Ontario. In addition, it produced some niobium metal from sponge and tantalum pentoxide from imported ores. The company is examining the market for its products with a view to the erection of a pilot plant near Ottawa or in the United States. The erection of such a plant would probably mean the commercial production of niobium concentrates at the company's gravel deposit on Bugaboo Creek, British Columbia.

Demand for tantalite in world markets was excellent during the year in contrast with the smaller demand for columbite. Apart from the abnormal demand from the chemical and electronics industries, its importance in certain atomic reactor designs has added to the shortage. It is probable that, with the greater missile production in the Free World, demand for niobium-bearing high-temperature alloys will increase. These developments, together with the future production of gas turbines for automobiles, are of particular importance to Canadian pyrochlore mines, which have a great potential output of niobium.

During the year, Wah Chang Corporation and Electro Metallurgical Company in the United States began commercial production of pure tantalum and niobium metal. Fansteel Metallurgical Corporation commenced production at its new tantalum-niobium plant at Muskogee, Oklahoma, to add to the production from its expanded North Chicago, Illinois, plant.

U. S. Industrial Chemicals Company, a division of National Distillers and Chemical Corporation, has begun construction of a pilot plant to produce niobium and tantalum metal. Output will commence in mid-1958 at Cincinnati, Ohio, the location of the company's research laboratories.

E. I. DuPont de Nemours and Company Incorporated,at Wilmington, Delaware, continued to carry out experimental production of high-purity niobium metal in conjunction with Thompson Products Incorporated.

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Niobium and Tantalum

Developments and Occurrences

Northwest Territories

In addition to the property of Boreal Rare Metals Limited, there are many niobium-tantalum occurrences in the Yellowknife area, north of Great Slave Lake. The presence of columbite-tantalite has been noted in many pegmatite dykes in association with beryl, spodumene and amblygonite. A small quantity of columbite-tantalite was produced in 1947 from the Peg property of Nationwide Minerals Limited near Upper Ross Lake, 45 miles northeast of Yellowknife.

British Columbia

On Bugaboo Creek, about 30 miles southeast of Golden, Quebec, Metallurgical Industries Ltd. has developed an extensive niobium-bearing gravel deposit. During 1956, a plant was installed to mine gravel and produce a gravity concentrate. The concentrates were processed to produce high-purity niobium oxide, niobium alloys and niobium sponge in a laboratory near Ottawa.

Ontario

The Consolidated Mining and Smelting Company of Canada Limited in 1956 took over the management of Beaucage Mines Limited, which has been developing a pyrochlore-uranium deposit located on and around islands in Lake Nipissing about 7 miles southwest of North Bay. A 50-ton test mill has been operated to check the laboratory findings of Battelle Memorial Institute.

Tonnage and grade estimates in a zone to the east of Newman Island, not including any material between the lake bottom and the 300-foot level, are as follows:

Tons	% U_3O_8	% Nb_2O_5
2,695,000	0.042	0.69
1,824,000	0.05	0.88
617,000	0.075	1.06

Multi-Minerals Limited has outlined two pyrochlore-bearing deposits on its Nemegos property about 14 miles from Chapleau. About 50 million tons of material averaging 0.26 per cent Nb_2O_5 have been indicated, with local concentration averaging around 1.0 per cent Nb_2O_5.

Dominion Gulf Company has outlined two areas of niobium mineralization in Chewett township, 17 miles northeast of Chapleau. One area contains 20 million tons of material averaging 0.5 per cent Nb_2O_5 plus a very substantial tonnage averaging down to 0.3 per cent Nb_2O_5. The other area indicates a possible 15 million tons above the 500-foot level.

Quebec

The main companies in the Oka area are: Quebec Columbium Limited, jointly owned by Molybdenum Corporation of America and Kennecott Copper Corporation; Columbium Mining Products Ltd., owned by Coulee Lead and Zinc Mines Limited and Headway Red Lake Gold Mines Limited; Oka Rare Metals Mining Company Limited; and St. Lawrence River Mines Limited.

The Quebec Columbium Limited property is reported to indicate 30 million tons averaging 0.6 per cent Nb_2O_5 in one zone and 25 million tons averaging 0.35 per cent Nb_2O_5 in another.

Columbium Mining Products Ltd. has outlined some 30 million tons of material averaging 0.35 per cent Nb_2O_5.

World Mine Production

World production of niobium and tantalum concentrates amounted to about 7,760,000 pounds in 1957 compared with 9,150,000 pounds in 1956, according to the United States Bureau of Mines. The main producer of niobium concentrates in 1957 was Nigeria, with a production of some 4,300,000 pounds. Production from the Belgian Congo and the United States increased considerably. The Belgian Congo was the largest producer of tantalum concentrates.

Production of niobium-tantalum concentrates from the placer mine at Bear Valley, Idaho, was reduced considerably during the first nine months of 1957.

N.V. Billiton Maatschappij and Colonial Development Corporation erected a 150-ton pilot plant for the production of niobium concentrates from their property at Panda Hill, Tanganyika. To the beginning of 1957, diamond drilling had indicated some 45 million tons of material averaging 0.3 per cent Nb_2O_5 plus 1 million tons averaging 1 per cent Nb_2O_5.

Consumption and Uses

The most important use of niobium is in the manufacture of stabilized austenitic stainless steels of A.I.S.I. Type 347, where niobium is added in the form of ferroniobium or ferrotantalum-niobium. Niobium is also consumed in the manufacture of certain high-temperature alloys to provide creep resistance at elevated temperatures.

Minor uses for niobium are in the manufacture of certain aluminum casting alloys and in the canning of uranium metal in atomic plants.

Probably the greatest tonnage use of tantalum is in the consumption of ferrotantalum-niobium in the manufacture of stainless steel and in the manufacture of capacitors for military and other electronic systems. Tantalum metal, being resistant to most corrosive acids, is widely used in hydrochloric acid absorption plants, in plants for the manufacture of pharmaceutical products, in spinnerets for extruding rayon fibres and in laboratory equipment such as spatulas and crucibles. Tantalum metal, being inert to body acids, is used in the repair of injuries to the skull and other bones and in plastic surgery. It is also used in the manufacture of vacuum tubes to remove gases from the tube when it is in operation.

Tantalum pentoxide is used as a catalyst in the synthesis of butadiene from ethyl alcohol and in the production of certain optical glasses.

The more important Canadian consumers of niobium and tantalum are: Atlas Steels, Limited, Welland, Ontario; Shawinigan Chemicals, Limited, Shawinigan, Quebec; and Fahralloy Canada, Limited, Orillia, Ontario. Other consumers are: Sheepbridge Engineering (Canada) Limited, Guelph, Ontario; Hayward Tyler of Canada, Limited, Kitchener, Ontario; and Massey-Harris-Ferguson Limited, Toronto, Ontario. These companies consume about 5 tons of niobium alloys each year.

Prices

Prices of columbium and tantalum according to E & M J Metal and Mineral Markets of December 26, 1957, were as follows:

Columbite, $1.15 - $1.20 per lb of pentoxide, basis 65% Nb_2O_5 and Ta_2O_5 with a Nb: Ta ratio of 10 : 1
$1.00 - $1.05 per lb of pentoxide with a ratio of 8 1/2 : 1

Tantalum, $128 per kilo for rods and $100 per kilo for sheet.

Ferroniobium, $4.90 per lb of contained Nb, ton lots, 50-60% Nb, max. 0.40% C, max. 8% Si f.o.b. destination continental U.S.

The Electro Metallurgical Company, New York, announced in October the availability of high-purity columbium-metal melting stock at prices ranging from $55 to $80 a pound, depending upon size and shape.

Tariffs

Canada

Ferroniobium and ferrotantalum-niobium: British preferential, free; most favoured nation, 5% ad valorem; general, 5% ad valorem.

United States

Ore: free.

Ferroniobium: 12 1/2% ad valorem.

Niobium and tantalum metal: 12 1/2% ad valorem.

PLATINUM METALS

by
D. B. Fraser

The platinum metals occur in small amounts in the nickel-copper ores of the Sudbury district of Ontario and are recovered in unrefined form from smelting and refining operations. The amount recovered is only about 0.02 ounce per ton of ore mined but, since large tonnages are treated (more than 18 million tons in 1957), the total is considerable. Output of platinum in 1957 was at a postwar high of 199,565 ounces, valued at $17,835,124. Output of palladium, rhodium, iridium, ruthenium and osmium totalled a near record of 216,582 ounces, valued at $7,896,209.

Canada became the world's leading producer of the platinum metals in 1934, when nickel production from Sudbury ores was expanded. Output reached an all-time high of 646,671 ounces in 1942 (see graph on page 177. In the past five years it has averaged about 351,000 ounces a year consisting of 162,000 ounces of platinum and 189,000 ounces of palladium and the other platinum metals. The other leading world producer, the Union of South Africa, whose production is almost entirely derived from primary platinum ores, equalled Canada's output from 1953 to 1955 and, in 1956, surpassed it by a considerable margin. Canada in 1957 produced 34 per cent of the estimated world output of 1,197,000 ounces, the Union of South Africa produced 51 per cent and Russia 10 per cent. The remainder originated mainly in Colombia and the United States.

At the beginning of 1957 platinum was in short supply and sold at a price of about $104 a troy ounce. There was a gradual reduction of demand during the year, mainly because there was a decrease in oil-refiners' requirements of platinum in catalytic reforming installations. At year-end the price was about $77 an ounce.

Production

The International Nickel Company of Canada Limited is Canada's chief producer of platinum metals, which it recovers from nickel-copper ores in the form of precious-metals concentrates. These are refined at the company's refinery at Acton, near London, England. Ore production from the company's Sudbury-district mines in Ontario was at an all-time high of 16,049,000 tons. Deliveries of platinum metals in 1957 by International Nickel amounted to 339,400 ounces.

Falconbridge Nickel Mines Limited also operates nickel-copper mines near Sudbury and recovers platinum metals at its refinery at Kristiansand, Norway. A record output of 2,018,809 tons of ore was mined in 1957.

Platinum

Platinum and Platinum Metals – Production and Trade

	1957		1956	
	Fine Ounces	$	Fine Ounces	$
Production (shipments)				
Platinum	199,565	17,835,124	151,357	15,725,992
Palladium, rhodium, ruthenium, iridium, and osmium	216,582	7,896,209	163,451	6,681,098
Total	416,147	25,731,333	314,808	22,407,090
Exports				
Platinum metals in concentrates (1)		17,261,343		20,157,210
Platinum metals, refined and semi-processed				
United States		10,081,412		14,814,488
Other countries		376,750		414,413
Total		10,458,162		15,228,901
Platinum, old and scrap				
United Kingdom		11,420		45,328
United States		89,659		224,948
Total		101,079		270,276
Imports				
Platinum and platinum metals, refined semi-refined, semi-processed, and manufactured				
United Kingdom (2)		15,194,988		19,139,549
United States		209,403		146,847
Other countries		26,540		293,430
Total		15,430,931		19,579,826
Platinum crucibles				
United States		1,361,181		1,766,733

(1) To United Kingdom for refining and processing.

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

Platinum and Platinum Metals - Production and Trade, 1947-57

	Production (1)			Exports (2)	Imports (3)
	Platinum (fine oz)	Other Platinum Metals (fine oz)	Total (fine oz)	($)	($)
1947	94,570	110,332	204,902	11,658,824	7,532,433
1948	121,404	148,343	269,747	16,776,733	10,738,062
1949	153,691	182,233	335,924	18,016,023	10,736,534
1950	124,453	148,741	273,194	21,200,788	21,339,915
1951	153,461	164,905	318,366	30,340,210	17,077,931
1952	122,315	157,407	279,722	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	163,461	314,818	35,386,111	19,579,826
1957	199,565	216,582	416,147	27,719,505	15,430,931

(1) Platinum and platinum-metals content of residues and concentrates shipped to the United Kingdom for treatment.

(2) Value of platinum and platinum metals contained in concentrates and residues shipped to the United Kingdom for treatment. Also included in this figure are the exports of refined and semi-processed platinum and platinum metals to the United States and other countries.

(3) Imports from the United Kingdom of refined and semi-processed platinum and platinum metals derived from Canadian residues and concentrates shipped to the United Kingdom for treatment.

North Rankin Nickel Mines Limited commenced production during 1957 from a 250-ton mill at Rankin Inlet, 320 miles north of Churchill, Manitoba. A total of 46,120 tons was milled, from which 7,474 tons of nickel and copper concentrates were recovered and shipped to the Falconbridge smelter for custom treatment. The company's ore reserves contain, in addition to nickel and copper, 0.03 ounce of platinum and 0.06 ounce of palladium per ton.

Developments

The International Nickel Company of Canada Limited carried on a full-scale construction and development program in north-central Manitoba. In addition to nickel, the ore in these deposits contains recoverable values in platinum and other precious metals. Production, scheduled to begin in 1960, will come initially from the Thompson mine.

Titanium

Eastern Mining and Smelting Corporation Ltd., and Norpax Nickel Mines Limited, adjoining to the west, continued exploration and underground development of nickel-copper properties in the Gordon Lake-Werner Lake district, 52 miles north of Kenora, Ontario.

Properties and Uses

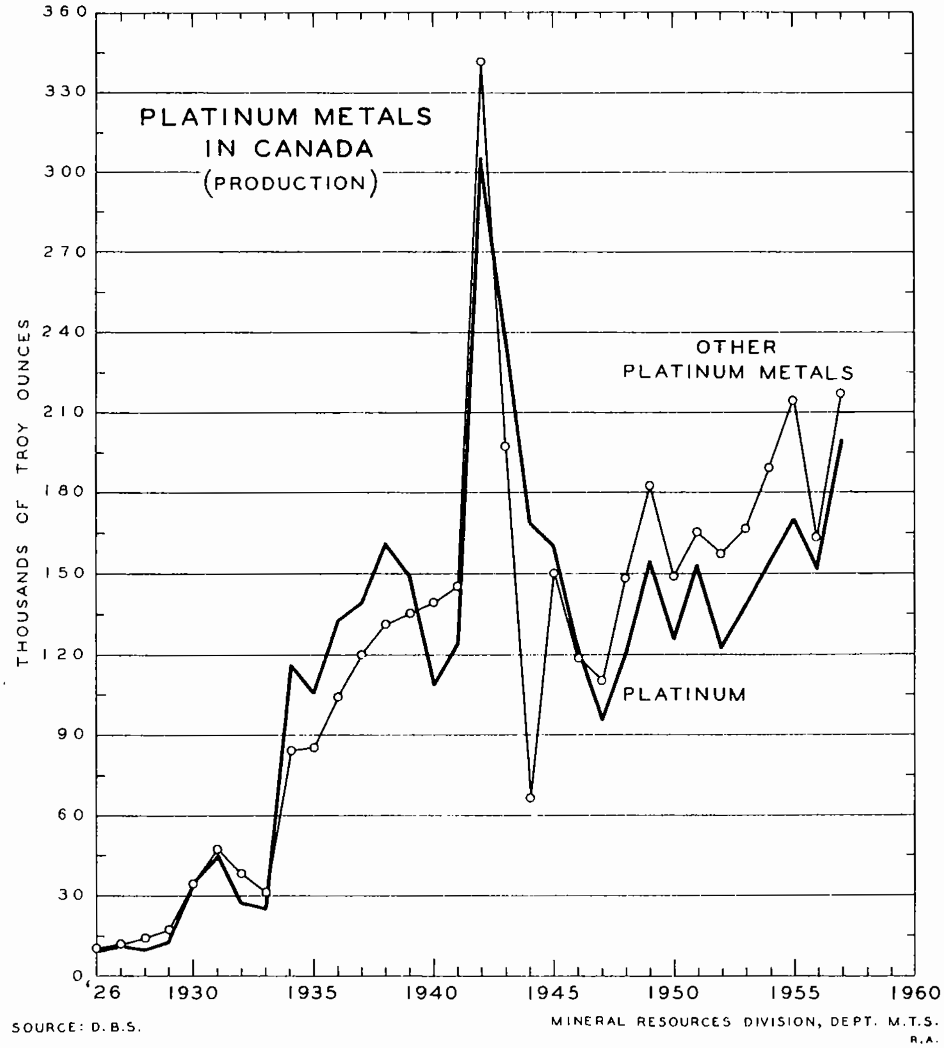
The platinum metals are notable for their high melting points and for extreme resistance to chemical and high-temperature corrosion. Platinum and palladium, the most abundant and widely used of the group, are active catalysts and are ductile and malleable. Rhodium, ruthenium, iridium and osmium are not easily worked and are seldom used in pure form, their principal function being to harden platinum- and palladium-base alloys. Rhodium has recently been used as an electrodeposited plating, in which form it is extremely hard and has a high reflectivity.

In the United States, which is the largest consumer, about 70 per cent of the total supply of platinum is used in the chemical industry, which includes petroleum-refining. The electrical industry uses 13 per cent, and the remainder is distributed among jewelry, decorative, dental and medical uses. Palladium finds its main use in the electrical industry.

Platinum is used as a catalyst by the chemical industry in the production of nitric and sulphuric acid, in the hydrogenation of organic materials, in the synthesis of hydrocarbons and in hydroxylation. Since 1950 it has been increasingly used in the catalytic reforming process for raising the octane rating of low-grade and natural gasoline. Palladium catalyst is used in hydrogenation and in producing certain fine chemicals, such as streptomycin and deoxidized hydrogen. Permanent platinum anodes are used in the production of such 'per' chemicals as hydrogen peroxide and persulphates. Pure platinum is used in laboratory utensils and in crucibles for melting special glasses. Platinum-rhodium alloy is used in fiberglas extrusion equipment. Platinum-gold alloy is used in fine-diameter nozzles for the drawing of rayon threads from viscose. The thermocouple of platinum and 13-per-cent-rhodium platinum is widely used in measuring extremely high temperatures of, for example, liquid steel.

In the electrical industry, palladium and platinum are used as light-pressure contacts where freedom from tarnish is essential to reliable operation. In heavy-duty contacts the harder platinum-group alloys are used. Common applications include telephone and telegraph relays, voltage regulators, thermostats and high-tension magneto contacts. High-quality spark plugs employing platinum-alloy electrodes are used in aircraft engines. Other applications include resistors, fine-wire electrical fuses and furnace safety devices.

Owing to their fine appearance, workability and mechanical strength, platinum and palladium alloys are extensively used in gem-set jewelry. They are also used in dental alloys and as hard tips for fountain-pen nibs and


PLATINUM METALS
IN CANADA
(PRODUCTION)
OTHER
PLATINUM METALS
PLATINUM
THOUSANDS OF TROY OUNCES
360
330
300
270
240
210
180
150
120
90
60
30
0
'26
1930
1935
1940
1945
1950
1955
1960
SOURCE: D.B.S.
MINERAL RESOURCES DIVISION, DEPT. M.T.S.
R.A.

phonograph needles. Among the principal consumers of platinum metals in Canada are: Baker Platinum of Canada Limited, Toronto; Johnson Matthey & Mallory Limited, Toronto; Imperial Smelting & Refining Company Limited, Toronto; Northern Electric Company Limited, Montreal; Williams Gold Refining Company Limited, Fort Erie, Ontario; and Goldsmith Bros. Smelting and Refining Company Limited, Toronto.

Prices

Prices of platinum metals in the United States, according to E & M J Metal and Mineral Markets of December 26, 1957, were:

	Per Troy Ounce
Platinum	\$ 76 to \$ 80
Palladium	\$ 21 to \$ 22.50
Osmium	\$ 80 to \$100
Iridium	\$100 to \$110
Rhodium	\$118 to \$125
Ruthenium	\$ 45 to \$ 55

SELENIUM

by

R.J. Jones

Selenium in 1957 was highlighted by a lower production of refined metal, drastic cuts in the volume of exports and consumption, a build-up of producers' stocks and lower prices. It is highly probable, as in the case of other metals, that consumers reduced their inventories in order to drive prices lower in an unstable market. Competition from ultra-pure silicon had its effect on the rectifier industry as noted in producers' shipments. Consumption in the glass and rubber industries was normal.

Canadian production of selenium is derived from the refining of blister copper at Canadian Copper Refiners Limited at Montreal East, Quebec, and at the copper refinery of The International Nickel Company of Canada Limited at Copper Cliff, Ontario. Some selenium is also recovered from scrap left over in the manufacture of rectifiers and from old rectifiers. Production in 1957 amounted to some 321,392 pounds compared with 330,389 pounds in 1956. Production of refined selenium was lower in 1957, at 332,011 pounds.

Canadian Copper Refiners Limited, a subsidiary of Noranda Mines Limited, operates the largest selenium metal-and-salts plant in the world. This plant adjoins its large copper refinery. Production of selenium commenced in 1933 and has been continuous since; the plant now has a rated annual capacity of 450,000 pounds of selenium and a wide range of selenium compounds. The selenium originates from copper anodes produced at the Noranda and Murdochville smelters in Quebec plus blister copper from the Flin Flon, Manitoba, smelter. In addition to commercial selenium (99.5% Se) and high-purity selenium (99.99% Se), selenium dioxide (71% Se), sodium selenate (41% Se), sodium selenite (45% Se) and ferroselenium (55-57% Se) are produced.

From the treatment of nickel-copper ores of the Sudbury area, The International Nickel Company of Canada Limited recovers selenium in the form of a minus 200 mesh, 99.7-per-cent powder at its refinery adjacent to its copper refinery at Copper Cliff, Ontario. The plant, which commenced production in 1931, has a rated capacity of 270,000 pounds of selenium a year.

Consumption and Uses

The major single use of selenium is in the manufacture of dry-plate rectifiers and other electronic equipment. High-purity selenium is used for this purpose. Applications for rectifiers include radios, television sets, battery chargers, electroplating equipment, magnetic brakes and circuit breakers. Some of the advantages of selenium rectifiers are their high efficiency, small size and weight, ruggedness and long life. Technical advantages and other considerations have brought forth serious and increasing competition from silicon and germanium. For large, fixed, power applications, Selenium - Production, Exports and Consumption

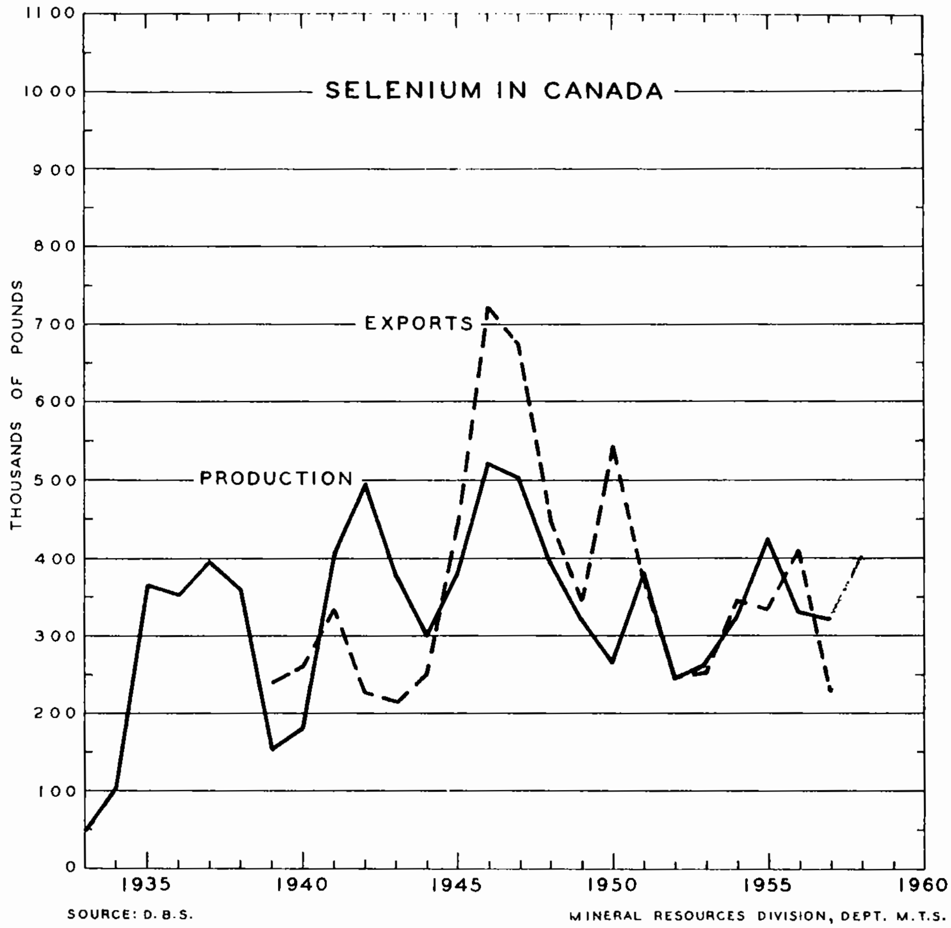
	1957		1956	
	Pounds	$	Pounds	$
Production[1]				
Quebec	168,290	1,851,190	117,555	1,586,993
Ontario	86,459	951,049	109,156	1,473,606
Saskatchewan and Manitoba ...	66,643	733,073	103,678	1,399,653
Total	321,392	3,535,312	330,389	4,460,252
Production				
Refined[2]	332,011		355,024	
Exports, metal and salts				
United States	134,561	1,421,117	228,348	3,395,348
United Kingdom	90,525	1,262,860	169,857	2,573,205
Italy	1,050	15,750	1,663	52,380
India	714	18,231	44	1,295
Other countries	1,201	21,062	9,817	320,520
Total	228,051	2,739,020	409,729	6,342,748
Consumption, approximate, by industries (selenium content)				
Glass	7,885		8,090	
Electronics	3,433		14,072	
Rubber	2,835		4,963	
Agriculture	16		104	
Alloy steel	1,403		4,440	
Total	15,572		31,669	

(1) Recoverable selenium content of blister copper produced from domestic ores, plus some refined selenium.
(2) Refined-selenium production, including production from scrap.

Production, Exports and Consumption, 1947-57

	Production		Exports	Consumption[c]
	All Forms[a]	Refined[b]	Metals and Salts	
	Pounds	Pounds	Pounds	Pounds
1947	501,090	496,756	673,588	2,380
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

(a) Recoverable selenium content of blister copper produced from domestic ores, plus some refined selenium.
(b) Refined selenium production, including production from scrap.
(c) Producers' domestic shipments of selenium products.



germanium rectifiers are being substituted for selenium rectifiers. Silicon is replacing selenium rectifier plates where high-temperature conditions prevail. Other uses of high-purity selenium are in the manufacture of photoelectric cells and in xerography, a dry-print photographic process employing selenium-coated metal disks from which the photographic image is transferred by static electricity.

Commercial-grade selenium powder is used to neutralize the green colour imparted to container glass by iron impurities in the glass batch. Selenium is also added to glass to produce ruby-coloured material required for signal lenses for railway and marine use and for decorative tableware. Commercial-purity selenium powder is also used in the pigment, rubber and pharmaceutical industries. The pigment industry uses selenium to provide colours ranging from intense orange to dark maroon, for applications such as coloured glaze for chinaware, pottery, plastics, vitreous-enamel cover coats and printing inks for glass containers. In the rubber industry, selenium is used to increase the rate of vulcanization and to increase resistance to heat, oxidation and abrasion. The pharmaceutical industry employs selenium in the preparation of selenium sulphides which are said to control dermatitis of the scalp in humans and of the skins of animals.

Sodium selenate is employed as a soil additive in commercial greenhouses to repel spiders and insects that prey upon certain flowers. Sodium selenite is used to produce brown tones in photographic prints and dyes.

Ferroselenium is added to certain grades of stainless steels to improve machinability without affecting the corrosion resistance and the cold-working and hot-forging properties. It is also used for the same purpose in certain copper alloys.

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, Montreal, Quebec; Atlas Steels Limited, Welland, Ontario; Shawinigan Chemicals Limited, Shawinigan Falls, 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, 1957, at $12 a pound and high-purity selenium at $15 a pound. These respective grades were reduced to $10.50 and $13.50 a pound on May 28, 1957, and further cut to $7.50 and $10.50 a pound on November 18, 1957. Ferroselenium was reduced from $11.25 to $8 a pound at the same time.

SILVER

by
D.B. Fraser

Silver production continued to increase during 1957 and rose to 28,823,298 troy ounces from the 28,431,847 troy ounces produced in the previous year. The increase resulted mainly from the entry into production of base-metal mines in Ontario and New Brunswick and from expanded output from Newfoundland. The decline in Quebec production resulted from the closing of mines and from production cutbacks brought on by low base-metal prices.

Sixty per cent of the output was derived from lead-zinc and silver-lead-zinc ores, most of which were mined in British Columbia and Yukon. Twenty-three per cent came from copper, copper-zinc and nickel-copper ores, 15 per cent from the silver-cobalt ores of northern Ontario, and the remainder from lode and placer gold operations.

Fine silver was produced by The Consolidated Mining and Smelting Company of Canada Limited, 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 1957 was an estimated 228,700,000 ounces. Mexico, with 47 million ounces, was again the leading producer, followed by the United States, with 36,279,000 ounces, Canada, with its 28,823,298 ounces, was in third place.

Developments at Producing Mines*

Yukon

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 5,694,850 ounces in the fiscal year ended September 30, 1957, the average recovery amounting to 35.6 ounces per ton milled. Mill feed totalling 159,885 tons was derived mainly from the Hector and Calumet mines; a small amount originated in the development work in the Elsa mine.

* See map on page 189.

Silver - Production and Trade

	1957		1956	
	Ounces	$	Ounces	$
Production				
By provinces				
British Columbia and				
Alberta	8,585,030	7,500,741	8,801,412	7,893,106
Ontario	6,910,130	6,037,381	6,626,447	5,942,597
Yukon	6,484,185	5,665,232	6,192,706	5,553,619
Quebec	3,645,856	3,185,384	4,063,966	3,644,565
Manitoba and				
Saskatchewan	1,553,405	1,357,210	1,609,234	1,443,161
Newfoundland	1,196,414	1,045,307	957,125	858,350
Nova Scotia and				
New Brunswick*	69,104	60,376	111,041	99,582
Northwest Territories .	379,174	331,284	69,916	62,701
Total.................	28,823,298	25,182,915	28,431,847	25,497,681
Refined silver	20,004,360		21,599,798	
By sources				
Base-metal ores	23,842,036		23,071,468	
Gold ores	648,862		623,935	
Silver-cobalt ores				
and silver ores	4,316,480		4,721,556	
Placer gold operations .	15,920		14,888	
Total.................	28,823,298		28,431,847	
Imports				
Unmanufactured				
United States	1,856,377	1,630,621	1,006,590	898,454
United Kingdom	2,754	2,428	3,590	3,236
Total.................	1,859,131	1,633,049	1,010,180	901,690
Manufactured				
United Kingdom		415,538		450,796
United States		186,059		203,930
Denmark		35,191		64,755
West Germany		26,530		21,378
Other countries		19,625		31,171
Total.................		682,943		772,030

Silver - Production and Trade (cont'd)

	1957		1956	
	Ounces	$	Ounces	$
Exports				
In ore and concentrates				
United States	5,374,362	4,440,106	6,475,439	5,479,732
Belgium	296,431	249,933	278,862	243,024
West Germany	223,342	188,460	170,113	148,682
Mexico	85,324	64,655	-	-
Total	5,979,459	4,943,154	6,924,414	5,871,438
Silver bullion				
United States	12,078,820	11,038,340	13,363,996	11,943,229
West Germany	721,170	653,123	827,009	746,360
United Kingdom	-	-	150,748	131,806
Total	12,799,990	11,691,463	14,341,753	12,821,395
Manufactured				
United States		28,154		29,921
Other countries		4,208		4,267
Total		32,362		34,188

* Nova Scotia's production in 1956 was 92,859 ounces. With the closure of the Stirling mine of Mindamar Metals Corporation Limited in April 1956, Nova Scotia's 1957 production dropped to 1 ounce, derived from gold ore.

Silver - Production, Trade and Consumption, 1947-57
(ounces)

	Production		Exports			Imports	Consumption[(b)]
	All Forms[(a)]	Fine Silver	In Ore and Concentrates	In Bullion	Total	Unmanufactured	
1947	12,504,018	10,171,396	2,722,261	7,514,373	10,236,634	71,499	4,202,671
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	30,050,306	20,004,360	5,979,459	12,799,990	18,779,449	1,859,131	10,730,255

(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

Milling at Galkeno Mines Limited, adjoining United Keno Hill's Galena Hill properties, was suspended in September owing to low lead and zinc prices and unfavourable mining conditions.

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 10,877,532 ounces from lead-zinc smelting and refining operations at Trail. Much of the total was derived from domestic and foreign custom ores and concentrates, the principal custom shippers being in British Columbia and Yukon. The company operated four base-metal mines during the year, one of which, Tulsequah Mines Limited, in northwestern British Columbia, was closed in August owing to low base-metal prices. The Sullivan mine at Kimberley is the principal source of silver produced from company-owned mines.

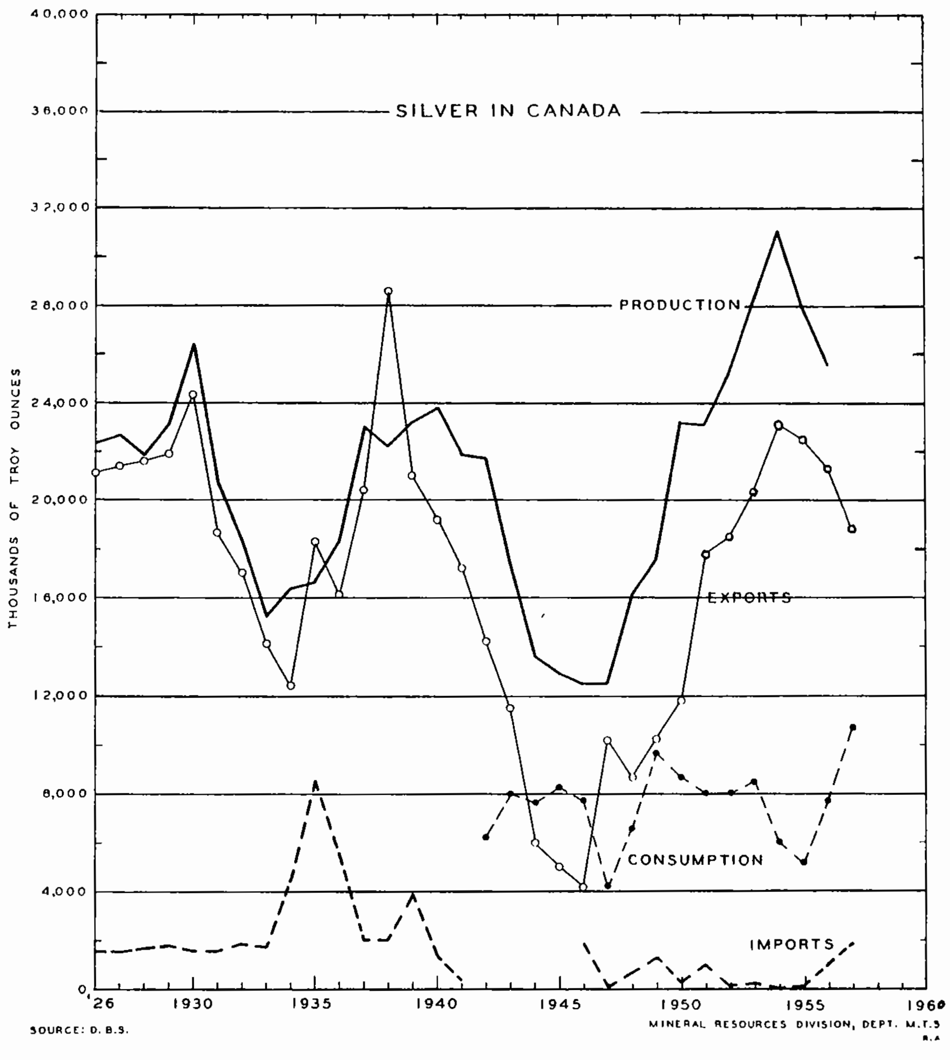
Torbrit Silver Mines Limited, milled 154,419 tons of ore from its silver-lead mine near Alice Arm, from which were produced 1,674,166 ounces of silver in concentrates and bullion. Ore reserves at the end of 1957 were 75,208 tons grading 13.7 ounces of silver per ton.

Highland-Bell Limited, at Beaverdell, milled 15,779 tons of silver-lead-zinc ore and recovered 716,546 ounces of silver in lead and zinc concentrates. The daily tonnage of ore treated for the last six months of the year was increased from 55 to 75.

Other important producers were Silver Standard Mines Limited, near Hazelton; ViolaMac Mines Limited in the Slocan district; Sunshine Lardeau Mines Ltd. at Camborne; Western Exploration Co. Ltd. at Silverton; Yale Lead and Zinc Mines Limited at Ainsworth; and Sheep Creek Mines Limited near Invermere. Giant Mascot Mines Limited near Spillimacheen ceased operations in June, when its Silver Giant lead-zinc deposit was mined out.

Some production was obtained from two large copper mines, The Granby Consolidated Mining, Smelting and Power Company Limited, near Princeton, which was closed in April, when ore was exhausted, and Britannia Mining and Smelting Company Ltd. The latter operated continuously through 1957 but closed in March 1958 owing to low copper and zinc prices.

The rest of the output was made up of shipments from small base-metal producers and by-product silver from lode gold operations.


SILVER IN CANADA
40,000
36,000
32,000
28,000
24,000
20,000
16,000
12,000
8,000
4,000
0
THOUSANDS OF TROY OUNCES
PRODUCTION
EXPORTS
CONSUMPTION
IMPORTS
'26
1930
1935
1940
1945
1950
1955
1960
SOURCE: D.B.S.
MINERAL RESOURCES DIVISION, DEPT. M.T.S.

Silver

Manitoba and Saskatchewan

Most of the output is derived from the copper-zinc mines of the Flin Flon area, operated by Hudson Bay Mining and Smelting Co. Limited, which produced 1,543,732 ounces of silver contained in blister copper. The remainder is a by-product of operations of Sherritt Gordon Mines Limited at Lynn Lake in northern Manitoba and of gold mines at Snow Lake and Rice Lake.

Ontario

About 65 per cent of the province's output comes from the mines of the Cobalt-Gowganda area. The principal producers were Siscoe Metals of Ontario Limited; Silver-Miller Mines Limited; Castle-Trethewey Mines Limited; Langis Silver & Cobalt Mining Company, Limited; Nipissing-O'Brien Mines Limited; and Cobalt Consolidated Mining Corporation Limited. Practically all the products of these mines were shipped to the refinery of Deloro Smelting and Refining Co. Ltd., at Deloro, Ontario.

The International Nickel Company of Canada Limited, at Copper Cliff, recovered 1,450,000 ounces of silver from the treatment of nickel-copper ores.

Two new copper-zinc producers, Geco Mines, Limited, and Willroy Mines, Limited, at Manitouwadge commenced production during the latter part of the year. The Manitouwadge reserves grade from 1 3/4 ounces to 2 1/3 ounces of silver per ton. The rated capacity of the Geco mill is 3,300 tons a day, and of the Willroy, 1,000 tons.

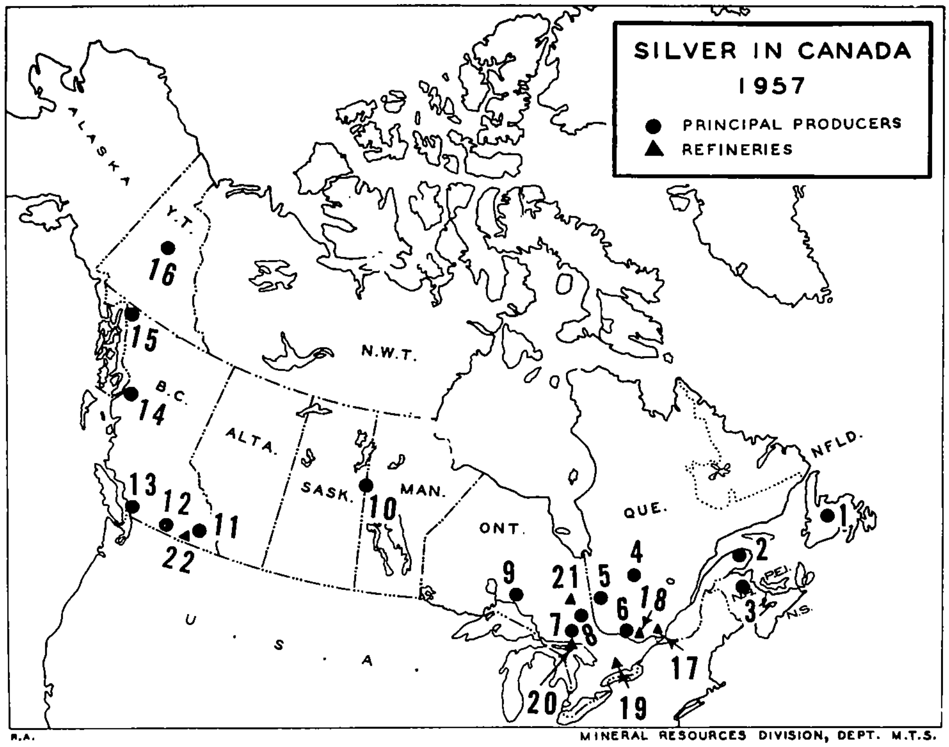
The rest of the production came from Jardun Mines Limited near Sault Ste. Marie, which was closed in April and from Falconbridge Nickel Mines Limited, Coldstream Copper Mines, Limited, and numerous lode-gold mines.

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.

Silver is contained in the blister copper of Gaspe Copper Mines Ltd., from which it is recovered by Canadian Copper Refiners at Montreal East, and in lead and zinc concentrates from several mines, which are shipped abroad for refining.

The principal producers in 1957 were Noranda Mines, Limited; Golden Manitou Mines Limited; Normetal Mining Corporation, Limited; Quemont Mining Corporation Limited; Barvue Mines Limited, which ceased operations in September; New Calumet Mines Limited, which reduced its milling rate by



Producers

1. Buchans Mining Co. Ltd.
2. Gaspe Copper Mines Ltd.
3. Heath Steele Mines Ltd.
4. Campbell Chibougamau Mines Ltd.
   Opemiska Copper Mines (Quebec) Ltd.
5. Barvue Mines Ltd.
   Golden Manitou Mines Ltd.
   East Sullivan Mines, Ltd.
   Noranda Mines, Ltd.
   Quemont Mining Corp. Ltd.
   Waite Amulet Mines Ltd.
   Normetal Mining Corp., Ltd.
6. New Calumet Mines Ltd.
7. Silver-Miller Mines Ltd.
   Cobalt Consolidated Mining Corp. Ltd.
   Nipissing-O'Brien Mines Ltd.
   Langis Silver & Cobalt Mining Co. Ltd.
   Castle-Trethewey Mines Ltd.
   Siscoe Metals of Ontario Ltd.
8. International Nickel Co. of Canada Ltd., The
   Falconbridge Nickel Mines Ltd.
9. Geco Mines, Ltd.
   Willroy Mines, Ltd.
10. Hudson Bay Mining and Smelting Co. Ltd.
11. Consolidated Mining and Smelting Co. of Canada, Ltd., The (Bluebell and Sullivan mines)
    Giant Mascot Mines Ltd.
    Sunshine Lardeau Mines Ltd.
    ViolaMac Mines Ltd.
    Yale Lead and Zinc Mines Ltd.
12. Highland-Bell Ltd.
    Granby Consolidated Mining, Smelting and Power Co. Ltd., The
13. Britannia Mining and Smelting Co. Ltd.
14. Silver Standard Mines Ltd.
    Torbrit Silver Mines Ltd.
15. Tulsequah Mines Ltd.
16. United Keno Hill Mines Ltd.
    Galkeno Mines Ltd.

Refineries

17. Canadian Copper Refiners Ltd.
18. Royal Canadian Mint
19. Deloro Smelting and Refining Co. Ltd.
20. International Nickel Co. of Canada Ltd., The
21. Hollinger Consolidated Gold Mines, Ltd.
22. Consolidated Mining and Smelting Co. of Canada Ltd., The

38 per cent in September; Gaspe Copper Mines Ltd.; East Sullivan Mines, Limited; Waite Amulet Mines Limited; Campbell Chibougamau Mines Ltd.; and Opemiska Copper Mines (Quebec) Limited.

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, opened a 1,500-ton mill near Newcastle in February and recovered by-product silver in base-metal concentrates that were shipped abroad for refining. The mill operated on a break-in basis throughout the year. In March 1958, owing to low metal prices, the scale of operations was reduced to less than one third of capacity.

Newfoundland

Buchans Mining Company Limited produced silver contained in base-metal concentrates which were exported for treatment.

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 sunk to 487 feet and surface plant construction was completed. This deposit, discovered and diamond-drilled during 1956, contains 3,832,400 tons grading 1.96 ounces of silver per ton.

Ontario

Consolidated Sudbury Basin Mines, Limited, brought its base-metal properties near Sudbury to the production stage. All work was suspended in September owing to low base-metal prices. Reserves are over 17 million tons averaging 1.58 ounces of silver per ton.

Quebec

The Coniagas Mines Limited continued development of a zinc-silver-lead deposit at Bachelor Lake. The shaft, originally scheduled to bottom at 850 feet, was deepened to 1,350 feet, and exploratory drilling was carried out at the 1,000-foot horizon, where new ore was located.

The Mattagami Syndicate began a diamond-drilling program near Watson Lake, about 100 miles north of Senneterre. About 21,000 feet of drilling was completed by the end of 1957 and a large zinc-copper deposit containing silver was outlined.

New Brunswick

Brunswick Mining and Smelting Corporation Limited continued to develop its zinc-lead-copper deposits near Bathurst, which contain more than 57 million tons averaging 1.8 ounces of silver per ton. A commercial flotation process was developed and plans were made for production on an initial scale of 2,000 tons a day. Development was suspended in March 1958 owing to the unfavourable base-metals market.

Nigadoo Mines Limited continued detailed exploration of a base-metal orebody 11 miles northwest of Bathurst and carried on the sinking of a 965-foot shaft.

Anacon Lead Mines Limited and Sturgeon River Mines Limited suspended underground development of base-metal properties in the Bathurst area.

Domestic Consumption

Owing to a large increase in the minting of coins, there was a sharp rise in the use of silver in Canada in 1957.

Consumption of Silver

	1957 (fine ounces)	1956 (fine ounces)
Coinage	4,886,118	2,505,131
Silverware	1,896,116	1,972,053
Plating	1,662,213	1,347,698
Photography	1,493,484	1,174,427
Wire and rod	224,536	199,079
Grain	120,301	-
Brazing alloys	80,779	107,763
Lead-silver alloys	9,258	14,363
Sheet	638	2,954
Miscellaneous	356,812	387,457
Total	10,730,255	7,710,925

Prices

The Canadian price of silver was 88 cents an ounce at the beginning of 1957 and decreased progressively to 85.88 cents an ounce in July. Subsequently the price increased, and at year-end was 88.50 cents. The average price for the year, as computed by the Dominion Bureau of Statistics, was 87.33 cents.

TELLURIUM

by

R. J. Jones

Tellurium is recovered from the anode slime produced during the electrolytic refining of copper and lead. It also occurs in gold and silver ores but is not recovered from these sources.

Canadian production of tellurium is derived from the refining of copper by The International Nickel Company of Canada Limited at Copper Cliff, Ontario, and by Canadian Copper Refiners Limited, Montreal East, Quebec.

International Nickel Company's sources of tellurium are the copper-nickel ores of its deposits in the Sudbury area of Ontario. Canadian Copper Refiners obtains most of its tellurium from blister copper derived from copper-zinc ores of the Flin Flon mine on the Saskatchewan-Manitoba boundary and produced in the copper smelter of Hudson Bay Mining and Smelting Co. Limited, Flin Flon, Manitoba. Tellurium contained in anodes produced at the Noranda copper smelter from the treatment of Quebec copper ores is also recovered at the Montreal East refinery, and it is probable that some tellurium is recovered from anodes produced at the smelter of Gaspe Copper Mines Limited.

Because tellurium compounds, absorbed into the body through the skin and by the inhalation of dust and fumes, give the breath an odour of garlic, industry has shied away from the use of this substance. Tellurium is almost always in excess supply. If the labour problems connected with the handling of tellurium are solved, expanded uses and markets can be expected. Other world producers of tellurium are the United States, Australia, West Germany and Sweden.

As shown in the following graph and tables, 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.

Consumption and Uses

The rubber industry probably provides the largest single outlet for tellurium. It is added as a secondary vulcanizing agent to natural rubber and to GR-S (synthetic) to increase the rate of vulcanization and resistance to abrasion and heat and to improve the aging and mechanical properties. Rubber containing tellurium is used in portable rubber-covered cables for mining, dredging and welding units, and also in conveyor belts for special applications.

Tellurium - Production and Consumption

	1957		1956	
	Pounds	$	Pounds	$
Production (all forms)(1)				
Manitoba and Saskatchewan ...	1,681	2,942	1,562	2,733
Quebec	22,928	40,124	-	-
Ontario	6,915	12,101	6,305	11,034
Total	31,524	55,167	7,867	13,767
Production				
Refined	34,895		15,915	
Consumption(2)	6,770		8,500	

(1) Recoverable tellurium in blister copper produced from domestic ores.
(2) Producers' domestic shipments.

Summary of Production, 1947-57

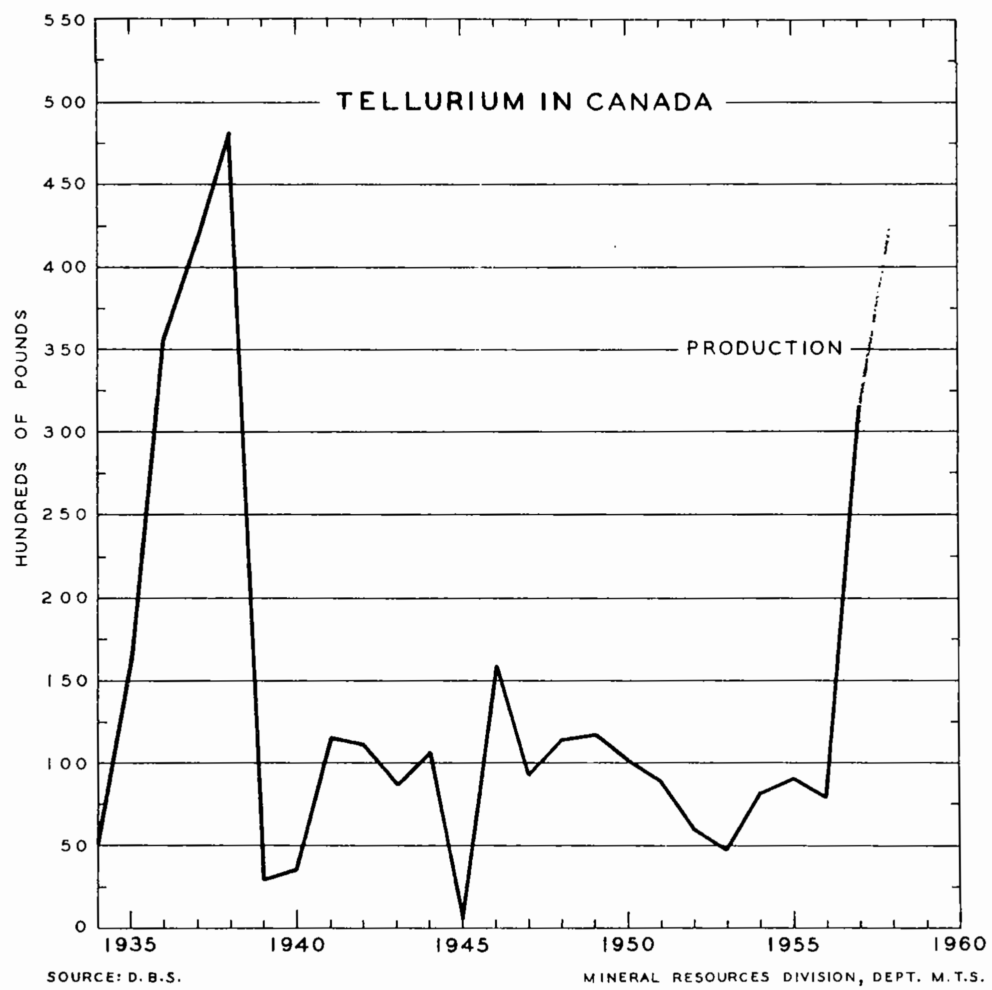
	Production (all forms)*	Production (refined)
	Pounds	Pounds
1947	9,194	6,169
1948	11,425	8,739
1949	11,692	8,726
1950	10,075	6,010
1951	8,913	6,301
1952	6,035	5,710
1953	4,694	17,295
1954	8,171	7,990
1955	9,014	6,516
1956	7,867	15,915
1957	31,524	34,895

* Recoverable tellurium in blister copper produced from domestic ores.

Tellurium is added to copper to form a 99.5-per-cent-copper and 0.5-per-cent-tellurium alloy. The electrical and thermal conductivity and machinability of this alloy are very good: they make it suitable for the mass production of electrical connectors in the electrical, radio and television industries. It is also used in welding and cutting tips.

Less than 0.1 per cent tellurium is added to certain iron castings to control the depth of chill in order to produce a hard, abrasion-resistant surface.

Tellurium



Tellurium is added to lead to increase corrosion resistance and hardness. This alloy has wide application in the lining of tanks and pipes used for sulphuric acid. An alloy of tellurium and lead is sometimes used in the manufacture of submarine-cable sheathing.

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.

Prices

During 1957 the price of tellurium in the United States was quoted by E & M J Metal and Mineral Markets at $1. 50 to $1. 75 a pound at the beginning of the year, and at $1. 65 to $1. 75 a pound during the second half of the year.

TIN

by
H. D. Worden

Canada's sole production of tin is derived from accessory minerals extracted from mill tails in the treatment of zinc-lead-silver ore from the Sullivan mine. The plant, located in southeastern British Columbia, is operated by The Consolidated Mining and Smelting Company of Canada Limited, which in 1942 commenced tin recovery in its beneficiation plant. Production of tin in concentrates ranged from 553* tons in 1942 to 93 tons in 1949. During 1957 the combined tin content of tin in concentrates and tin in tin-lead alloy reached 317 tons, valued at $580,342. This is 21 tons less than in 1956.

Canadian Occurrences

Cassiterite, a tin-oxide mineral, is the principal source of tin, and stannite, a complex sulphide containing tin and copper, ranks second as a source. Although no economic deposits of these minerals have been found in Canada, mineralogical occurrences of cassiterite are widespread. Cassiterite resists weathering well and is seven times heavier than water, and these properties have contributed to large foreign resources in alluvial and eluvial deposits. The predominance of such deposits, however, does not preclude the importance of lode deposits, all of which are invariably associated with granitic intrusions.

Near New Ross in Lunenburg county, Nova Scotia, tin occurs in veins of greisen and quartz in muscovite granite. The occurrence has been known since 1906, but exploration has been disappointing. This year, however, geochemical methods of soil analysis are being used to explore overburdened areas surrounding the original outcrop discoveries, and the added information about mineralization may encourage further work. In New Brunswick, assays of tin have been obtained from sulphide orebodies near Bathurst; and in the Canadian Shield, a number of cassiterite occurrences have been examined in northern Ontario and in southeastern Manitoba.

World Production and Trade

World production of tin in concentrates declined by approximately 1,000 tons, or 1 per cent of the previous year's figures, owing to decreased output in the two principal producing countries - Malaya and Indonesia. The smaller tonnage from Malayan mines was due to dwindling ore reserves brought about by terrorist activities which prevented prospecting and exploration in the jungle

* Tons refer to long tons of 2,240 pounds.

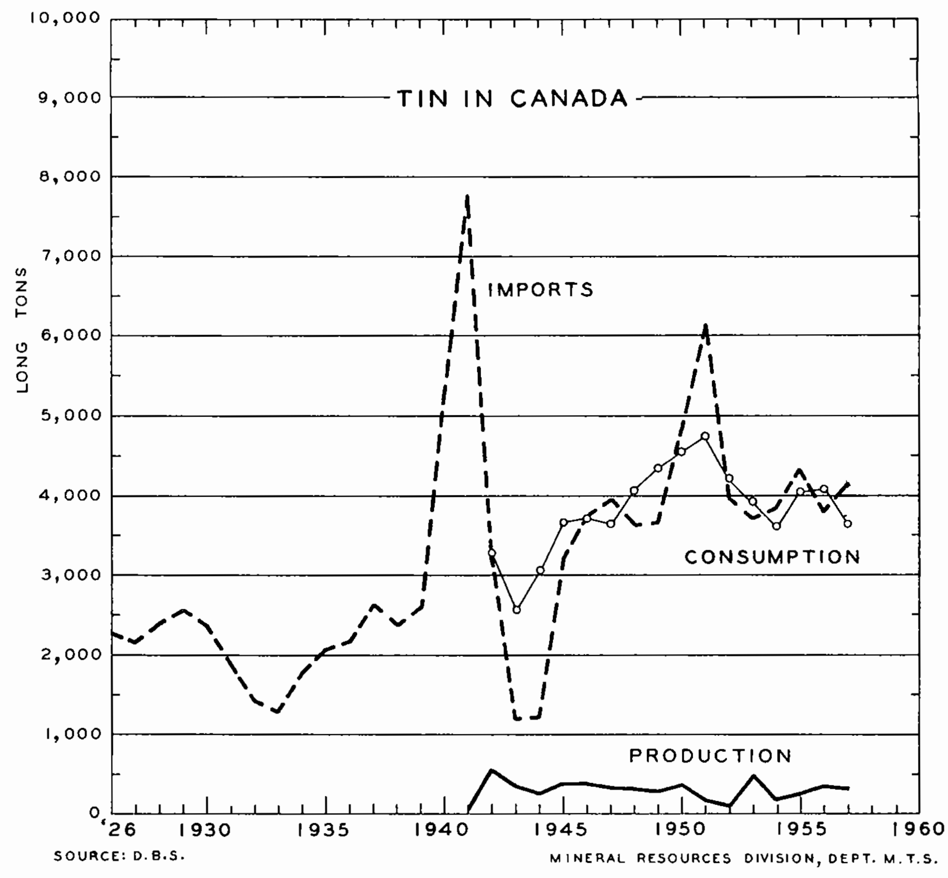
Tin - Production, Imports and Consumption

	1957		1956	
	Long Tons	$	Long Tons	$
Production				
(tin content of tin concentrates shipped and tin content of lead-tin alloy produced).........	317	580,342	338	670,441
Imports				
Blocks, pigs, bars				
Malaya...................	1,510	3,098,599	1,410	2,981,229
Belgium..................	1,059	2,170,851	1,210	2,634,832
Netherlands	680	1,390,987	369	812,941
United States..............	463	978,809	352	806,849
United Kingdom	342	704,204	424	936,951
West Germany	101	195,291	-	-
Portugal..................	-	-	9	21,565
Total.....................	4,155	8,538,741	3,774	8,194,367
Tin plate				
United Kingdom	3,486	730,667	3,106	653,385
United States..............	1,398	314,882	311	111,295
Total.....................	4,884	1,045,549	3,417	764,680
	Pounds		Pounds	
Tin foil				
United States	15,031	15,488	15,291	17,517
United Kingdom	1,229	1,092	178	126
Total.....................	16,260	16,580	15,469	17,643
Babbitt metal				
United States	32,600	27,321	35,600	29,306
United Kingdom	4,500	2,773	4,500	2,868
Total.....................	37,100	30,094	40,100	32,174
	Long Tons		Long Tons	
Consumption				
(virgin tin)				
Tin plate	1,275		1,396	
Tinning	559		625	
Solder	1,268		1,428	
Babbitt...................	248		276	
Bronze...................	157		222	
Foil......................	13		15	
Collapsible tubes..........	12		11	
Galvanizing...............	14		17	
Other Uses	76		95	
Total.....................	3,622		4,085	

Tin - Production, Imports and Consumption, 1947-57
(long tons)

	Production*	Imports				Consumption
		Blocks, Pigs, Bars	Tin Foil	Babbitt Metal	Tin Plate	Virgin Tin
1947	319	3,961	4	33	62,594	3,628
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	3,903
1954	149	3,836	13	12	9,116	3,604
1955	220	4,318	15	19	9,915	4,019
1956	338	3,774	7	18	3,417	4,085
1957	317	4,155	7	17	4,884	3,622

* Tin metal was produced from 1947 to 1952 inclusive. Beginning 1953 tin production includes the tin content in tin concentrates and tin in tin-lead alloy. No tin metal has been produced since 1952.



Tin Traffic during 1957 in Long Tons*

	Production		Exports	Consumption
	Mine (tin in concentrates)	Smelter (metal)	(tin in concentrates)	(metal)
Malaya	59,293	71,289	59,632	72
Indonesia	27,723	600	27,375	480
Bolivia	27,796	328	27,530	-
Belgian Congo	14,281	2,651	11,819	-
Thailand	13,531	-	13,345	180
Nigeria	9,612	-	10,006	-
China (mainland)	16,000(e)	16,000(e)		4,800(e)
United Kingdom	1,028	34,174		21,787
Netherlands	-	29,259		2,759
Belgium	-	9,869		2,209
Canada	317	-		3,622
United States	-	1,564		54,429
Japan	945	1,261		8,270
Portugal	1,127	1,359	101	360
Australia	2,100	1,806	137	2,633
Rest of world	6,247	4,840		53,399
Total,world**	180,000	175,000		155,000

* Published by International Tin Council.
** Excludes U.S.S.R.
(e)Estimated.

country. As a result, about half of the small tin-dredging mines, which operate on high-grade deposits, have had to close. Handicaps also prevailed in Indonesia, where labour and financial difficulties kept production uncertain, and civil strife aggravated the deteriorating production conditions.

Bolivian tin production in 1957 increased by about 1,000 tons to 27,800 despite reports of declining mine conditions which began when the nationalized Corporación Minera de Bolivia took over tin-mine management in 1952. The situation has been investigated by foreign consultants who attribute the deterioration of Bolivian tin mines to worn-out machinery, low-grade deposits, inefficient mining, and poor relations among labour, mine managers, investors and the government.

An outstanding problem is the country's social welfare law, which prevents dismissal of employees. This law has created large labour forces without proportionate increases in production, with the result that monetary inflation has reached more than 10,000 bolivianos for one United States dollar at the free rate of exchange.

Countries which produced smaller amounts of tin, in general increased 1957 production slightly, and where the associated minerals, columbite and wolframite, are produced, as in Nigeria and Burma respectively, these countries may continue mining at a relatively high level.

Tin-smelting in 1957 was subject to important adjustments. Early in the year the United States Government discontinued smelting Bolivian ores and stockpiling tin. To meet the situation, European smelters operated at increased capacities to handle the additional ore. Another change in smelting practice was imminent at year-end as the remodelled Texas City smelter prepared to treat United States requirements of Banka brand Indonesian tin.

This year's surplus world tin stocks have been created by the addition of 17,000 tons which in former years were absorbed in stockpiling by the United States Government. The surplus has been bolstered by a registered brand of tin from the Novosibirski Olovo Zavod in Siberia. The situation emphasizes the difficulties of international production control when countries that are not parties to the International Tin Agreement become important producers. The problem is real since metal production is currently more than 20,000 tons greater than consumption.

Consumption of tin decreased by 6,041 tons in the United States, while in Europe it increased by 1,635 tons. On each continent, fluctuations in tinplate production accounted for most of the change. Although the United States steel plants are geared for expanded production of electrolytic and hot-dipped tinplate, tonnages declined in the face of decreased retail demands. A similar trend started in the final quarter of the year in the United Kingdom after the giant new Velindre tinplate mill of The Steel Company of Wales Ltd. commenced production at record rates.

Uses and Consumption

Dominion Foundries and Steel Limited and The Steel Company of Canada, Limited, at Hamilton, are the sole producers of tinplate in Canada. Both companies produce electrolytic and hot-dipped tinplate used by canning factories for packaging foods and beverages and by fabricators of kitchenware, hardware, industrial equipment, ornaments, etc. The fact that less tinplate was produced in 1957 than in the preceding two years reflects the use of substitutes in the packaging industry as fibre and plastic containers become popular for certain products. In this regard, it is notable that in the United States a large oil-packaging plant has contracted to use aluminum quart-size oil cans, and the success of this venture, which depends on the salvage value of used cans, could have a noticeable effect on tinplate consumption. In Europe a type of rigid aluminum can is being produced by an impact extrusion process which will no doubt replace a quantity of tinplate.

A decrease in the consumption of solder, which ranks with tinplate in volume of tin used, is indicative of general business conditions. Solder is used in numerous electrical appliances in the home and industry, including electronic and various communication systems and automatic instrument circuits. Large quantities are also used by plumbing trades in pipe- and roof-joining, and it is an important ingredient in machine bearings composed of tin, lead and copper. A new bearing alloy containing 20 per cent tin and 1 to 3 per cent copper, the remainder being of aluminum, is now in use. In this alloy, tin forms a reticular or continous structure within the aluminum, making a high-quality bearing surface. It has advantages in heavy mechanical units because the alloy is set in steel and can be installed in semi-finished form for boring in place.

Tinning, hot-dipping and wiping are important methods of applying tin to dairy and laboratory equipment as well as to many kitchenware articles to protect food from metallic contamination. Tin foil, in the form of wrapping, tubes and vials, is used in packaging medical, dental and chemical supplies. Tin chemicals are active ingredients in a variety of medicines and biocidal fungicides, and an organotin chemical added to vinyl plastics prevents discolouring and deterioration.

Principal Virgin-tin Consumers

Tinplate (electrolytic and hot-dip)

Dominion Foundries and Steel Limited, Hamilton, Ontario
The Steel Company of Canada, Limited, Hamilton, Ontario

Tinning

General Steel Wares Limited, Toronto, Ontario
Canadian Wire and Cable Company Limited, Toronto, Ontario
Northern Electric Company Limited, Lachine, Quebec
Phillips Electrical Company Limited, Brockville, Ontario
Canadian Pacific Railway Stores Department, Montreal, Quebec
Casavant Freres Ltée., St. Hyacinthe, Quebec

Solder

Federated Metals Canada Limited, Toronto, Ontario
The Canada Metal Company Limited, Toronto, Ontario
The Canada Metal Company Limited, Montreal, Quebec
Kester Solder Co. of Canada Ltd., Brantford, Ontario
Metals and Alloys Limited, Leaside, Ontario

Babbitt

The Canada Metal Company Limited, Toronto, Ontario
The Canada Metal Company Limited, Montreal, Quebec
Federated Metals Canada Limited, Toronto, Ontario

Bronze

Anaconda American Brass Limited, New Toronto, Ontario
Noranda Copper and Brass Limited, Montreal, Quebec
The Canada Metal Company Limited, Toronto, Ontario
McKay Smelters Limited, Eastview, Ontario

Foil

Canada Foils Limited, Toronto, Ontario

Collapsible containers

Sun Tube Corporation of Canada Ltd., Ottawa, Ontario

Markets

Uncertainty shrouded the tin markets in the first quarter of the year. The Suez Canal crisis resulted in longer shipping lanes. A 62-day smelter-labour strike in Malaya seemed to foreshadow scarcity, while saleable stockpiles in the United Kingdom (3,000 tons) and Canada (2,500 tons) had the opposite effect. Additional market concern was created by the Bolivian and Malayan governments voicing appeals to the International Tin Council (I. T. C.), governing body of the International Tin Agreement (I. T. A.), for higher tin prices in order to meet rising mining costs. The I. T. A. aims at maintaining reasonable tin prices for both producers and consumers, although from inception on July 2, 1956, until mid-1957 tin prices remained above the Agreement purchase level, with the result that consumers have had no buffer-stock protection against rising prices.

Consequently, when the I. T. C. granted the producers' demands for a higher floor price on March 20, it also meant that buffer stockpiling could begin earlier and so provide a measure of protection for consumers. The necessity for protecting the consumers was completely reversed by the end of 1957 as mounting supplies taxed all the resources of the I. T. C. to stem the flow of surplus tin. Producers were called upon for cash contributions, as specified in the I. T. A. This money was used by the I. T. A. Buffer Stock Manager to purchase excess tin for stockpiling. These purchases maintained floor prices on the London Metal Exchange for spot tin, but future-stock prices fluctuated as much as £46 below the floor price, and Singapore prices were uncontrollable.

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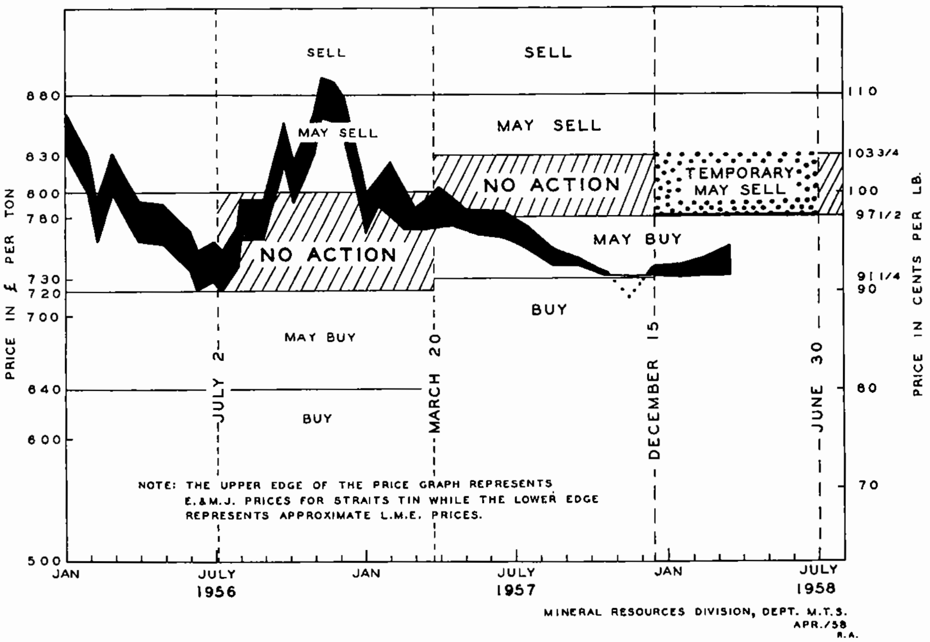
Under these circumstances the I. T. C. called an emergency meeting in December and allotted export quotas to the producing countries. These quotas, now in force, restrict normal exports by 40 per cent from December 15, 1957, to June 30, 1958. The effect of market conditions can be seen on the accompanying graph, which indicates the tin prices prevailing over the past two years. The outcome of I. T. C. controls will be felt by the industry during 1958.

I.T.A. PRICE CONTROL RANGES
REFERENCE FOR BUFFER STOCK MANAGER



Prices

Canada

The Canadian price of Straits tin f. o. b. Montreal in Canadian currency ranged between a low of 85. 52 cents a pound and a high of 99. 93 cents at the beginning of the year. The price at the year-end was 93. 59 cents a pound.

United States

The New York price for Straits tin ranged between a low of 88. 875 cents a pound and a high of 102. 750 cents. The price at the end of the year was 92. 625 cents.

Tariffs

Canada

Block, pigs, or bars for use in Canadian manufacture	free
Tin-strip waste and tin foil	free
Babbitt metal and type metal	
British preferential	10% ad valorem
Most favoured nation	20% ad valorem
General	20% ad valorem
Phosphor tin and phosphor bronze	
British preferential	5% ad valorem
Most favoured nation	7 1/2% ad valorem
General	10% ad valorem

United States

Tin ore, cassiterite, and black oxide of tin	free
Tin in bars, blocks or pigs, alloys which derive their value chiefly from tin not specially provided for, and grain or granulated and scrap tin, including scrap tinplate	free

TITANIUM

by

T. H. Janes

Since Canada's titanium industry is based almost entirely on the manufacture of titanium-dioxide slag for pigment manufacture, the curtailment in the United States defence purchase program of the metal has had no direct effect on the industry in this country. New records were established in 1957 for shipments of ilmenite ($FeTiO_3$) by Quebec Iron and Titanium Corporation (QIT) from Havre St. Pierre, Quebec, to the smelter site at Sorel, and in shipments of titanium-dioxide slag and remelt iron (Sorelmetal) from the smelter to the company's customers.

Canada's first plant for the manufacture of titanium-base pigments, that of Canadian Titanium Pigments Limited (CTP), a subsidiary of National Lead Company of the United States, was officially opened at Varennes, Quebec, on September 11. Its output will result in considerable reduction of Canadian imports of titanium-dioxide pigments, which have amounted to between 30,000 and 40,000 tons annually valued at from $10 million to $15 million.

Also in 1957, shipments amounting to approximately 15,000 gross tons of ilmenite, to be used as heavy aggregate in concrete for shielding nuclear reactors, were reported by QIT and Continental Iron and Titanium Mining Limited. Some finely ground ilmenite was sold for use as a weighting material (filler) in the coating applied to gas- and oil-transmission pipelines. Minor tonnages of ilmenite were shipped from the Baie St. Paul area of Quebec to manufacturers of ferrotitanium in the United States.

In the spring of 1957, the cutback in United States military requirements for titanium metal caused a serious decline in production and consumption for the rest of the year. The recently booming metal industry in that country was advised at the May 21 meeting of the Titanium Producers and Fabricators Industry Advisory Committee that military requirements for titanium over the next few years would be substantially below the 30,000 tons* a year estimated late in 1956. Toward the end of the year, sponge-metal manufacturers were operating at less than 50 per cent of capacity.

However, despite the cutback, production of sponge metal in the United States increased about 18 per cent, from 14,595 tons in 1956 to an estimated 17,249 tons in 1957. Sponge consumption was 25 per cent below that of 1956, much of the metal being delivered to the General Services Administration under United States Government contracts (10,577 short tons for the year).

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

Titanium - Production and Trade

	1957		1956	
	Short Tons	$	Short Tons	$
Production (shipments)				
Ilmenite				
Ore received at Sorel from Havre St. Pierre	813,662		627,901	
Ore shipped from St. Urbain area	10,770		2,296	
Total ore shipped	824,432		630,197	
Ore treated at Sorel	635,067		520,400	
Titanium dioxide slag produced from Allard Lake ilmenite at the Sorel smelter	258,920		218,575	
Titanium-dioxide content of slag	186,422	9,740,570	157,374	7,682,911
Exports				
Titanium-dioxide slag				
United States	185,032	7,855,779	184,571	6,547,077
Japan	26,390	1,265,916	11,202	396,078
Italy	11,201	438,958	5,822	187,128
Others	458	21,200	281	10,512
Total	223,081	9,581,853	201,876	7,140,795
Imports				
Titanium oxide and pigments containing not less than 14% titanium dioxide				
United States	22,875	6,070,811	28,035	8,637,934
United Kingdom	11,359	4,711,732	9,715	3,884,323
West Germany	330 (lb)	190	53	32,056
Others	534 (lb)	106	69	43,720
Total	34,234	10,782,839	37,872	12,598,033

Titanium

Production (shipments) of mill products during 1957 totalled 5,658 short tons as against 5,166 short tons the previous year. Thus, despite the accelerated let-down in the last half of 1957, the complete year's performance exceeded the previous record established in 1956.

In spite of the widespread interest and rapid growth in the titanium-metal production and fabricating industries, about 98 per cent of total world production of titanium-bearing minerals continues to be used in the titanium-dioxide pigment industry.

Summary information on the production of ilmenite and titanium-dioxide slag and on the imports of titanium pigments for the period 1947-57 is provided in the following table.

Production of Ilmenite and TiO_2, and Imports of Titanium Pigments, 1947-57

	Production		Imports
	Ilmenite(1)	Titanium-dioxide(2) Slag (TiO_2 content)	Titanium Oxide and Pigments(3)
	(short tons)	(short tons)	(short tons)
1947	7,104	-	13,656
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

(1) Ilmenite shipped from Allard Lake to Sorel and from St. Urbain area to customers.

(2) Titanium-dioxide content of titanium slag produced at Sorel from Allard Lake ilmenite. Slag contains approximately 70% TiO_2.

(3) Containing not less than 14% TiO_2.

Production and Development in Canada

Quebec Iron and Titanium Corporation

The Allard Lake ilmenite deposits are 22 miles north of Havre St. Pierre, the shipping point on the north shore of the Gulf of St. Lawrence 540 miles downriver from the smelter site at Sorel. They contain one of the largest known reserves of ilmenite in the world. This ilmenite is intergrown with hematite in orebodies consisting of dikes, irregular lenses or sill-like bodies lying within an anorthosite mass covering 134 acres. Reserves of about 150 million tons of ore, averaging 35 per cent titanium dioxide and 40 per cent iron, have been indicated by diamond-drilling. The largest orebody, located at Lac Tio, contains estimated reserves in excess of 125 million tons of ilmenite. These deposits are owned by Quebec Iron and Titanium Corporation, formed in October 1948, with Kennecott Copper Corporation holding a two-thirds interest and The New Jersey Zinc Company the remainder.

Following construction of a 28-mile railroad, wharves and terminal and harbour facilities, the first shipments of ore were made from Havre St. Pierre to Sorel in 1950.

At Sorel, the company built docks, unloading facilities and a large electric smelting plant containing five electric-arc ore-treatment furnaces, each designed to treat 300 tons of ore a day. The company began test operations with one furnace in 1950 and since then has carried out continuous studies of the process and operation of the furnaces.

Throughout 1957, all five original furnaces were in operation. A sixth and larger furnace, construction of which was started early in the year, was completed and put into operation in December. Ground was broken for two additional furnaces, which are scheduled to begin operation late in 1958. This is part of the expansion of facilities, begun early in 1957, to increase production of TiO_2 slag at the Sorel smelter by 60 per cent. The three new furnaces, with auxiliary equipment, are being built at a cost of more than $16 million.

Auxiliary installations completed at Sorel during 1957 included a new 50,000-kva transformer, a 600-foot extension of the dock with a combination loading and unloading tower, improvements in the slag-handling circuit from furnaces to stockpile and enlarged water-pumping capacity. At Havre St. Pierre, improvements were made to the ore-shipping terminal wharf.

Ore fed to the beneficiation plant at Sorel during 1957 averaged 34.2 per cent TiO_2 and 39.1 per cent iron. The ore was crushed and separated into two sizes -5/16" +20-mesh and -20-mesh. Upgrading of the respective fractions was accomplished in eight Dutch State Mine cyclones and 72 Humphreys spirals. The combined concentrates, analyzing about 37 per cent TiO_2 and 42 per cent iron, were calcined in rotary kilns to eliminate the sulphur. Electric smelting of this product, in arc furnaces with powdered anthracite coal, yielded a slag containing about 70.5 per cent TiO_2 and 14 per cent FeO and a low-phosphorus iron containing about 0.12 per cent sulphur and 2.25 per cent carbon. This remelt iron (Sorelmetal) was ladle-desulphurized to low-sulphur content and cast into pigs on two 2-strand casting machines.

Sized ore was sold during the year for use as heavy aggregate in concrete for nuclear reactors and as weighting material (filler) in the coating applied to oil- and gas-transmission pipelines. Tailings from the beneficiation plant were also sold for fluxing purposes in steel metallurgy.

Production figures for 1956 and 1957 are listed in the following table:

	Gross Tons	
	1957	1956
Ore shipped from Havre St. Pierre to Sorel	726,518	560,626
Ore smelted	560,049	420,308
TiO_2 slag produced	231,179	195,156
TiO_2 slag shipped	234,713	190,841
TiO_2 content of slag shipped	165,500	134,500
Desulphurized iron produced	167,437	142,745
Desulphurized iron shipped	169,397	140,221
High-sulphur iron shipped	-	3,119

Baie St. Paul Titanic Iron Company Limited

For some years this company has produced ilmenite from its holdings north of Baie St. Paul in Charlevoix county, about 60 miles downriver from Quebec City. From this St. Urbain region, 10,770 short tons were shipped to metallurgical works in the United States for the manufacture of ferrotitanium. In the previous year this amount was 2,296 tons.

Continental Iron and Titanium Mining Limited

This company, formed in 1955, holds several ilmenite properties in the St. Urbain region of Charlevoix county, a short distance north of Baie St. Paul. Approximately 10,000 long tons of ilmenite were shipped from the 'Furnace' deposit in 1957 to be used as heavy aggregate in concrete shielding of nuclear reactors in the United States. Picked samples of massive ore from the 'General Electric' deposit averaged 44.27 per cent TiO_2 and 31.80 per cent iron, with a 9.42-per-cent rutile content.

Canadian Titanium Pigments Limited

In July this company completed its Varennes plant, 15 miles from Montreal on the south shore of the St. Lawrence and 40 miles upriver from Sorel. By September, when the plant was officially opened, production had already started, inventories had been built up, and sufficient working inventories of TiO_2 pigments of both anatase and rutile grades of all types had been established.

Raw material for plant feed is TiO_2 slag from the Sorel smelter of QIT, crushed to -1/2 inch and brought to the Varennes plant of CTP by truck or rail. Sulphuric acid, the other main ingredient used in TiO_2 pigment manufacture, is made in the company's contact acid plant adjoining the pigment-processing plant. Plant capacity is rated at 18,000 tons of TiO_2 pigments a year, present output going to domestic producers of paints, paper, rubber, plastics, floor tile, linoleums, etc.

World Production of Titanium Ores and Concentrates

Even though titanium is estimated to be the ninth most abundant element in the earth's crust, only two titanium minerals - ilmenite and rutile - are considered to be of commercial importance. Ilmenite ($FeTiO_3$) theoretically contains a maximum of 53 per cent titanium dioxide, and rutile (TiO_2) ideally contains 100 per cent TiO_2. Sphene ($CaTiSiO_5$ - also called titanite), containing up to 41 per cent TiO_2, is mined in the Kola Peninsula of Russia.

Rutile has been preferred as the raw-material source for the manufacture of titanium metal, but it appears that the production and reserves of rutile will be inadequate to meet the growing demand for metal in the future. Therefore, any major expansion of the industry will probably be dependent upon the use of ilmenite (or titanium slag), of which there are large reserves in Canada and the United States.

The following tables show the production of rutile and ilmenite concentrates by the major producing countries in 1955 and 1956, and the consumption of titanium concentrates in the United States in 1956.

Production of Rutile Concentrates

	1957	1956
Australia	146,600	107,886
United States	10,702	11,997
Other countries	1,098	1,817
Total	158,400	121,700

Production of Ilmenite Concentrates

	1957	1956
United States	757,180	684,956
India	331,521	376,321
Canada*	269,690	220,885
Norway	231,693	209,990
Finland	116,568	113,444
Malaya	102,742	136,837
Other countries	115,706	49,567
Total	1,925,100	1,792,000

Source: United States Bureau of Mines, Minerals Yearbook, 1957.

* Production of slag containing about 70% TiO_2, plus ilmenite shipped as such.

Consumption* of Titanium Concentrates in the United States in 1957, 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)	832.3	429.0	114.2	80.9	-	-
Titanium metal	(3)	(3)	(4)	(4)	36.0	34.5
Welding-rod coatings	1.1	0.6	1.5	1.0	14.5	13.7
Alloys and carbide	7.3	4.5	(4)	(4)	0.6	0.6
Ceramics	0.02	0.01	-	-	0.4	0.3
Fiberglass	-	-	-	-	1.1	1.1
Miscellaneous(5)	0.02	0.01	0.8	0.6	0.8	0.7
Total	840.7	434.1	116.5	82.5	53.4	50.9

* United States Bureau of Mines, Minerals Yearbook, 1957.

(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 chemicals and experimental purposes.

Titanium-metal Production and Fabrication

Titanium is a low-density, silver-white metal. It owes its importance to a combination of lightness, strength and resistance to corrosion. Because of its high strength-weight ratio, titanium metal and alloys have special applications in the aircraft industry, particularly in jet aircraft and guided missiles. Owing to high corrosion resistance, it is expected that titanium metal will find increasing acceptance in the food-processing and chemical industries. The chief disadvantages are high cost, difficulties of fabrication and excessive reactivity at high temperatures. Although the melting point of titanium (3,020°F) is very high, it absorbs oxygen, nitrogen and hydrogen and becomes brittle with prolonged atmospheric exposure when its temperature is above 1,000°F.

There is no commercial production of titanium metal in Canada. Dominion Magnesium Limited, at Haley Station, Ontario, produces pilot-plant quantities of the metal from imported refined TiO_2. Shawinigan Chemicals Limited early in 1957 discontinued its research on the electrolytic production of titanium sponge. The Mines Branch, Ottawa, conducts investigations on various phases of titanium research from the processing of ores through to the production and fabrication of the metal and its alloys.

Commercial production and fabrication of titanium mill products and forgings from imported sponge and billets is carried out by several Canadian firms. These include the following companies: Atlas Titanium Limited, Welland; Vanadium Alloys Steel Canada Limited, London; Thompson Products Limited, Toronto; and Canadian Steel Improvement Limited, Welland.

The United States, which produced 14,500 tons in 1956, is by far the world's leading producer of titanium metal. Japan and the United Kingdom produced, respectively, an estimated 2,700 and 1,700 tons of the metal in that year. These three countries are the only ones producing titanium metal outside the Russian orbit.

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 paint pigment and in the manufacture of ceramics, cosmetics, food products, paper and rayon.

Consumption of Refined TiO_2, Extended TiO_2 Pigments, and Ferrotitanium in Canada

Material and End Use	1956	1955
	(short tons)	(short tons)
Refined titanium dioxide (TiO_2)		
Paints	12,725	11,637
Linoleum and oilcloth	2,287	2,047
Pulp and paper	1,549	1,640
Rubber goods	872	728
Polishes and dressings	150	147
Misc. non-metallic mineral products*	300	301
Extended TiO_2 pigments		
Paints	14,599	13,936
Estimated TiO content	4,380	4,180
Ferrotitanium		
Primary iron and steel	277	156

* Includes consumption for ceramic purposes.

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 ferrotitanium, 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 1957.

The E & M J Metal and Mineral Markets of December 26, 1957, quotes the following United States prices for titanium ores:

Ilmenite, per gross ton, 59.5% TiO_2, f.o.b. Atlantic Seaboard - $26.25 and $30.00.

Rutile, per lb, minimum 94% concentrate for delivery within 12 months - $120 to $125 per short ton. Price lower for more distant delivery.

Sponge Titanium

Further price reductions, effective June 1957 on titanium sponge, were announced by United States producers, as follows:

	Old Price $	New Price $
Per lb, Grade A - 1 sponge (max. 3% Fe)	2.75	2.25
Grade A - 2 sponge	2.50	2.00
A - 2 fines	2.25	2.00

Titanium sponge was first produced and marketed by E. J. du Pont de Nemours & Company, Incorporated, in 1948 at $5 per pound.

TUNGSTEN

by
R.J. Jones

World prices for tungsten concentrate continued the steady decline which began in 1951 when the price reached a high of 675 shillings per long-ton unit (22.4 pounds) of WO_3. Prices at the end of 1957 were quoted at 92 shillings 6 pence to 100 shillings per long-ton unit of WO_3, c.i.f. European ports, in the London market while foreign scheelite was quoted at $11 to $12 per short-ton unit of WO_3, c.i.f. United States ports, in the United States market. Prices at the beginning of the year were about $27.50 per short-ton unit. Present prices for tungsten are about at the level of those of the 1930's.

Canadian production of scheelite is derived from the Salmo, British Columbia, operations of Canadian Exploration Limited. Canadian shipments in 1957 amounted to 1,921,483 pounds of WO_3; in 1956 they amounted to 2,271,437 pounds. These shipments went to the United States stockpile.

Production

Canadian Exploration Limited

The tungsten orebody at the Emerald mine 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 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 General Services Administration of the United States Government that called for 570,000 short-ton units of WO_3 from 1952 to June 30, 1958, at a price grading from $60 to $55 a unit.

The company purchased the new mill from the Canadian Government. It also bought back the remaining ore reserves at the Emerald mine, the repurchase becoming effective on October 1, 1952. The mine and mill have been in continuous operation since then and mill capacity has been gradually increased to 700 tons a day, the flowsheet being changed to increase recovery and eliminate the necessity of shipping low-grade flotation concentrates to the United States for upgrading to contract specifications. During the eight-month period ended in April 1957, the recovery at the mill was over 79 per cent.

Tungsten - Production, Trade and Consumption

	1957 Pounds	1957 $	1956 Pounds	1956 $
Production (shipments)				
WO_3 content	1,921,483	5,279,275	2,271,437	6,362,368
Imports				
Scheelite(1)				
Bolivia	118,800	72,506	-	-
Korea	44,800	29,642	-	-
United States	44,900	34,831	92,000	126,951
Other countries	22,200	10,732	31,800	33,604
Total	230,700	147,711	123,800	160,555
Ferrotungsten(2)				
United Kingdom	165,600	114,367	194,500	262,864
United States	3,100	6,607	11,000	7,395
Sweden	1,500	1,479	-	-
Total	170,200	122,453	205,500	270,259
Exports				
Tungsten concentrate(1)				
United States	3,096,900	5,456,264	3,306,500	6,201,026
West Germany	-	-	8,500	6,000
Total	3,096,900	5,456,264	3,315,000	6,207,026
Consumption (W content)				
Scheelite	59,037		64,957	
Ferrotungsten	47,117		60,459	
Tungsten metal and tungsten metal powder	31,591		42,499	
Tungsten carbide and carbide powder	130,664		103,142	
Tungsten wire and miscellaneous(3)	9,563		13,261	
Total	277,972		284,318	

(1) WO_3 content not known.
(2) W content not known.
(3) 'Miscellaneous' includes tungsten chemicals.

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Tungsten - Production, Trade and Consumption, 1947-57

(pounds)

	Production(1)	Imports(2)		Exports(3)	Consumption(4)
		Tungsten Ores	Ferrotungsten	Scheelite	
	(WO_3 content)			(W content)	(W content)
1947	496,023	97,500	684,500		593,924
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

(1) Producers' shipments of scheelite.
(2) Gross weight: tungsten content not available.
(3) Export statistics for 1947-51 not available.
(4) Scheelite, ferrotungsten and other tungsten products reported by consumers. Prior to 1951, totals refer to tungsten content, ferrotungsten and scheelite only.

It is planned to continue shipments of high-grade scheelite from developed ore reserves when the General Services Administration contract has been fulfilled. Development work on a new orebody, the Invincible, has been suspended. Diamond-drilling has indicated possible reserves of 386,000 tons grading 0.83 per cent WO_3.

Domestic Refinery Production

A plant operated by a division of Kennametal Inc. at Port Coquitlam, British Columbia, produces tungsten carbide and tungsten powder directly from low-grade imported tungsten concentrates. No ferrotungsten is made in Canada.

World Mine Production

World production of tungsten ore and concentrate in 1957 amounted to 72,000 tons contained in 60 per cent WO_3 concentrates, according to the United States Bureau of Mines. China accounted for 22,000 tons, followed by the U.S.S.R. (8,300), the United States (5,520), Bolivia (4,809), Portugal (4,641), Korea (4,580) and Australia (2,605).

Production in 1957 in the United States, the largest producer in the Free World, decreased gradually from 70,000 short-ton units of WO_3 in January to about 25,000 short-ton units in December.

World production declined in 1957 because of low prices, declining demand and the termination of supply contracts with the United States Government. Australian and Canadian contracts are due to expire in 1958 and, with current low world prices, a large further reduction in world output can be expected.

As of December 31, 1957, deliveries of WO_3 to the General Services Administration totalled 2,996,280 short-ton units against a July 1, 1958, goal of 3 million short-ton units.

Consumption and Uses

Tungsten is utilized as scheelite, ferrotungsten and pure metal (powder, wire, rod, sheet) and in various chemical compounds such as the metatungstates. The greatest single use of tungsten is in the steel industry, where it is used in the form of scheelite or as ferrotungsten for the production of high-speed steel. The type most widely used (commonly known as the 18-4-1 type) contains 18 per cent tungsten, 4 per cent chromium and 1 per cent vanadium.

Tungsten carbide is used for tipping tools such as milling cutters, reamers, punches and drills; for dies in wire-and tube-drawing; for wear-resistant parts such as gauges, valve seats and valve guides; and as cores in armour-piercing shells.

In the non-ferrous 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-resisting 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.

The pure metal is used in ignition and other contact points in the automotive industry. It is also used for incandescent lamp filaments and in making certain types of bronze.

Stellite, a non-ferrous 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.

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Tungsten

The commercial applications of chemical compounds of tungsten are numerous. In some of the more important of these, such compounds are used in flameproofing combustible materials, in the dyeing industry, as catalysts and tanning agents and in making X-ray screens.

The more important consumers of tungsten in Canada are: Atlas Steels Limited; Canadian General Electric Company Limited; Shawinigan Chemicals Limited; A. C. Wickman Limited; Kennametal of Canada Limited; Deloro Smelting and Refining Co. Ltd.; Wheel Trueing Tool Company of Canada Limited; Boyles Bros. Drilling Company Limited; J. K. Smit and Sons of Canada Limited; Johnson, Matthey and Mallory Limited; Canadian Westinghouse Company Limited; and Dominion Colour Corporation Limited.

Atlas Steels Limited, by far the largest consumer, uses approximately 80 per cent of the total in the form of ferrotungsten and scheelite.

Prices

According to E & M J Metal and Mineral Markets for December 26, 1957, tungsten prices in the United States were as follows:

Tungsten ore, per short-ton unit of WO_3 concentrates of known good analysis, basis 65%:

Foreign ore, nearby arrival, c.i.f. U.S. ports, duty extra:	
Wolfram	$12 to $13
Scheelite	11 to 12

Tungsten metal, per lb:

98.8% min., 1,000-lb lots	3.15
Hydrogen-reduced, 99.99%	4.10 to 4.20

Ferrotungsten, per lb of W contained, 70-80% W, in lots of 5,000 lb or more, f.o.b. destination continental U.S.: 2.15

Tariffs

Canada

	British Preferential	Most Favoured Nation	General
Tungsten ore	free	free	free
Tungsten metal	"	"	"
Tungsten oxide	"	"	5% ad valorem
Ferrotungsten	"	5% ad valorem	5% ad valorem

	British Preferential	Most Favoured Nation	General
Tungsten rod and wire	free	free	25% ad valorem
Tungsten carbide	"	"	free

United States

Tungsten ore and concentrates, on tungsten content - 50¢ per lb

Tungsten metal, tungsten carbide and combinations containing tungsten carbide or tungsten metal, on tungsten content - 42¢ per lb plus 25% ad valorem

Ferrotungsten, on tungsten content - 42¢ per lb plus 12 1/2% ad valorem

Tungsten acid and other compounds, on tungsten content - 42¢ per lb plus 20% ad valorem.

URANIUM

by
R.A. Simpson

A threefold increase over the production of 1956 placed uranium sixth in value of production among Canadian minerals after petroleum, nickel, copper, iron ore and gold. In all, 6,636 tons of uranium precipitate were produced, valued at $136,304,364; the output in 1956 amounted to 2,281 tons valued at $45,732,145. Mines in Ontario produced 3,986 tons and those in Saskatchewan 2,231 tons. The remaining 419 tons came from operations in the Northwest Territories.

Eleven new mines and seven new processing plants came into production during 1957. Two established producers increased capacities. The total rated plant capacity of the industry was thereby increased from 9,250 tons a day at the end of 1956 to 27,100 tons at the end of 1957.

Despite the spectacular increase in output in 1957, the industry is expected to more than double its production during 1958. The reason is that most of the new producers in 1957 did not begin until late in the year and will reach full production only in 1958. In addition, six new mines and processing plants will commence production in that year. The daily capacity to process uranium ore will then be 43,000 tons. This will yield an estimated 45 tons of uranium oxide precipitate a day.

Mine Production

Northwest Territories

Prior to 1957 the only uranium production in the Territories came from the Port Radium mine of Eldorado Mining and Refining Limited on the eastern shore of Great Bear Lake. This mine has been producing uranium continuously since 1942. High-grade concentrate and chemical precipitate are produced. The concentrate is treated at the company's Port Hope, Ontario, refinery. Precipitate is produced at the mine from stockpiled concentrator tailings as well as from concentrator tailings from current production. About 300 tons a day of tailings are fed to the Port Radium mill.

In mid-1957 Rayrock Mines Limited began producing precipitate at its mine on Sherman Lake about 28 miles north-northwest of Marion Lake. Capacity of the mill is rated at 150 tons a day, but production has been below this rate since commencement. Initial production came from stockpiled development ore, but by September all feed to the mill was derived from underground. Grade averages better than 6 pounds of U_3O_8 per ton.

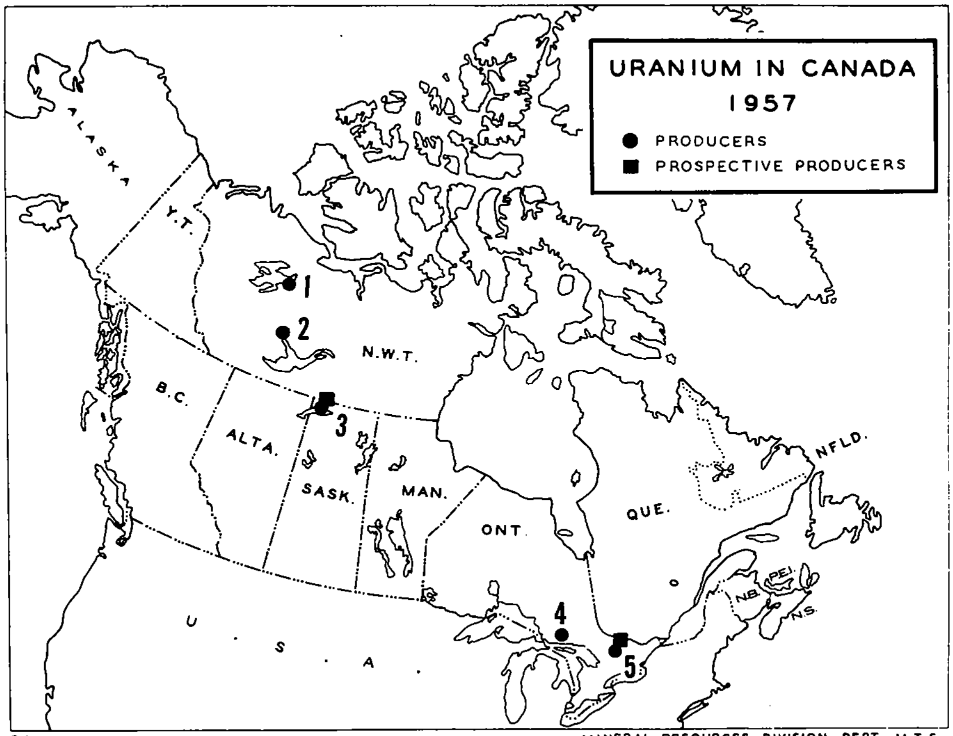
Uranium Producers

Company and Location*	First Production	Approximate Year-end Milling Rate (tons per day)	Rated Milling Capacity (tons per day)	Approximate Year-end Mining Rate (tons per day)	Contract ($)
Northwest Territories					
Eldorado Mining and Refining Limited(1)	1942	300	300	-	
Rayrock Mines Limited(2)	1957	150	150	150	15,792,000
Lake Athabasca, Saskatchewan(3)					
Cayzor Athabaska Mines Limited	1957	ships to Lorado		150	
Eldorado Mining and Refining Limited	1953	2,000	2,000	1,900	211,000,000[a]
Gunnar Mines Limited	1955	1,650	1,650	1,650	76,950,000[b]
Lake Cinch Mines Limited	1957	ships to Lorado		75	
Lorado Uranium Mines Limited	1957	550	750	150	64,356,000
National Explorations Limited	1956	ships to Lorado and Eldorado		50	
Rix Athabasca Uranium Mines Limited	1954	ships to Eldorado		100	
Elliot Lake District(4)					
Algom Uranium Mines Limited					206,800,000
Quirke mine	1956	3,300	3,000	3,300	
Nordic mine	1957	3,300	3,000	3,300	
Can-Met Explorations Limited	1957	1,250	2,500	1,250	79,573,000
Consolidated Denison Mines Limited	1957	3,000	6,000	3,000	202,225,000
Milliken Lake Uranium Mines Limited	1958	0	3,000	0	95,000,000
Northspan Uranium Mines Limited					278,471,000
Buckles mine	1957	ships to Lake Nordic		650	
Lake Nordic mine	1957	2,000	4,000	1,500	
Panel mine	1958	0	3,000	0	
Spanish American mine	1958	0	2,000	0	
Pronto Uranium Mines Limited	1955	1,500	1,500	1,500	55,000,000
Stanleigh Uranium Mining Corporation Limited	1958	0	3,000	0	90,830,000
Stanrock Uranium Mines Limited	1958	0	3,300	0	96,660,000
Bancroft Area(5)					
Bicroft Uranium Mines Limited	1956	1,200	1,000	1,200	35,805,000
Canadian Dyno Mines Limited	1958	0	1,000	0	34,876,000
Faraday Uranium Mines Limited	1957	1,000	1,000	750	45,204,800
Greyhawk Uranium Mines Limited	1957	ships to Faraday		250	

* See map page 222. Numbers in brackets refer to map locations.

(a) Contract includes Port Radium operations.

(b) Original contract – Gunnar is negotiating on additional contract.



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

Saskatchewan

All uranium production in Saskatchewan came from an area on the north shore of Lake Athabasca. Of the seven mines in production at the end of the year, four had reached production prior to 1957. Eldorado Mining and Refining Limited commenced production of precipitate in 1953. Rix Athabasca Uranium Mines Limited began shipping ore to Eldorado in 1954 and National Explorations Limited began in 1956. Gunnar Mines Limited commenced production in 1955 from the only open-pit uranium mine in Canada.

In 1957 Eldorado and Gunnar increased milling capacity, the former from 1,700 to 2,000 tons a day and the latter from 1,250 to 1,650 tons. Gunnar also completed a second sulphuric-acid plant, also based on elemental sulphur, which increased acid-plant rated capacity to 150 tons a day. During the year the company continued development work underground in preparation for underground mining early in 1958. It is expected that about 60 per cent of the mill feed will come from the open pit and the remainder from underground.

Rix Athabasca shipped an average of 120 tons a day to the Eldorado mill on a custom basis. The average grade was 4.75 pounds U_3O_8 per ton.

Lorado Uranium Mines Limited officially opened its custom mill early in August although the mill had been in operation prior to this date. Ore came from its own mine as well as from three custom shippers. Capacity of the mill is rated at 750 tons a day, but, because of the unexpectedly high carbonate content of the ores, excessive acid consumption reduced throughput. In the initial period the mill was treating about 400 tons a day, but by the year-end this figure had been increased to 550 tons a day. To keep production as high as possible until remedial measures could be completed, the company obtained additional supplies of acid from Gunnar Mines Limited. The company plans to convert the pyrite-burning acid plant to a sulphur-burning unit and thereby increase acid output. Some method of separating carbonate ores from the sulphide ores may also be required to reduce acid consumption. The carbonate fraction can then be treated separately.

Companies that shipped ore to Lorado included Cayzor Athabaska Mines Limited, Lake Cinch Mines Limited and National Explorations Limited. Two other companies hold contracts with Lorado but did not ship any ore in 1957. These are St. Michaels Uranium Mines Limited and Black Bay Uranium Limited.

At the year-end Lorado was shipping about 200 tons of ore a day from its mine to its custom mill, Cayzor about 175 tons a day, Lake Cinch about 125 tons a day and National Explorations about 50 tons a day. All of the custom shippers are capable of producing ore in excess of these quantities, but the capacity of the custom mill governs the rate of delivery.

Ontario

Production from uranium mines in Ontario rose to a record high, considerably above the production from all other areas in Canada, and it amounted to 60 per cent of Canadian production. Production came from two areas - Elliot Lake and Bancroft. Mines in the Elliot Lake district produced six times as much as those in the Bancroft region; in fact, production from Elliot Lake was more than the combined production from the rest of Canada. This condition will be accentuated in ensuing years because mines in the Elliot Lake area were producing at only part of their potential, while output from outside of this camp was near its ultimate production.

Elliot Lake District

Five new mines reached production in 1957, bringing the total number of producing mines to seven. The two established producers - Pronto Uranium Mines Limited and the Quirke mine of Algom Uranium Mines Limited - operated at full capacity.

The Nordic mine of Algom Uranium Mines Limited came into production in January, and output from this mine was at capacity for nearly the whole of 1957. Both mines of Algom Uranium produced in excess of the rated capacity of 3,000 tons a day.

In July the Buckles mine of Northspan Uranium Mines Limited began stockpiling ore at Northspan's Spanish American mine for milling and recovery of uranium in September. Unexpected water conditions underground forced

Spanish American Mines Limited to reschedule the opening of the mine and mill for 1958. Shipments from Buckles, amounting to about 650 tons a day, were therefore diverted to Northspan's Lake Nordic mine.

By mid-1957, one circuit of the mill of Consolidated Denison Mines Limited was in operation, taking about 2,000 tons a day. By the year-end, capacity had been increased to 3,200 tons a day. This rate will be increased to 6,000 tons a day as soon as the mine is able to supply the additional mill feed, probably in June 1958.

The Lake Nordic plant of Northspan Uranium Mines Limited began operations in September and by the year-end was operating at 2,000 tons a day. Full capacity is not expected to be attained until July 1958.

In October, the mill of Can-Met Explorations Limited began to take ore from the company's mine, and reached a capacity of 1,100 tons a day by the end of the year. The plant has a rated capacity of 2,500 tons a day, but output at this rate depends upon underground development and is not expected to be reached until June 1958.

Bancroft Area

At the beginning of the year, Bicroft Uranium Mines Limited was the only producer in this area although other mines were being prepared for production. In April, Faraday Uranium Mines Limited brought its plant into production. The rated capacity of the mill is 1,000 tons a day, but at the end of the year this rate was being exceeded. In July, Faraday began taking ore from Greyhawk Uranium Mines Limited in accordance with an agreement which permitted Greyhawk to ship up to 250 tons a day until October and up to a maximum of 500 tons a day after October.

Development

Northwest Territories

At present, no additional uranium producers are expected to be developed in the Northwest Territories. Rayrock is expected to reach full production early in 1958; therefore uranium production in this region will be at its maximum for virtually the full year.

Saskatchewan

Mines and plants in the Lake Athabasca region had almost reached full capacity by the end of 1957. Black Bay Uranium Limited sank a shaft to 618 feet during the year, but operations were suspended in December. The company has announced that it will ship some stockpiled ore to the Lorado mill in 1958. If shipments are to be made in the summer, a road will have to be built to the Lorado mill. St. Michaels Uranium Mines Limited, which has a contract to ship ore to Lorado, has been inactive since 1956.

Ontario

Six new producers are looking toward production in 1958. Five of these are in the Elliot Lake district and one is near Bancroft.

More than 14,000 tons a day in milling capacity will be added to the total capacity of the processing plants in the Elliot Lake district. This will bring to 11 the number of mills in the district. There will be 12 operating mines until about mid-year, when the Buckles mine will probably be mined out and its shipments to Lake Nordic cut off.

The mill and mine of Spanish American will be ready for production in May. The company believes that full production of 2,000 tons a day will be reached in July.

The Panel mine of Northspan Uranium Mines Limited planned to begin bedding down the circuit in February. In May the company will commence milling at 1,000 tons a day; it hopes to reach its full production of 3,000 tons a day in June.

Milliken Lake Uranium Mines Limited was completing a mill and developing its mine at year-end. The company had prospects of beginning milling late in March and feeding 1,000 tons a day in April. Full capacity of 3,000 tons a day will not be looked for until June.

Stanleigh Uranium Mining Corporation Limited planned to begin production early in January 1958, but in November 1957 the leaching section of the mill was destroyed by fire. Production was not to begin until April 1958 and full production will not be reached before mid-year, when underground development will permit production at 3,000 tons a day.

Stanrock Uranium Mines Limited hoped to begin feeding the milling circuit in February 1958. Production at 1,000 tons a day was expected initially, and full production of 3,300 tons should be reached in the fall of 1958.

World Mine Production

The major share of uranium production in the Free World came from the United States, Canada and South Africa. Lesser quantities are produced in the Belgian Congo, Australia, France, Portugal and Northern Rhodesia.

The increase in Canadian production to 6,636 tons of U_3O_8 in 1957 raised Canada from third to second place, after the United States. Year-end milling capacity totalled 21,200 tons a day. On the basis of an average grade of 2.5 pounds per ton, the industry was capable of producing 26.5 tons of precipitate a day. This will be substantially increased in 1958.

In 1957 the United States increased its production to an estimated 9,200 tons of U_3O_8 from the 6,000 tons turned out in 1956 and remained the largest producer of uranium for the second successive year. As of June 30, 1957, 11 ore-processing mills were in operation with a capacity to treat ore equal to 8,610 tons a day. Ten mills with a total rated capacity of 9,375 tons a day were under construction. With completion of these mills, the capacity to treat ore will be raised to 17,705 tons a day.

South Africa's production during 1957 totalled 5,699 tons of U_3O_8. This came from 27 mines feeding 17 treating plants. In 1956, 4,250 tons of precipitate were produced. One new mine came into production during the year, increasing the industry's capacity to treat ore to 62,167 tons a day. Uranium is found associated with gold ores in South Africa and is recovered from gold ore tailings. The grade is usually low, averaging about 0.5 pound per ton. On this basis South Africa's U_3O_8 producing capacity at the end of 1957 was equal to about 15.5 tons a day.

Production from the Belgian Congo's Shinkolobwe mine is not published. A treatment plant with a rated capacity of 8,000 tons a day was built after World War II.

Although no official total for production from Australia has been reported, it is estimated that the 1957 production was about 475 tons of U_3O_8. Two mines feeding two processing plants with a total capacity of 335 tons a day were in operation. A third mill and plant with a rated capacity of 1,100 tons a day were under construction.

France is the leading producer of uranium in western Europe. In 1957 production amounted to 500 tons of U_3O_8 from two chemical leaching plants having a total rated ore-treating capacity of about 550 tons a day. One plant is to be enlarged and another is under construction.

Portugal has some production in its northern region, but production and operating statistics have not been released.

A small ore-treating plant in Northern Rhodesia commenced production in 1957 to treat ore from the Nkana mine.

Consumption and Uses

Production of uranium in Canada is directed almost exclusively to fulfilling commitments to the United States. In 1957 exports to that country were valued at $127,934,004.

Contracts between the governments of the United States and Canada, as well as between the governments of the United States and South Africa, the Belgian Congo and Australia, were negotiated to assure that all military requirements would be met. At the time of the negotiations, the civilian nuclear-power industry was not in being. It is only now beginning to make itself felt. Of the countries interested in this new form of power, only the United Kingdom has embarked upon a program which will assure nuclear-powered electricity a significant share of the nation's energy output and consumption of appreciable quantities of uranium for peaceful purposes. Outside of the military program, it is undoubtedly nuclear power that holds the greatest promise for large consumption of uranium.

Uranium can also be used to fuel reactors for other purposes. These have been covered in the reports of various atomic energy authorities and research organizations. A few of the uses will suffice to indicate how uranium will be used. Nuclear power now propels submarines, and there is little doubt that it will be used in other types of marine craft. Uranium can be used to generate steam for industrial purposes and to heat entire communities remote from supplies of conventional fuel. Radioactive isotopes are being produced in reactors throughout the world. Uranium will eventually find its way into other fields but these are unlikely to require the quantities that will be needed to supply a uranium-based nuclear-energy industry.

Prices

Eldorado Mining and Refining Limited, a Crown agency, is the sole buyer of uranium in Canada. The corporation buys uranium ores and concentrates at the maximum rate of $7.25 a pound of contained uranium oxide. All uranium to date, however, has been procured through special contracts with companies that produced chemical precipitates, and all contracts so far negotiated have involved production of a precipitate. The prices paid to the companies are confidential and vary with the companies. They are based on amortization of pre-production expenses, recoverable ore grades, estimated operation costs and a profit allowance. A commonly quoted average price, $10 a pound, represents a reasonable average.

The average unit cost of uranium delivered to the United States during the fiscal years 1956 and 1957 is shown below. These costs include bonus payments for initial production of uranium ore.

Average Cost Per Pound of Uranium Concentrates

	1956	1957
From U.S. sources	$11.96	$10.80
From other countries	10.94	11.18
From all sources	11.35	11.00

Tariffs

There is no tariff on uranium entering the United States. At the end of 1957 there was no tariff on uranium entering Canada, but after June 30, 1958, there will be a 15-per-cent customs duty on uranium pig, ingot, billet and bars.

ZINC

by
D.B. Fraser

Canada's output of zinc in 1957 declined by 8,892 tons, chiefly owing to reduced production following a price drop of 3 1/2 cents a pound.

Production from Quebec mines decreased by 11,678 tons. Barvue Mines Limited, the leading producer in the province, ceased operations in September owing to the low price of zinc, and several other mines made production cutbacks. In British Columbia, two major zinc operations were closed at mid-year, and in Yukon, Galkeno Mines Limited closed its mill in September. Output from Manitoba and Saskatchewan was 4,485 tons less than in 1956. Production gains totalling 12,852 tons were made in Ontario and New Brunswick, where new base-metal mines were brought into operation. Newfoundland's zinc output increased by 1,018 tons.

The graph on page 232 records the varying trends in zinc output since 1926 and emphasizes the importance of the export market 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 for large-scale production. Additional major sources of zinc were developed in northern Manitoba and Newfoundland in the late 1920s 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 1957, though 19,616 tons below this record, was at a relatively high level, the third highest in the history of the industry. Canada ranks second, after the United States, in mine production of zinc. Other leading producers are Russia, Australia, Mexico and Peru.

In 1957 The Consolidated Mining and Smelting Company of Canada Limited (Cominco), 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 247,351 tons of refined zinc; in 1956 their output was 255,564 tons.

Zinc produced from the provinces east of Manitoba was exported in concentrate form, chiefly to 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, were treated at Trail.

Zinc - Production, Trade and Consumption

	1957		1956	
	Short Tons	$	Short Tons	$
Production				
All forms				
British Columbia.....	221,779	53,626,157	224,324	66,579,127
Quebec	74,295	17,964,469	85,973	25,516,714
Saskatchewan	45,070	10,897,967	45,380	13,468,767
Newfoundland	35,698	8,631,847	34,680	10,293,055
Manitoba	13,729	3,319,758	17,904	5,313,968
Ontario	11,296	2,731,334	1,227	364,218
Yukon	8,560	2,069,741	10,526	3,124,194
New Brunswick	3,314	801,260	531	157,460
Nova Scotia	-	-	2,088	619,841
Total	413,741	100,042,533	422,633	125,437,344
Refined	247,316		255,564	
Exports				
Refined metal				
United States	104,990	22,882,621	115,895	31,077,002
United Kingdom	86,643	18,622,851	63,838	15,038,273
Philippines	2,924	551,761	662	149,131
Korea	2,492	495,373	378	91,173
India	1,596	262,661	1,120	245,011
Other countries	3,362	665,873	1,835	412,623
Total	202,007	43,481,140	183,728	47,013,213
Zinc contained in ore and concentrates				
United States	147,957	18,680,091	173,325	23,501,976
United Kingdom	14,370	925,763	6,311	752,167
Belgium	11,109	436,057	7,376	799,285
Other countries	13,705	748,165	12,301	1,431,172
Total	187,141	20,790,076	199,313	26,484,600
Zinc scrap				
Netherlands	1,751	161,990	1,220	92,082
Japan	1,548	262,758	-	-
Belgium	1,009	73,261	3,000	246,554
United States	542	77,483	685	101,991
Other countries	507	74,504	561	72,227
Total	5,357	649,996	5,466	512,854
Zinc manufactures				
Netherlands		114,863		148,773
Mexico		40,345		-
United States		38,296		56,198
Other countries		3,406		16,470
Total		196,910		221,441

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

	1957 Short Tons	1957 $	1956 Short Tons	1956 $
Imports				
Zinc and zinc products				
Blocks, pigs, bars, plates		18,234		42,934
Strips, sheets		693,907		765,392
Dust		204,227		154,031
Zinc slugs		194,965		317,595
Zinc chloride		34,499		52,784
Zinc sulphate		139,128		117,403
Zinc white		196,671		174,792
Lithopone		197,418		348,267
Zinc manufactures, n.o.p.		2,342,493		2,464,058
Total		4,021,542		4,437,256
Consumption				
Refined zinc (virgin)				
Electrogalvanizing	964		1,130	
Hot-dip galvanizing	25,616		32,125	
Zinc die-cast alloys	8,517		9,253	
Brass and bronze	6,678		7,699	
Other alloys	639		683	
Rolled and ribbon zinc	1,136		1,284	
Zinc oxide	7,778		7,494	
Zinc castings	667		753	
Other uses	718		752	
Total	52,713		61,173	
Secondary zinc	1,707		1,016	
Total	54,420		62,189	
Scrap zinc	884		869	
Total consumption refined zinc from all sources	55,304		63,058	

Zinc - Production, Exports and Consumption, 1947-57

(short tons)

	Production		Exports			Consumption
	All Forms(1)	Refined	In ore and Concentrates	Refined	Total	Refined(2)
1947	207,863	178,264	40,575	137,228	177,803	51,065
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

(1) Refined zinc made in Canada from Canadian ores, plus recoverable zinc in ores and concentrates exported.

(2) Refined virgin zinc only.

World Production of Zinc(a)

Mine Basis

(short tons)

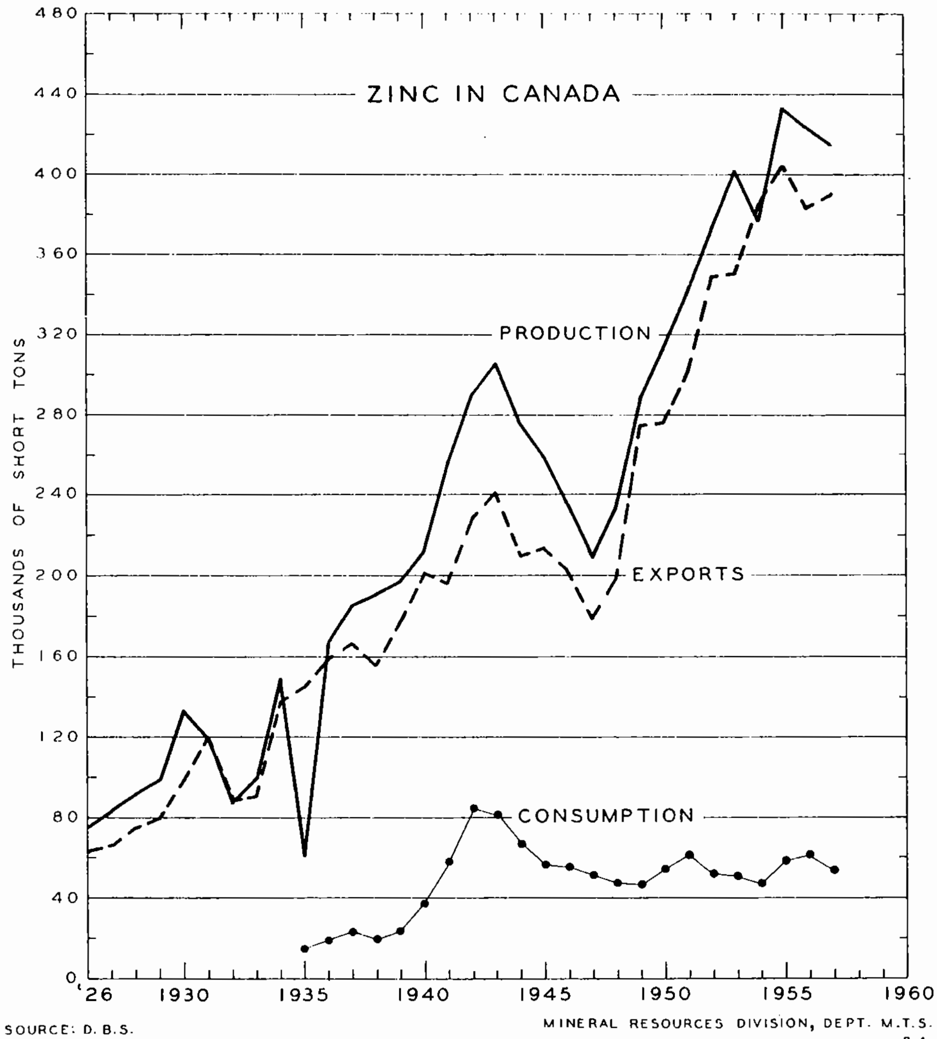
	1957	1956	1955
United States	531,735	542,340	514,671
Canada(b)	413,741	422,633	433,357
Russia(e)	375,000	336,000	300,000
Australia	274,320	261,620	241,376
Mexico	267,889	274,348	296,959
Peru	170,257	193,038	183,072
Japan	149,919	135,198	119,786
Poland(e)	124,500	143,500	154,500
Italy	122,162	115,534	110,738
Belgian Congo	117,680	129,549	74,700
West Germany	104,014	101,897	101,557
Other countries	554,362	529,627	495,113
Total	3,205,579	3,185,284	3,025,829

(a) American Bureau of Metal Statistics.

(b) Dominion Bureau of Statistics.

(e) Estimated.

Zinc


ZINC 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.

The domestic consumption of primary refined zinc decreased to 52,713 tons from the 61,173 tons consumed in 1956. All the main consuming industries except the zinc-oxide industry showed declines, the largest being in the hot-dip galvanizing field.

Industrial consumption of refined zinc in the United States, Canada's major market, declined from 1,008,790 tons in 1956 to an estimated 935,620 tons in 1957, owing principally to a sharp drop in the amount used in galvanizing. In the United Kingdom, consumption of zinc was down to 317,265 tons from the 319,822 tons consumed in 1956.

Developments at Producing Mines*

British Columbia

The Consolidated Mining and Smelting Company of Canada Limited (Cominco) produced 3,273,613 tons of ore from its four mines, about 387,000 tons less than in 1956. The 2,423,577 tons produced by the Sullivan Mine at Kimberley brought its ore production since 1910 to just under 74 million tons. The open-pit section at the southern extremity of the orebody was closed in May, as its low-grade ore was uneconomic at decreased prices. From the H.B. mine, 22 miles east of Trail, 451,381 tons were mined, and from the Bluebell mine, on the east shore of Kootenay Lake, 256,118 tons. Cominco's northern subsidiary, Tulsequah Mines Limited, produced 142,537 tons of zinc-copper-lead ore up to August, and was then closed because of low metal prices. Production from the Tulsequah operation commenced in 1951.

Zinc concentrates from the company's mines, together with custom ores and concentrates from British Columbia, Yukon, and foreign shippers, were treated in Cominco's electrolytic zinc refinery at Trail. Output from all sources in 1957 was 189,295 tons; in 1956 it was 193,041 tons.

Canadian Exploration Limited produced from the Jersey mine near Salmo 35,000 tons of zinc-lead ore a month with mill heads averaging about 4 per cent zinc and 1.4 per cent lead. The major part of the tonnage was mined by underground trackless methods.

Reeves MacDonald Mines Limited, 12 miles south of Salmo, treated 405,531 tons of zinc-lead ore and produced zinc concentrate containing 13,689 tons of zinc. The shaft was extended 503 feet in the footwall of the main orebody to develop deep-level ore for production.

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* See map, page 234.

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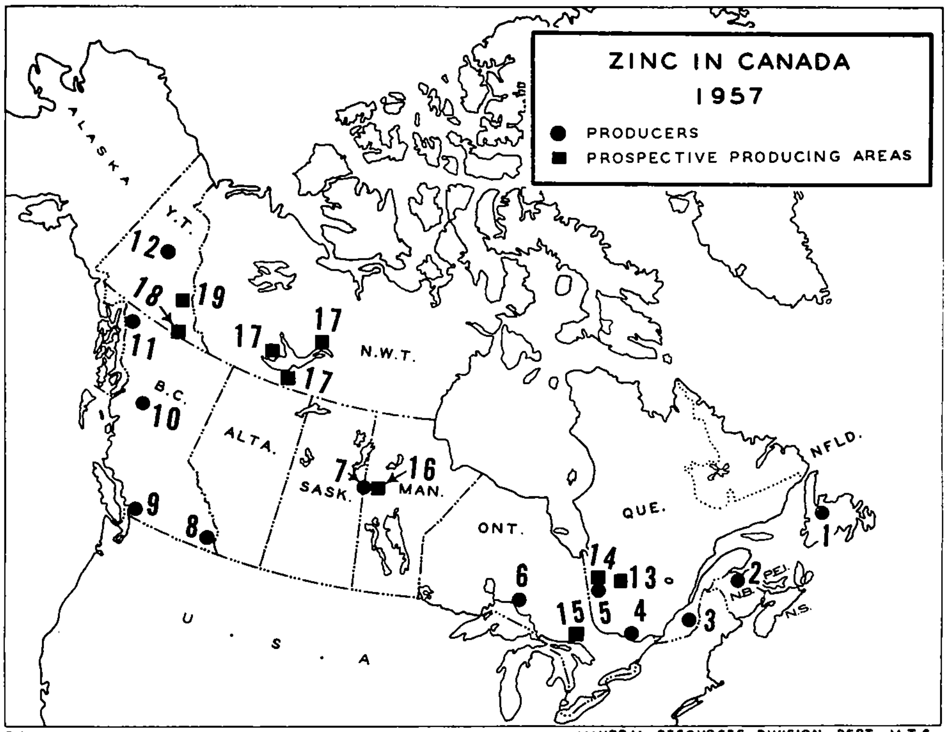
Zinc



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

Producers

1. Buchans Mining Co. Ltd.
2. Heath Steele Mines Ltd.
3. Weedon Pyrite & Copper Corp. Ltd.
4. New Calumet Mines Ltd.
5. Golden Manitou Mines Ltd.
   East Sullivan Mines Ltd.
   Bravue Mines Ltd.
   Quemont Mining Corp. Ltd.
   Waite Amulet Mines Ltd.
   West Macdonald Mines Ltd.
   Normetal Mining Corp. Ltd.
   Geco Mines Ltd.
6. Willroy Mines Ltd.
7. Hudson Bay Mining and Smelting Co. Ltd. (also refinery)
8. Reeves MacDonald Mines Ltd.
   Canadian Exploration Ltd.
   Consolidated Mining and Smelting Co. of Canada Ltd., The (also refinery)
   Sheep Creek Mines Ltd.
   Giant Mascot Mines Ltd.
   Sunshine Lardeau Mines Ltd.
   ViolaMac Mines Ltd.
   Yale Lead and Zinc Mines Ltd.
   Slocan Van Roi Mines Ltd.
   Western Exploration Co. Ltd.
   Highland-Bell Ltd.
9. Britannia Mining and Smelting Co. Ltd.
10. Cronin Babine Mines Ltd.
    Silver Standard Mines Ltd.
11. Tulsequah Mines Ltd.
12. United Keno Hill Mines Ltd.
    Galkeno Mines Ltd.

Prospective Producing Areas

13. Bachelor Lake
14. Mattagami Lake
15. Sudbury Basin
16. Snow Lake
17. Great Slave Lake
18. Watson Lake
19. Hyland River
    Pelly River

Britannia Mining and Smelting Company Ltd. milled 849,212 tons of ore from its copper-zinc mine on Howe Sound, from which 15,924 tons of zinc concentrate containing 9,403 tons of zinc were produced. It became apparent toward the end of the year that the mine would be forced to close because of low copper and zinc prices. In December, therefore, the federal and provincial governments, the company management and the employees worked out a co-operative program by which the milling rate was reduced and a subsidy was paid in an effort to keep the mine open. Production was continued under this schedule until March 31, 1958, when operating losses forced the complete closure of the mine and mill.

Sheep Creek Mines Limited operated its Mineral King mine and mill in the Lake Windermere district at 500 tons a day. The grade of ore treated was about 4 1/2 per cent zinc and 1 per cent lead. Exploration continued between the third and the seventh levels, where new ore was located in 1956. No work was done at the Paradise mine, 10 miles to the northeast.

ViolaMac Mines Limited mined an average of 1,700 tons a month from the Victor mine near Sandon. The ore was trucked to Silverton and custom-milled by Western Exploration Co. Ltd., which treated its own ore from the Mammoth mine at 80 tons a day, and ViolaMac's ore on a week-about basis.

Sunshine Lardeau Mines Ltd., near Camborne, milled 28,176 tons averaging 9.3 per cent zinc, 7.4 per cent lead, and 9.7 ounces of silver per ton in the fiscal year ended October 31, 1957, and shipped 331 tons of high-grade direct-smelting ore. Reserves at this date were 12,000 tons.

Other producers of zinc concentrate included Silver Standard Mines Limited, near Hazelton, and Highland-Bell Limited at Beaverdell, both of which produced mainly silver; Yale Lead and Zinc Mines Limited, at Ainsworth; New Cronin Babine Mines Limited, near Smithers; Slocan Van Roi Mines Limited, at Silverton; and Carnegie Mines Limited, near Sandon. Giant Mascot Mines Limited ceased operations in June when commercial ore was exhausted.

Manitoba and Saskatchewan

Hudson Bay Mining and Smelting Co. Limited, Canada's second largest zinc producer, mined 1,377,751 tons of copper-zinc ore from the Flin Flon mine on the provincial boundary, and 73,346 tons from the Schist Lake mine 3 1/2 miles southeast of Flin Flon. At the company's zinc plant 110,574 tons of zinc concentrate and 42,624 tons of fume and stack dust were treated to produce 58,800 tons of slab zinc. The tonnage of zinc concentrate treated and the grade of oxide fume were less than in the previous year, and slab zinc production declined by 4,484 tons. There were also produced 43,177 tons of zinc residue, 42,329 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.

Zinc

Production from the Schist Lake mine, whose ore is trucked to Flin Flon for milling, was stopped in August so that the shaft could be deepened and a lower orebody developed. At year-end, 595 feet of deepening had been completed.

Ontario

Jardun Mines Limited, 18 miles northeast of Sault Ste. Marie, ceased production in April. Ore reserves at time of closure were about 36,000 tons grading 3.1 per cent zinc and 4.2 per cent lead.

Geco Mines Limited, at Manitouwadge, completed the construction of a 3,300-ton mill and commenced production early in September. Full capacity was attained in October. Mill feed was drawn from the western section of the orebody by blast-hole stoping and gravity ore-handling methods. Production from September to December was 345,762 tons of copper-zinc ore, from which 7,701 tons of zinc concentrate were produced, containing 4,137 tons of zinc.

Willroy Mines Limited, adjoining Geco on the west, opened a 1,000-ton mill late in July, and operated at an average of 800 tons a day, treating zinc-copper-lead ore grading approximately 10 per cent zinc.

Quebec

Barvue Mines Limited closed its mine and 5,300-ton mill 7 miles north of Barraute in September owing to the low price of zinc. During 1957, 384,705 tons were milled, and 19,295 tons of zinc concentrates were produced, containing 8,059 tons of zinc and 389,231 ounces of silver. Production from November 1952, when the mill was opened, to the time of closure, was 5,625,864 tons of ore, 141,994 tons of zinc contained in concentrates, and 3,979,685 ounces of silver. Reserves in September were 4,058,000 tons.

Quemont Mining Corporation Limited, in Rouyn-Noranda county, milled 837,251 tons of copper-zinc ore, which gave 31,360 tons of zinc concentrate containing 16,190 tons of zinc, 3,651 tons less than in the previous year. Sublevel mining and shrinkage-stope mining were increased and cut-and-fill mining was proportionately reduced, so that the cost of mining would be reduced.

Normetal Mining Corporation Limited, Abitibi West county, treated 378,283 tons of zinc-copper ore and produced 30,963 tons of zinc concentrate containing 15,987 tons of zinc. Slightly less ore was treated than in the previous year, and the zinc grade was down fractionally. The result was a reduction of 1,320 tons in zinc output.

Golden Manitou Mines Limited, Abitibi East county, treated 171,870 tons of zinc ore and 297,565 tons of copper ore in a split-circuit mill, and produced 18,618 tons of zinc concentrate containing 11,209 tons of zinc.

Waite Amulet Mines Limited, in Rouyn-Noranda county, milled 289,617 tons of copper-zinc ore, which gave zinc concentrate containing 8,384 tons of zinc, about the same as in 1956.

West Macdonald Mines Ltd., in Rouyn-Noranda county, mined zinc-pyrite ore at a rate of 900 tons a day. The ore was transported by a 6-mile aerial tramway to the Waite Amulet mill for treatment. A total of 329,314 tons was milled, from which zinc concentrate containing 14,500 tons of zinc was produced.

East Sullivan Mines Limited, Abitibi East county, milled 905,241 tons averaging 0.44 per cent zinc and 0.95 per cent copper, as well as 0.28 ounce of silver and 0.007 ounce of gold per ton. New low-level stopes were brought into production and supplied 50 per cent of the mill feed.

New Calumet Mines Limited, in Pontiac county, milled 142,324 tons of zinc-lead-silver ore in the fiscal year ended September 30, 1957, and obtained 7,458 tons of zinc contained in concentrates. In August, the milling rate was reduced from 550 to 340 tons a day, owing to low zinc and lead prices, and mining was concentrated in the higher-grade No. 4 shaft area.

Weedon Pyrite & Copper Corporation Limited, in Wolfe county, milled 107,418 tons of copper-pyrite-zinc ore and produced copper and pyrite concentrates regularly and zinc concentrate intermittently. Zinc concentrate is recovered only for the purpose of producing a satisfactory grade of pyrite concentrate. A total of 269 tons of zinc was recovered in 1957.

New Brunswick

Heath Steele Mines Limited, 32 miles northwest of Newcastle, opened a 1,500-ton mill in February and operated on a breaking-in basis at plant scale throughout the year. Mill feed was supplied from a copper and a zinc-lead pit. Ore treatment problems were unusually difficult owing to partial oxidation of the mill feed and the complexity of the ore. Development of the 'B' or easterly orebodies for trackless underground mining continued. The new Canadian National Railways branch line running from Bartibog to the mill site was completed in November. In March 1958, the scale of operations was reduced to less than 500 tons a day owing to low metal prices, and metallurgical research continued at this reduced scale.

Newfoundland

Buchans Mining Company Limited milled 371,000 tons of ore, producing concentrates of zinc, lead and copper, the zinc concentrate totalling 69,515 tons. The estimated recoverable zinc content of all concentrates was 35,698 tons. The new circular concrete-lined MacLean shaft, designed to open up the deeper-seated orebody on the extension of the Rothermere ore zone, was collared and sunk to a depth of 276 feet at year-end.

Zinc

Yukon Territory

United Keno Hill Mines Limited, Mayo district, milled 159,885 tons in the fiscal year ended September 30, 1957, and produced zinc concentrate and lead concentrate containing 9,060 tons of zinc. The Hector mine supplied 49 per cent of the mill feed and the Calumet mine 44 per cent. The rest was development ore from the Elsa and Jock mines.

Galkeno Mines Limited, adjoining United Keno's Galena Hill property, operated a 220-ton mill up to September, when low lead and zinc prices and an excessive water problem forced the closure of the mill. Underground development continued until December, when all operations were suspended.

Other Developments

British Columbia

Silbak Premier Mines Limited, in the Portland Canal area, whose 600-ton mill was burned late in 1956, deferred rebuilding in view of low zinc and lead prices. Reserves of 75,250 tons grading 2.7 per cent zinc, 1.8 per cent lead and 2.8 ounces of silver per ton have been proven. The adjoining deposit of the Premier Border Gold Mining Company Limited, which was to have been mined with Silbak Premier's ore, contains 74,000 tons averaging 6.4 per cent zinc, 4.3 per cent lead and 2 ounces of silver per ton. Sil-Van Consolidated Mining and Milling Company Ltd. in September suspended development of its property near Smithers until market conditions improve. Development was also deferred at the Jordan River lead-zinc deposit, held by American Standard Mines Limited, in the Revelstoke district.

Manitoba

Mine development was started 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 and 70 miles east of Flin Flon, a surface plant was constructed and fully equipped. A 3-compartment shaft was collared and sunk to 487 feet at year-end, and stations were cut for two levels. An 8.5-mile road and 4.7-mile transmission line to the mine site were completed. Ore reserves remained unchanged at 3,832,400 tons averaging 11 per cent zinc, 0.91 per cent lead and 0.42 per cent copper, as well as 1.96 ounces of silver and 0.066 ounce of gold per ton. At the Stall Lake deposit, 4 miles southeast of Snow Lake, containing 783,200 tons grading 4.5 per cent copper and 0.4 per cent zinc, plus silver and gold, a half-mile road and a 4-mile transmission line were completed, and a 3-compartment shaft was sunk from a temporary installation to a depth of 713 feet. Arrangements were completed for the Canadian National Railways to build a branch railroad for hauling ore from the Snow Lake mines to Flin Flon for treatment. No work was done at the Ghost Lake deposit, three quarters of a mile east of Chisel Lake, or at Osborne Lake, 13 miles northeast of Snow Lake.

Saskatchewan

Development work at Hudson Bay Mining and Smelting Co.'s Coronation mine, 13 1/2 miles southwest of Flin Flon, included the driving of crosscuts to the orebody on seven levels in preparation for shrinkage-stope mining. Ore reserves are 825,000 tons grading 5 per cent copper and 0.4 per cent zinc.

Parrex Mining Syndicate diamond-drilled an anomaly at Hanson Lake, 40 miles west of Flin Flon, and obtained evidence of zinc-copper mineralization. Underground exploration is planned. Westore Mines Limited and Paramount Petroleum and Mineral Corporation Ltd. carried out exploratory diamond-drilling in the Brabant Lake area, 95 miles northeast of Lac la Ronge.

Ontario

Consolidated Sudbury Basin Mines Limited brought its zinc-copper-lead properties 15 miles northwest of Sudbury to the production stage but in September postponed opening the mill until base-metal prices improve. Initial output was to have been at a rate of 1,000 tons a day from the Vermilion mine, whose ore grades 4.2 per cent zinc and also contains copper, lead and silver. Total reserves at the Vermilion and the Errington mines are 17,810,256 tons averaging 3.9 per cent zinc, 1.1 per cent copper, 1.1 per cent lead and 1.6 ounces of silver per ton.

Quebec

The Coniagas Mines Limited continued development of a zinc-silver-lead property at Bachelor Lake, about 100 miles northeast of Barraute, where 394,000 tons of ore were previously indicated. New ore was outlined at the 1,000-foot horizon. The shaft, originally scheduled to bottom at 850 feet, was deepened to 1,350 feet and exploratory drilling was carried out from the 1,075-foot level.

The 6-company Mattagami Syndicate diamond-drilled an aerial electromagnetic anomaly near Watson Lake, in the Mattagami Lake area, 100 miles north of Senneterre. Thirty-seven holes totalling 21,000 feet were drilled, and a large deposit containing mainly zinc values, with minor amounts of copper, gold and silver, was outlined. The six companies participating were Area Mines Limited, Dome Mines Limited, Highland-Bell Limited, Iso Uranium Mines Limited, Leitch Gold Mines Limited and Teck-Hughes Gold Mines Limited.

Zinc

New Brunswick

Exploration and development of Bathurst district deposits were less active than in former years, owing partly to the fall in metal prices and to the fact that the more obvious sulphide bodies have been located.

Brunswick Mining and Smelting Corporation Limited continued mineral-dressing tests on the complex zinc-lead-pyrite ores of its two deposits 12 miles and 17 miles southwest of Bathurst. The chief effort was directed toward improving the flowsheet for processing ore from the north section of the No. 12 deposit. This project was completed successfully, and the main outline of a production program, with estimated costs, was drawn up. Its chief features were the construction of a 2,000-ton mill to be increased after 3 1/2 years to 4,000-ton capacity, the construction of a lead smelter, the provision of rail transportation to Bathurst from the mines, and the placing of dock installations and deepening of the harbour at Bathurst. The production shaft at No. 12 mine was sunk to 800 feet. Owing to the unfavourable market outlook for base metals, the production program was deferred early in 1958 and further development stopped on March 31.

Nigadoo Mines Limited continued mine development 11 miles northwest of Bathurst. The shaft was sunk to 900 feet, two levels were established and detailed exploration of the complex ore structure was carried out. The company acquired the 250-ton mill of Keymet Mines Limited for metallurgical testing and eventual production. The mill had been closed since early in 1956.

Kennco Explorations (Canada) Limited continued the exploration of the Murray group, 35 miles west of Bathurst.

The Consolidated Mining and Smelting Company of Canada Limited diamond-drilled a deposit near Canoe Lake, 25 miles southwest of Bathurst.

Anacon Lead Mines Limited discontinued underground development of the New Larder 'U' deposit 15 miles south of Bathurst in February. Since 1954, a 1,450-foot shaft has been sunk and six levels have been established. Reserves at the time of closure totalled 1,428,000 tons averaging 6.48 per cent zinc, 2.35 per cent lead and 2.16 ounces of silver per ton.

Sturgeon River Mines Limited suspended mine development 12 miles west of Bathurst in August. A shaft was sunk to 550 feet in 1956, and lateral development on two levels, totalling 3,000 feet, was completed at the time of closure. Reserves are 518,000 tons averaging 3.54 per cent zinc, 2.58 per cent lead and 4.68 ounces of silver per ton.

No work, except for assessment purposes, was done on the Middle River deposit, held by Texas Gulf Sulphur Company and Conwest Exploration Company Limited and situated 12 miles west of the Heath Steele property. The Anaconda Company (Canada) Ltd. carried out surface exploration and detailed mapping on ground surrounding the extensive Caribou deposit, 30 miles west of Bathurst, which was diamond-drilled in 1956.

Northwest Territories

No work was done by Pine Point Mines Limited, a Cominco subsidiary, on its extensive zinc-lead deposit south of Great Slave Lake, previous exploration having outlined adequate reserves.

Yukon

Prospectors Airways Company Limited carried out an electromagnetic survey in the immediate area of the zinc-lead deposit of Vangorda Mines Limited, 30 miles west of the Canal Road-Pelly River crossing, but no mineralization was indicated. A total of 9,400,000 tons grading 4.96 per cent zinc, 3.16 per cent lead and 1.76 ounces of silver per ton, plus minor copper and gold values, was outlined by diamond-drilling in 1954 and 1955.

Uses

The main consuming industries and the tonnages used by each are shown on page 230.

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, 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, especially 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 in the form of sheets and strips, tubes, rods and wire, and as extruded shapes and castings. 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

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, articles exposed to corrosion, such as weather-stripping, roofing drains, and gutters, and anti-corrosion plates for boilers and ships' hulls. Burgess Battery Company Limited, Niagara Falls, is the only producer of rolled zinc in Canada, almost all 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 most Special and High Grade zinc is produced. To meet consumer requirements for Prime Western, Canadian producers debase the higher grades by adding lead.

The United States regularly consumes about one third of the world's zinc production. In 1957, Canadian shipments to this market amounted to 253,489 tons of zinc. Consumption of slab zinc in 1957 and 1956 by the United States industry was as follows:

	1957	1956
	Short Tons	
Galvanizing	367,757	439,146
Brass products	112,390	124,004
Zinc-base alloys	376,039	360,507
Rolled zinc	41,269	47,359
Zinc oxide	20,428	19,160
Other	17,737	18,614
Total	935,620	1,008,790

Source: United States Bureau of Mines.

Prices and Tariffs

The Canadian price of Prime Western zinc was 13.5 cents a pound from January to the beginning of May. The price dropped in five successive stages to 10 cents a pound between May and July and remained at this level for the rest of the year. The average price for the year was 11.4 cents a pound. High Grade and Special High Grade zinc were respectively an additional 0.6 cent and 1 cent a pound.

The United States price of Prime Western zinc was the same as the Canadian price throughout the year. Premiums on High Grade and Special High Grade zinc were respectively 1.35 and 1.75 cents a pound.

Zinc ores and concentrates entered Canada duty-free; slab zinc was subject to a 0.75-cent-a-pound British preferential duty, and to a 1-cent-a-pound most favoured nation and general duty. Varying schedules were applied to imports of zinc in semi-fabricated forms.

The United States tariff on the zinc content of ores and concentrates was 0.6 cent a pound. On slab zinc it was 0.7 cent a pound. Varying tariffs were applied to imports of zinc in other forms.

ABRASIVES

by
J. S. Ross

A natural abrasive is any mineral or rock employed for its grinding, smoothing or polishing qualities. Such raw materials are common to most countries and may be employed in many ways. Abrasives may be classified into groups according to their degree of hardness, the 'high-grade' variety including diamond, corundum, emery and garnet. Rocks or minerals with a large silica or silicate content, such as quartz, quartzite, flint, sandstone, pumice, pumicite and ground feldspar, are classed as 'low-grade'. Mild abrasives used for polishing and mild abrasions include diatomite, tripoli, microcrystalline silica, rottenstone, chalk, lime, china clay, iron oxide and bath brick.

Various types of natural abrasives have been produced in Canada since 1886, but the quantities have been very small. Although production statistics for 1957 are only partially available, it is known that the value of the year's output of artificial abrasives was $49,682,293, or 11 per cent more than the production value of 1956. Canada is by far the largest producer of crude artificial abrasives, mainly because of its large supply of cheap hydro power. The principal types manufactured include fused alumina and silicon carbide.

Natural abrasives to the value of $19,472 were exported in 1957, whereas exports of artificial abrasives amounted to $34,633,321, an increase of 19 per cent over 1956. The bulk, crude variety comprises 98 per cent of the latter, the exports being far larger than those of any other country during the year. The value of imports of abrasives was slightly lower than in 1956, that of imports of black and bort diamonds being more than 62 per cent of the total. These were followed by artificial abrasives, such as sized grains, grinding wheels and bonded grains, and coated papers.

The Canadian consumption of artificial abrasives is many times that of the natural variety . Both were used in smaller amounts in 1957 than in 1956. Natural abrasives generally have many substitutes and have recently suffered further severe competition in the field of industrial diamonds. Although the diamond industry experienced record sales in 1957, General Electric Company manufactured a small quantity of synthetic industrial diamonds in the United States which are comparable to the natural variety in all respects for industrial uses. The company estimates that its synthetic-diamond production in 1958 will be 3.5 million carats, approximately one half the current United States imports or slightly less than one fifth the world production of industrial diamonds. Africa and South America are the present sources of the diamonds imported from the United States.

(text continued on page 247)

Abrasives – Production, Trade and Consumption

	1957 Short Tons	1957 $	1956 Short Tons	1956 $
Production				
Artificial abrasives				
Crude silicon carbide	83,321	11,828,856	80,467	10,430,549
Crude fused alumina	218,187	21,902,425	181,830	17,636,382
Abrasive wheels and segments		7,100,348		7,206,636
Sharpening stones and files		308,067		268,886
Other products(1)		8,542,597		9,157,047
Total		49,682,293		44,699,500
Imports				
Natural and artificial abrasives(2)				
Artificial abrasive grains		2,199,990		2,333,133
Diamond dust, black and bort for boring		10,825,940		10,369,632
Emery in bulk(3)		248,887		242,834
Grinding wheels, with natural or artificial grains		1,947,311		2,148,715
Grinding stones or blocks, manufactured by bonding together either natural or artificial abrasives n.o.p.		407,882		381,823
Grindstones, not mounted, and not less than 36 inches in diameter		12,982		24,620
Grindstones n.o.p.		6,748		7,544
Pumice and pumice stone, lava and calcareous tufa not further manufactured than ground		254,427		242,656
Coated abrasive paper or cloth		725,652		1,053,800
Manufactures of abrasives n.o.p.		625,769		561,663
Total		17,255,588		17,366,420
Natural abrasives from the United States (4)				
Corundum	179	56,901	194	48,842
Emery powder, grains and grits	955	88,758	1,439	128,601
Natural grindstones and pulpstones	199	17,594	371	42,835
Whetstone, sticks, files and blocks, etc.	35	34,812	4	9,286
All other natural abrasives	15,720	921,355	15,111	868,960
Total natural abrasives	17,088	1,119,420	17,119	1,098,524
	Carats		Carats	
Diamond grinding wheels, sticks, etc.	75,077	430,210	85,880	429,294
Diamond powder	124,423	407,348	152,556	447,121

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

	1957 Short Tons	1957 $	1956 Short Tons	1956 $
Exports				
Natural and artificial abrasives(2)				
Abrasives, natural, n.o.p., in ore, bulk, crushed or ground form		19,472		17,004
Abrasives, artificial, crude		33,911,082		28,388,901
Abrasives, artificial, manufacturing		24,606		17,447
Sandpaper and emery cloth		651,811		665,764
Grindstones, manufacturing		45,822		96,642
Total		34,652,793		29,185,758
Consumption				
Abrasives, natural and artificial, consumed in the production of artificial-abrasives products				
Natural abrasive grains				
Garnet	217	59,276	307	76,185
Emery	61	10,946	63	10,258
Quartz or flint	148	10,065	299	21,025
Other		1,800		1,873
Total		82,087		109,341
Artificial abrasive grains for wheels, paper, etc.				
Fused alumina	2,748	798,644	3,202	869,978
Silicon carbide	2,182	621,083	2,610	623,401
Total	4,930	1,419,727	5,812	1,493,379

(1) Includes abrasive cloth, abrasive paper, abrasive tiles, artificial pulpstones, boron carbide and fused magnesia, some of which were reported by only one or two companies and therefore cannot be shown separately.

(2) Trade of Canada.

(3) Includes also corundum and garnet. Separation not possible.

(4) The official Canadian trade statistics do not distinguish between natural and artificial abrasives. The natural abrasives imported into Canada from the United States are recorded in United States Exports of Domestic and Foreign Merchandise, Report FT 410, Part 1, and are shown here.

Domestic Producers

Canada's production of natural abrasives is limited to quartz sand, feldspar, beach sand and pebble grinding media.

Dominion Silica Corporation Limited grinds and sizes quartzite at Lachine for use as quartz sand for sand-blasting purposes. Beach sands are employed locally and in minor amounts for the same purpose.

Crushed and sized quartz and sandstone may also be employed for the foregoing purposes and quartz and quartzite for coated papers.

Grinding Pebbles

A method of pebble-grinding relatively new to the Canadian mining industry is replacing conventional grinding with grinding pebbles in tube mills and is taking the place of ball-mill grinding to some extent. It involves grinding in conventional mills with carefully sized ore as media instead of grinding in large-diameter mills with a mixture of all sizes of media. This method, first used in Canada in 1949, may be applied to many types of ore and is at present employed by such companies as Lake Shore Mines Limited, Wright-Hargreaves Mines Limited, Bicroft Uranium Mines Limited, Faraday Uranium Mines Limited and North Rankin Nickel Mines Limited.

Minor amounts of siliceous grinding pebbles used to be produced each year from morainic material in the Cypress Hills area of southern Alberta and Saskatchewan by W. May of Elkwater, Alberta. Commonly, grinding pebbles are of flint and quartz and are used for grinding ceramic and other materials where iron contamination is not desired and in ore-dressing in tube-mill grinding.

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.

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.

Canada imported 179 tons of finely ground corundum from the United States in 1957. None of this was mined in the United States: it probably came from Rhodesia and Nyasaland and the Union of South Africa.

World production for 1957 is estimated at 10,000 metric tons, 45 per cent of which came from Rhodesia and Nyasaland.

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Abrasives

Corundum is used mainly in the manufacture of grinding wheels. The coarser material is used in snagging wheels and the finest in optical grinding.

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 as an additive to surfaces of 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.

The several varieties of garnet are all essentially aluminum silicates. The mineral commonly occurs in metamorphic rocks and some beach sands. To be employed in the abrasive industry, garnetiferous material must have a uniform colour and the property of continuously wearing down into sharp angular fragments when used.

Garnet has been mined in Ontario - in Ashby township, Addington county, and in Dana township, about 20 miles northwest of Sturgeon Falls. There are other garnet properties of interest in Canada, some of which are in the Sudbury area.

Garnet is almost totally used in garnet papers and cloths. Loose grains can be used for sand-blasting and metal-spraying, but the commodity commonly is not able to compete economically with quartz.

Grindstones, Oilstones, Pulpstones, etc.

Suitable sandstone deposits for the manufacture of grindstones, oilstones, pulpstones, etc., are found in Nova Scotia, New Brunswick and British Columbia. Minor shipments have been made from a stockpile in the Bay of Chaleur district but there has been no appreciable production in Canada for a number of years. Some of the deposits of the Maritime Provinces were worked extensively in the past, but bonded silicon carbide was recently substituted for natural abrasives in pulpstones,and some natural grindstones are being imported from the United States and Europe.

Pumice and Pumicite

Pumice and pumicite are glassy silicates of aluminum that were ejected from volcanoes. 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.

Both occur in Canada in very thin beds. 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. Extensive but thin beds of pumicite occur in Saskatchewan, Alberta and British Columbia, generally far removed from markets.

Pumice is used in polishing compounds, abrasive soaps, acoustic stucco and plaster and as a lightweight aggregate in concrete. Pumicite is employed in the preparation of wood and metal surfaces and in glass-polishing.

Other Natural Abrasives

Other natural abrasives consumed in Canada include tripoli, diatomite, lava and calcareous tufa.

Prices

Bauxite

E & M J Metal and Mineral Markets, Dec. 19, 1957: abrasive grade, crushed and calcined 80 to 84% Al_2O_3, f.o.b. Arkansas mines, per long ton, $17; crude (not dried) 50 to 52%, f.o.b. Arkansas mines, $5 to $5.50.

Corundum

E & M J Metal and Mineral Markets, Dec. 19, 1957: crude, c.i.f. U.S. ports, per short ton $100 to $120, nominal.

Pumice stone

E & M J Metal and Mineral Markets, Dec. 5, 1957: f.o.b. New York or Chicago, in barrels, powdered, per lb, 3¢ to 5¢; lump, 6¢ to 8¢.

Silica

E & M J Metal and Mineral Markets, Dec. 5, 1957: air-floated, 92 to 99 1/2% through 325-mesh, in bags, per short ton $22 to $35.

Tripoli

E & M J Metal and Mineral Markets, Dec. 5, 1957: paper bags, minimum carload 30 tons, f.o.b. Missouri, per short ton - once ground through 40-mesh, rose and cream-coloured, $50; double-ground through 110-mesh, rose and cream, $52; air-floated through 200-mesh, $55.

Abrasives

Emery

Average value of emery grains used in Canada 1957, per ton, $179.

Garnet

Average value of garnet grains consumed in 1957, per ton, $273.

Quartz or Flint

Average value of quartz or flint grains consumed in 1957, per ton, $68.

Note: There are no current market quotations for the last three items.

LIGHTWEIGHT AGGREGATES

by
H.S. Wilson

The lightweight-aggregate industry as a whole showed little change in production from 1956. The individual types of aggregate presented a somewhat mixed picture of increase and decrease. Expanded-clay-and-shale aggregate increased 12 per cent as some of the newer plants had their first full year of production. Expanded slag decreased about 20 per cent. Vermiculite increased slightly in volume and decreased in value. Expanded perlite increased 20 per cent; one new plant began operations. The output of pumice, which is comparatively small, was lower than in 1956.

Production of Lightweight Aggregates*

	1957		1956	
	Cubic Yards	$	Cubic Yards	$
From domestic raw materials				
Expanded clay and shale.......	240,285	1,333,700	215,000	1,190,000
Expanded slag	189,500	443,000	242,000	547,500
	Cubic Feet		Cubic Feet	
From imported raw materials				
Exfoliated vermiculite**.......	7,361,760	1,473,700	6,928,070	1,535,800
Expanded perlite	2,762,700	707,200	2,317,000	583,600
Pumice		78,000		110,000
Total		4,035,600		3,966,900

* Information in the table was supplied by the producers.
** A small proportion of the raw vermiculite used was mined from a deposit near Perth, Ontario.

Lightweight Aggregates

Types of Lightweight Aggregate

The five lightweight aggregates can be classified into two types, namely, high-strength and low-strength. The high-strength aggregates - clay, shale, slag and pumice - are generally used in load-bearing concrete. Vermiculite and perlite, owing to their low unit weight and good insulating qualities, are used for insulating purposes and non-load-bearing concrete and plaster.

Raw Materials

The 'common' clays and shales are the most widespread of the materials used in the production of lightweight aggregate. Nine plants were in operation during the year, the one longest in production being at Cooksville, Ontario. The others are at Winnipeg, Regina, Calgary and Edmonton and at Abbotsford, British Columbia. The nine plants use rotary kilns to expand the raw material.

Expanded blast-furnace slag is a by-product of the iron-and-steel industry. This 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. Most of the raw vermiculite exfoliated in Canada is imported from the Transvaal, Union of South Africa, and the United States. Four companies produce vermiculite from imported raw material at 10 locations, namely, Vancouver, Calgary, Regina, Winnipeg, St. Thomas, Cornwall, Rexdale, Toronto, St. Laurent and Montreal. The one plant exfoliating domestic vermiculite is near Perth, Ontario, the raw material being from local deposits. The area is underlain by rocks of Precambrian age. The vermiculite occurs associated with Grenville metamorphic pyroxenites, amphibole, and mica schists.

Perlite is a volcanic rock which pops when heated and thus forms 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. Six plants were in operation during the year. They are located at Caledonia and Hagersville in Ontario, and at Montreal, Winnipeg, Calgary and New Westminster.

Pumice is a highly vesicular material of volcanic origin and 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 are too far from transportation facilities.

Lightweight Aggregate Plants in Canada

Company	Location	Aggregate
Burtex Industries Limited	Calgary, Alta.	Expanded shale
Consolidated Concrete Industries Ltd.	Calgary, Alta.	" "
The Cooksville Company Limited	Cooksville, Ont.	" "
Clayburn Harbison Ltd.	Abbotsford, B. C.	" "
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.	" "
Winnipeg Light Aggregate Ltd.	Transcona, Man.	" "
Dominion Iron and Steel Limited	Sydney, N. S.	Expanded slag
National Slag Limited	Hamilton, Ont.	" "
Canadian Gypsum Company Limited	Hagersville, Ont.	Perlite
Canadian Perlite Corporation	Montreal, Que.	"
Gypsum Lime and Alabastine (Canada) Limited	Caledonia, Ont.	"
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.	"
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.	"
Northern Vermiculite Limited	Perth, Ont.	"
Siscoe Vermiculite Mines Limited	Cornwall, Ont.	"
	Rexdale, Ont.	"
Vermiculite Insulating Limited	St. Laurent, Que.	"
McCleery and Weston Limited	Vancouver, B. C.	Pumice
Plant under Construction		
Quebec Lightweight Aggregates Mining Corporation	Pierreville, Que.	Expanded clay

Uses

Clay and Shale

In 1957 approximately 85 per cent of the production of these aggregates was used for the production of concrete blocks and other lightweight concrete shapes, 11 per cent in ready-mix concrete, and 4 per cent as loose insulation and roofing aggregate, in the manufacture of cement, and as a carrier for fertilizers and weed killers.

Expanded Slag

Ninety per cent of production was used as aggregate in concrete block, and 10 per cent as aggregate in other pre-cast concrete shapes.

Vermiculite

Sixty-six per cent of expanded vermiculite was used as loose insulation, 28 per cent in insulating plaster, 2 per cent as aggregate in lightweight concrete, and 4 per cent in acoustic plaster, heat-insulating materials, fertilizer conditioner and underground-pipe insulation.

Perlite

Eighty-six per cent of expanded perlite was used in lightweight plaster, 7 and 2 per cent respectively in concrete shapes and ready-mix concrete, 3 per cent as oil-well drilling cement and 2 per cent in other commodities such as loose insulation, stucco admix, acoustical plaster and acoustical tile.

Pumice

All the pumice was used in the production of concrete block.

Prices

Expanded-clay-and-shale aggregate sells within the range of \$5 to \$6.50 a cubic yard and expanded slag at \$2.25 to \$3.25 a cubic yard. Vermiculite sells at 15 to 30 cents a cubic foot, depending upon the area in which the plant is located, and perlite at 25 to 35 cents a cubic foot. Vermiculite and perlite are marketed in bags containing 4 cubic feet.

ARSENIC TRIOXIDE

by
J.S. Ross

Refined arsenic trioxide, arsenious oxide, or white arsenic, 99 per cent pure, is the most commonly consumed form of arsenic. Metallic arsenic is produced in minor amounts in some countries other than Canada. To prevent air and stream pollution, arsenic trioxide 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.

Arsenic trioxide has been produced in Canada almost continuously since records were first kept in 1885. Deloro Smelting and Refining Co. Ltd., Deloro, Ontario, is the sole producer. Shipments in 1957 were the highest since 1942 and were more than twice the quantity shipped in 1956.

Exports were the highest since 1945. The almost threefold increase in exports over 1956 is credited to increased sales to the insecticide industry for control of the boll weevil in the southern United States.

World recovery of arsenic and arsenic compounds amounted to an estimated 43,000 short tons in 1957, with Sweden the leading producer. Canada recovers approximately one tenth of what Sweden recovers, but it will be self-sufficient in arsenic trioxide for the foreseeable future.

Domestic Production

Deloro Smelting and Refining Co. Ltd. recovers arsenic trioxide as a by-product from the smelting of cobalt-silver concentrates from the Cobalt and Gowganda areas of northern Ontario. Arsenic occurs in these concentrates as arsenides and sulpharsenides of cobalt, iron and nickel. The arsenic recovery plant was operated at capacity during the year. Capacity varies with the arsenic content of the custom ores. When output exceeds demand, the surplus can be stored indefinitely.

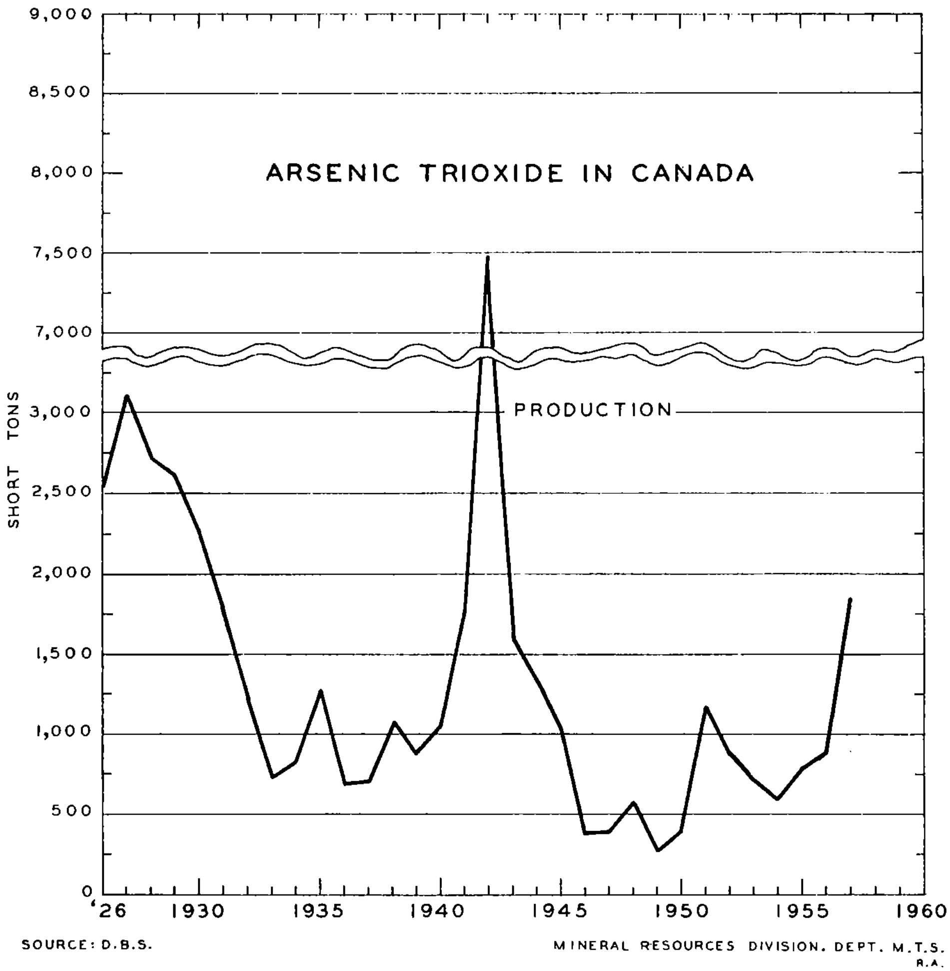
Other Domestic Sources

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.

Arsenic - Production, Trade and Consumption

	1957		1956	
	Pounds	$	Pounds	$
Production (shipments)[1]				
Refined As_2O_3	3,697,317	137,112	1,790,381	77,612
Exports[2]				
United States	3,207,400	119,141	1,088,400	46,968
United Kingdom	22,400	475	-	-
Other countries	-	-	79,700	3,514
Total	3,229,800	119,616	1,168,100	50,482
Imports				
Arsenious oxide and arsenic sulphide				
United States	1,559	420	16,320	1,691
Arsenic acid				
United States	519,631	18,262	408,840	14,490
Arsenate of lead				
United States	73,056	15,421	133,671	26,161
Arsenate of lime				
United States	81,000	4,952	12,000	888
Arsenate Binarseniate and stannate of soda				
United States	89,202	38,182	61,120	33,376
United Kingdom	67,200	5,703	11,200	1,105
Total	156,402	43,885	72,320	34,481
Grand total		82,940		77,711
Consumption				
Refined white arsenic (As_2O_3)				
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_3O_5)				
Miscellaneous chemicals ...	533,023		376,826	
Metallic arsenic				
White-alloy industry	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.



An appreciable quantity of crude white arsenic containing about 70 per cent As_2O_3 is stored at the properties of two former gold mines in western Quebec, namely, Beattie-Duquesne Mines Limited and O'Brien Gold Mines Limited, which roasted arsenical gold ores to improve the recovery of gold in cyanidation. The by-product, crude white arsenic, had to be recovered to prevent air and stream pollution.

Giant Yellowknife Gold Mines Limited and the Con and Rycon mines at Yellowknife, Northwest Territories, also roast arsenical ores to improve recovery. The crude arsenic trioxide recovered at the Giant mine is disposed of underground in specially prepared rooms.

Arsenic

Previously, Deloro Smelting and Refining Co. Ltd. recovered arsenic trioxide from arsenical residues from the plant of Eldorado Mining and Refining Limited, at Port Hope, Ontario. However, owing to a recent change in refining procedure, all arsenic currently produced by Eldorado is disposed of in solid form in a dump. Current concentrates are now much lower in arsenic. Some of the arsenical residues from former furnace operations are being sold to a company in the United States.

Minor amounts of arsenic are present in many other metalliferous deposits in Canada.

Use and Consumption

Arsenic compounds are used mainly in weed killers and wood preservatives and for debarking trees. The newer method of killing trees with sodium arsenate is becoming more widespread. This method reduces peeling, drying and the transportation costs of the pulpwood.

Until a few years ago about 70 per cent of the world output of arsenic trioxide was used in the manufacture of insecticides, rodenticides and other pesticides. Its consumption as an insecticide in the United States varies with the bool weevil menace in the southern states. In recent years organic and inorganic compounds have generally replaced calcium and lead arsenates in controlling insects and rodents. Pests, however, become immune to these new compounds and it is necessary to rotate the compounds with a different type of poison. Thus the use of arsenic compounds for this purpose may not disappear altogether.

The glass industry, the world's third largest consumer of arsenic, uses it to decolour glass. This industry accounted for 84 per cent of the arsenic consumed in Canada in 1956.

Compounds of arsenic are used in the tanning of hides, in paint pigments and for other minor purposes.

Most of the small consumption of arsenic metal is used in hardening lead shot and in making certain copper alloys.

Prices

The price of arsenic trioxide during 1957, as quoted by E & M J Metal and Mineral Markets, was 5 1/2 cents a pound powdered in barrels and carload lots. This price has remained unchanged since it was reduced from 6 1/2 cents a pound in August 1952.

ASBESTOS

by

H. M. Woodrooffe

Despite a period of business recession experienced generally on this continent during the last half of 1957, asbestos shipments were maintained at the high level of the past two years. Three per cent more fibre moved to the market, largely owing to abnormal shipments during September in anticipation of an increase in producers'prices. The value of shipments reached an all-time peak at $104,489,431.

For the second successive year, shipments of Group 4 were at a record level owing to the increasing demand for fibre of this grade in the manufacture of asbestos cement products.

Domestic consumption of asbestos remains small and almost all of Canada's production is exported to world markets. In 1957, shipments to the United States amounted to 48 per cent of the total value of asbestos exports. In overseas markets, and especially in Europe, Canadian fibre is experiencing competition from Russia and Rhodesia.

The significant developments in the industry during the year were confined largely to Quebec, the major producer. Expansion of facilities is in progress which, since 1950, when it commenced, has involved capital expenditures of close to $100 million. Three new mines will come into production in Quebec during 1958, increasing Canada's capacity for producing asbestos fibre by 15 per cent.

Exploration activity continued in Yukon, northern British Columbia, Quebec and Newfoundland.

Chrysotile, crocidolite and amosite are the three principal varieties of asbestos minerals important to industry, and of these only chrysotile is mined in Canada. Production has been continuous from the Eastern Townships of Quebec since 1878.

Chrysotile occurs in several places in northern Ontario, Quebec, Newfoundland, British Columbia and Yukon, but most of the occurrences are not of economic grade. Consequently production is restricted to British Columbia, Ontario and Quebec, with the last contributing 95 per cent of Canada's output of asbestos fibre.

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.

Asbestos - Production and Trade

	1957		1956	
	Short Tons	$	Short Tons	$
Production				
By shipments				
Crude	622	589,410	717	692,677
Milled fibres	404,016	73,219,785	392,983	69,397,107
Shorts and refuse	641,448	30,680,236	620,549	29,770,185
Total	1,046,086	104,489,431*	1,014,249	99,859,969*
By provinces				
Quebec	993,425	93,616,875	967,145	90,531,457
British Columbia	31,714	7,342,986	20,356	5,398,730
Ontario	20,947	3,529,570	26,748	3,929,782
Total	1,046,086	104,489,431*	1,014,249	99,859,969*
Exports				
Crude				
United States	233	197,432	210	173,970
United Kingdom	146	173,708	150	180,655
Japan	82	70,251	61	53,372
France	81	46,858	42	40,005
West Germany	32	23,894	65	50,926
Other countries	64	55,588	32	27,287
Total	638	567,731	560	526,215
Milled fibres				
United States	139,200	25,702,535	157,953	28,430,591
France	30,821	6,408,703	22,723	4,668,432
West Germany	30,608	5,965,602	24,382	4,443,312
United Kingdom	28,262	6,190,473	35,530	8,155,299
Japan	25,121	3,792,439	26,050	3,857,538
Belgium	20,490	4,008,821	17,360	3,351,391
Australia	18,869	3,335,847	12,235	1,968,017
Netherlands	8,770	1,773,024	6,518	1,174,365
Other countries	91,170	16,771,245	74,293	12,978,655
Total	393,311	73,948,689	377,044	69,027,600

Asbestos - Production and Trade (cont'd)

	1957		1956	
	Short Tons	$	Short Tons	$
Waste, refuse and shorts				
United States	505,124	25,122,789	468,493	23,413,004
United Kingdom	37,809	1,645,007	36,290	1,699,008
West Germany	30,350	1,610,115	27,236	1,411,464
Japan	13,522	1,097,680	15,191	1,225,177
France	11,774	673,585	8,812	571,743
Netherlands	10,649	496,530	5,219	289,500
Belgium	7,660	497,934	5,016	325,105
Other countries	19,723	1,398,349	20,060	1,406,031
Total	636,611	32,541,989	586,317	30,341,032
Asbestos brake linings and clutch facings				
Colombia		131,782		214,536
Cuba		49,110		34,372
Mexico		45,318		120,680
Venezuela		26,287		21,912
Other countries		285,375		221,767
Total		537,872		613,267
Asbestos packing				
Switzerland		11,681		12,577
Brazil		651		-
El Salvador		524		480
Other countries		1,297		30,041
Total		14,153		43,098
Other asbestos manufactures including asbestos roofing				
United States		1,289,810		3,078,456
Jamaica		16,391		5,107
Switzerland		10,623		-
Venezuela		6,247		-
Other countries		5,001		3,300
Total		1,328,072		3,086,863
Total exports of asbestos manufactured products		1,880,097		3,743,228

(continued)

Asbestos - Production and Trade (cont'd)

	1957		1956	
	Short Tons	$	Short Tons	$
Imports (manufactures)				
Packing		296,701		326,295
Auto brake linings		432,495		486,776
Auto clutch facings.....		329,426		394,673
Other brake linings and clutch facings		186,379		224,704
Other asbestos manufactures		3,912,050		3,951,187
Total................		5,157,051		5,383,635

* Does not include value of shipping containers. Value of containers in 1956 was $3,391,833; in 1957 it was $3,506,165.

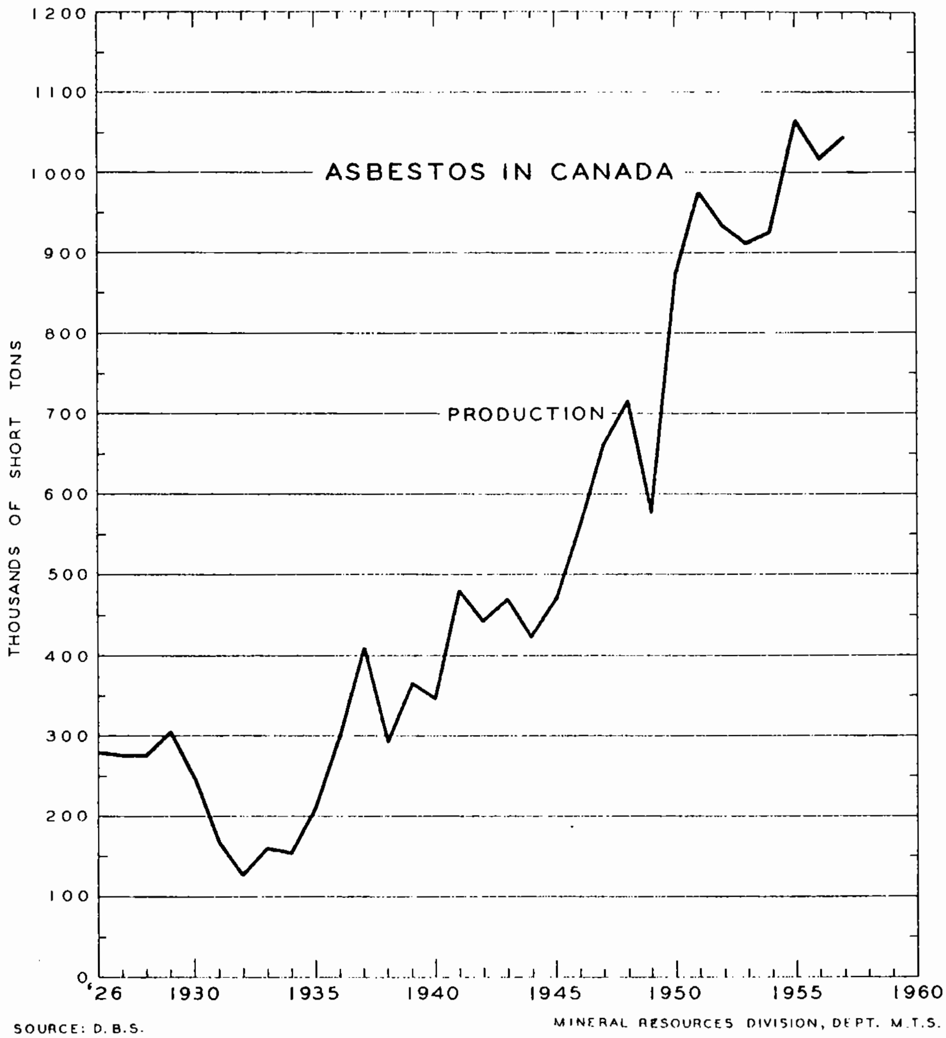
Asbestos - Production and Exports, 1947-57

(short tons)

	Production (shipments)				Exports			
	Crude	Milled	Shorts and Refuse	Total	Crude	Milled	Shorts and Refuse	Total
1947	958	222,196	438,667	661,821	953	223,693	412,250	636,896
1948	977	241,953	473,839	716,769	872	237,077	452,493	690,442
1949	652	194,583	379,671	574,906	631	181,641	352,718	534,990
1950	904	305,194	569,246	875,344	845	289,798	539,336	829,979
1951	748	333,001	639,449	973,198	660	324,594	617,060	942,314
1952	741	351,644	576,954	929,339	692	339,818	561,548	902,058
1953	781	326,340	584,105	911,226	638	316,588	561,304	878,530
1954	725	326,653	596,738	924,116	641	312,844	574,243	887,728
1955	724	395,096	667,982	1,063,802	586	365,980	635,261	1,001,827
1956	717	392,983	620,549	1,014,249	560	377,044	586,317	963,921
1957	622	404,016	641,448	1,046,086	638	393,311	636,611	1,030,560

Two mines are in operation outside Quebec, one near Matheson in northern Ontario and the other at Mount McDame in northern British Columbia.

Chrysotile generally occurs in two forms, a 'cross fibre' and a 'slip fibre'. In the former type the individual fibres lie across the vein in a parallel



manner, and the vein width indicates the fibre length. Fibres as long as 5 inches occur, but most of the production is from fibres one-half inch or less in length. Slip fibre is usually deposited along fault planes and the fibres lie in an overlapping manner. Much of the production from the region east of Thetford Mines, Quebec, is of this type. The physical properties of asbestos vary with its occurrence. Quebec produces a fine, silky fibre ideally suited for spinning; Ontario produces a harsh-textured fibre that is of importance in the asbestos cement product field, where it contributes desirable fast-filtering qualities. British Columbia asbestos is low in magnetite and is thus advantageous in heat-resistant, woven insulation used for electrical purposes.

Other forms of asbestos, such as fibrous tremolite, actinolite and anthophyllite, occur in various places in Canada, but none are being produced. The fibres of these varieties are usually weak and not suited for the manufacture of textiles. There are, however, certain uses for which their natural chemical and physical properties are suited. During the war, a small production of tremolite was reported in eastern Ontario. Occurrences of crocidolite are known to exist in the iron-ore region near the Labrador-Quebec boundary.

Production and Development

Newfoundland

Chrysotile occurs in several places in Newfoundland and Labrador. Recently an important deposit of semi-harsh fibre of good quality was discovered in the Baie Verte area of Burlington peninsula. Advocate Mines Limited has completed an extensive development program, and has outlined a deposit of sufficient size to support an open-pit operation. The company estimates ore reserves at 23 million tons and is planning construction of a 2,000-ton-a-day mill.

Quebec

Several major development projects which will increase the production capacity of this province are being completed by the asbestos industry.

Asbestos is produced in the southern part of the province in the counties of Richmond, Arthabaska, Megantic and Beauce. Eleven producing mines are located 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. Although it was originally an open-pit mine, production is principally from underground by the block-caving method. During the year installation of four additional primary milling lines to the new Jeffrey mill was completed. These will replace obsolete facilities in the old mill.

Asbestos Corporation Limited operates an underground mine, the King, at Thetford Mines, and three open-pit properties - the Normandie in Ireland township, the British Canadian at Black Lake and the Beaver in Thetford Mines. The company is modernizing its production facilities at Thetford Mines. The Beaver mill was shut down during the summer and is being rebuilt to an enlarged capacity of 5,000 tons a day. The new mill, which will process the combined output of the King and Beaver mines, is scheduled for completion in the summer of 1958.

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 located at Thetford Mines.

Open pits are worked by Flintkote Mines Limited a few miles east of Thetford Mines, Nicolet Asbestos Mines Limited at St. Remi de Tingwick, and Quebec Asbestos Corporation Limited at East Broughton. The last, through an associated company, Carey Canadian Mines Ltd., is completing a 2,500-ton-a-day mill at a new property near Tring Junction. Production, largely of 'shorts' from a slip fibre deposit, is scheduled for early 1958.

Lake Asbestos of Quebec Limited, a subsidiary of American Smelting and Refining Company, is preparing a large deposit for production at Black Lake. A 5,000-ton-a-day mill was virtually completed and shipments of fibre are expected to commence in mid-1958. Preparing this deposit for production was an important engineering task requiring draining of Black Lake and removal of large quantities of silt and waste.

National Asbestos Mines Limited, a subsidiary of National Gypsum (Canada) Limited, is completing a mill east of Thetford Mines. Production is scheduled for early 1958.

Ontario

The Munro mine of Canadian Johns-Manville Company east of Matheson in northern Ontario is the only producing asbestos property in the province. Development of underground mining was continued, production being planned for mid-1958.

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.

World Review

Since statistics of Russian production are lacking, it is possible only to estimate world production. Canada's output in 1957 approached 51 per cent of the world's production of 2,050,000 tons.

Asbestos is mined in several countries in varying amounts. However, Russia and Southern Rhodesia are, following Canada, the major producers of chrysotile and offer this country the greatest competition in overseas markets.

Russia has extensive deposits of chrysotile in the Ural region and elsewhere. These have been developed to provide for domestic needs and permit export of fibre of good quality to several Eurpoean countries in increasing quantity.

The Union of South Africa, Southern Rhodesia, and Swaziland all produce considerable fibre. Most of the world's crocidolite, is mined in the Transvaal and Cape provinces of South Africa, where amosite, a unique variety used in the manufacture of thermal insulation, is also produced.

During 1957 Southern Rhodesia produced 132,124 tons of chrysotile, mostly in medium- and long-fibre grades. This asbestos is characterized by low iron impurities and finds a market in the manufacture of textiles, especially for electrical use. Production from this source has increased to more than double in the past 10 years.

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 way as organic textile fibres. It is carded, spun and woven into cloth for use in the manufacture of heat-resistant friction materials, packing, and electrical insulation, and in fire-resistant applications. Asbestos may be combined with cement for the manufacture of many useful building materials. This branch of the industry has shown considerable growth since the war, and asbestos-cement building materials have an established place on this continent and in Europe. The principal products are shingle, tile, millboard, siding for enclosing building structures, and pipe for municipal water supply and distribution and for disposal of sewage waste. The durability and corrosion resistance of asbestos-cement products have contributed to their wide use. Asbestos is used in the manufacture of thermal insulation and asbestos paper.

The shorter grades are used in a variety of ways. 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 are an important use for very short grades of fibre.

Prices

The price of Canadian asbestos remained constant until October, when it was increased. Year-end prices in carloads lots, Canadian funds, f.o.b. Quebec producers, are as follows:

No. 1 crude			$1,480	per short ton
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 and grades of the sole producer in British Columbia at the end of 1957 are published as follows:

No. 1 crude	$1,522
AAA fibre	787
AA fibre	682
A fibre	494
AC fibre	325
AK fibre	220

BARITE

by
J.S. Ross

Barite, the naturally occurring form of barium sulphate, is at present the only barium mineral of economic importance in Canada. Although barite is reported to occur in all provinces except Alberta, Saskatchewan and Prince Edward Island, only three deposits were mined by two companies in 1957 in Nova Scotia and British Columbia. Reserves are adequate to supply normal Canadian requirements for many years.

Production decreased more than 28 per cent in quantity from the record year of 1956 and was the lowest since 1952. This lower output was the result mainly of a decrease of 42 per cent in shipments of crude barite caused by the physical limitations of the open pit of Magnet Cove Barium Corporation (Canadian Division), near Walton, Nova Scotia. In 1957 Canada dropped from third to fourth position as a world barite producer, third place going to Mexico, which exported 429,537 tons. World output for 1957 is estimated at 3,500,000 short tons.

Exports were down more than 54 per cent in quantity from those of 1956. Imports, which consisted of ground barite, went up by 24 per cent owing to greatly increased amounts from the United States. Approximately 83 per cent of consumption in 1956 was in the oil well drilling industry.

Domestic Producers

The largest Canadian barite mine, owned and operated by Magnet Cove Barium Corporation (Canadian Division), is near Walton, Hants county, at one of the world's largest known barite deposits. The official estimate of ore reserves, made on December 31, 1954, was 2,705,970 long tons. In 1957 this mine produced more than 92 per cent of the barite mined in Canada. Practically all production has been from an open pit, which closely approached its maximum economic depth at the end of the year. A minor amount of ore was hoisted as a result of the underground developments under way since 1956. This program, scheduled for completion early 1958, will allow all ore to be produced by underground block-caving methods. At the end of 1957 the shaft, to be sunk to a proposed depth of 1,000 feet, was approximately 850 feet deep. Levels have been established at 350, 520, and 690 feet.

Barite - Production, Trade and Consumption

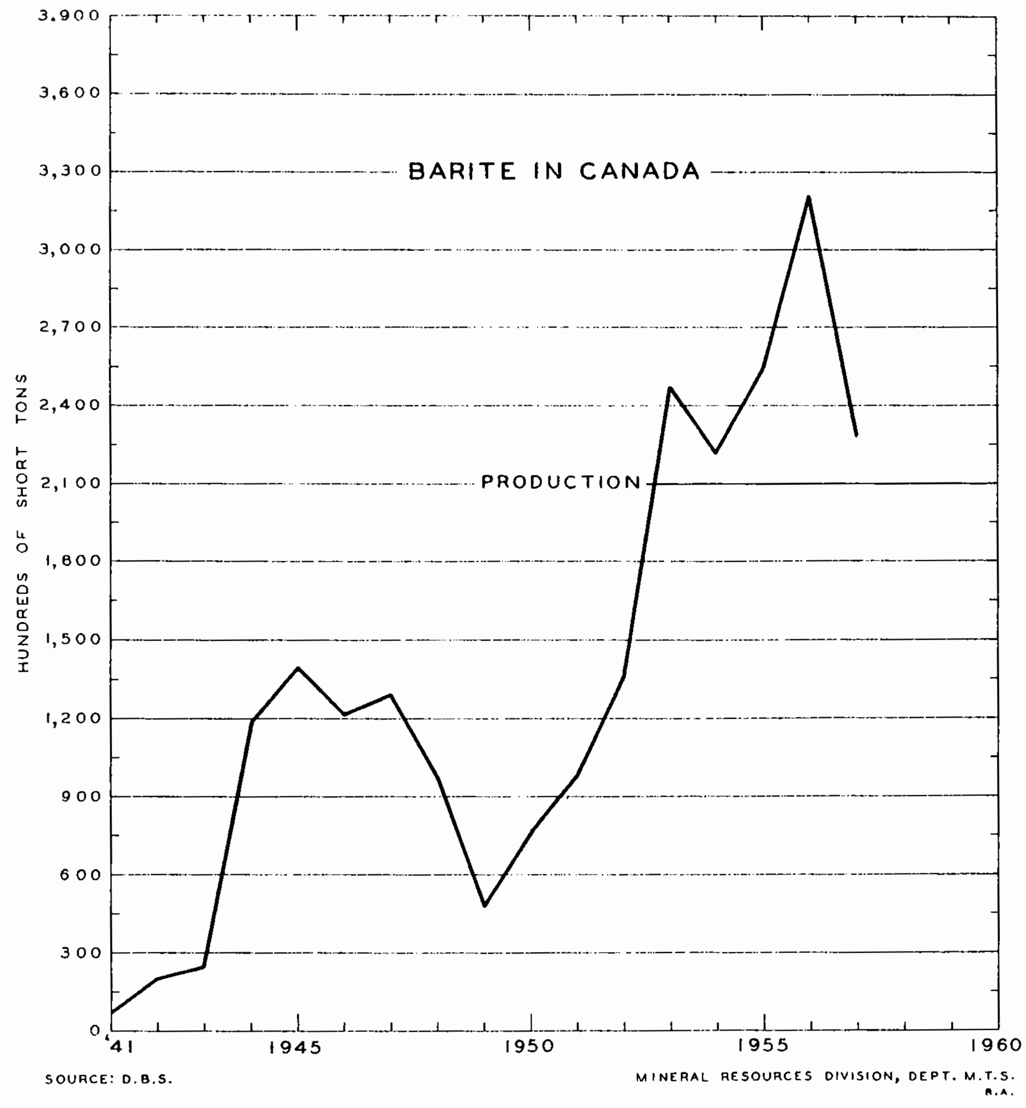
	1957		1956	
	Short Tons	$	Short Tons	$
Production (mine shipments)				
Crude	140,243	1,099,506	243,398	1,721,571
Ground	87,805	1,893,407	77,437	1,309,463
Total	228,048	2,992,913	320,835	3,031,034
Imports (ground)				
United States	1,427	47,682	897	37,053
West Germany	364	9,037	538	12,514
Italy	40	1,290	40	1,261
Total	1,831	58,009	1,475	50,828
Exports* (crude)				
United States	109,180	745,394	240,650	1,707,597
Consumption (available data)				
Glass	301		331	
Asbestos products			64	
Rubber goods	525		492	
Paints	962		869	
Oil-well drilling	12,000(e)		12,000(e)	
Miscellaneous chemicals			93	
Miscellaneous non-metallics			600(e)	
Total			14,449	

* Not recorded separately in the official Canadian trade statistics. The figures shown are reported in United States import statistics. Barite is also shipped to some South American countries, but the quantities are not available.

(e) Estimated.

Ore is trucked 2 1/2 miles to the mill at the port of Walton on the south shore of Minas Basin. Here, crude and ground barite are produced ready for shipment, mainly by boat. Construction of a modern beneficiation plant at the mine site was started in May. The plant, scheduled for operation early in 1958, is to have a rated capacity six times that of the old one and will be capable of beneficiating lower-grade material. Crude barite, the main product, is shipped largely to processing plants at United States ports along the Gulf of Mexico. The ground product is used mainly as a heavy medium in oil well drilling muds in Canada, the United States, Venezuela, Iran, Arabia, Trinidad and Indonesia.

Barite


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.
R.A.

British Columbia

Two barite vein deposits are quarried at Brisco and Parson in the Kootenay district by Mountain Minerals Limited. A primary crushing unit and a railway spur were constructed at Brisco during the year. All ore is shipped by rail to the plant at Lethbridge, Alberta, where it is processed further. It is finally shipped as ground barite, mainly for use in oil well drilling muds in western Canada.

Other Occurrences

Several smaller barite deposits have been mined intermittently, particularly during the early part of the century. There are numerous barite occurrences in most provinces, the more noteworthy being near Lake Ainslie and Brookfield, Nova Scotia; at St. Fabien, Quebec; on McKellar Island, in Lake Superior, near Port Arthur; in Penhorwood township, Sudbury district, and Langmuir township, Timiskaming district, northern Ontario; and in the form of gangue at the property of Giant Mascot Mines Limited, in 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 carried out on several barite deposits in Nova Scotia during 1957.

Uses and Specifications

Approximately 75 per cent of the world production of barite is used in oil-well drilling as a heavy medium in drilling mud to control gas and oil pressures and to float drill cuttings. Although figures are not available, probably a larger percentage of Canada's production is used in and is dependent upon oil and gas exploration and production. Specifications vary according to the particular needs of the consumer, but they commonly 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, as an extender and pigment in paints and a filler in paper; lithopone, as a white pigment in paints; barium chloride, for case-hardening and preventing scumming of brick; barium carbonate, to reduce scumming of brick and ceramics and in oil well drilling fluids. Barium oxide, hydrate, titanate, chlorate, nitrate, sulphide and phosphate are also manufactured.

Barium Compounds - Imports and Consumption

	1957		1956	
	Short Tons	$	Short Tons	$
Imports				
Lithopone (70% $BaSO_4$)				
United Kingdom	534	73,953	1,001	159,453
United States	435	79,814	826	126,715
West Germany	239	31,015	356	49,084
Other countries	157	12,636	112	13,015
Total	1,365	197,418	2,295	348,267
Blanc fixe				
West Germany	215	13,398	191	12,497
United States	101	18,255	164	17,687
Other countries	55	9,904	93	12,578
Total	371	41,557	448	42,762

	1956	1955
Consumption of the main barium compounds in the chemical- and allied-products industry		
Barium chloride	328	258
Barium nitrate	83	80
Barite	962	1,058
Blanc fixe	472	450
Lithopone	1,845	1,893

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.

Lithopone, previously the major source of white pigment for paint, has now been extensively replaced by titanium oxide, which has greater covering power. Consumption of lithopone in Canada decreased approximately 30 per cent in 1955 from that of 1954, and is expected to diminish even more. Barite is the most desirable commodity for use as a heavy oil well drilling medium, and it is not likely to be replaced by substitutes in the near future.

Prices

Prices quoted in E & M J Metal and Mineral Markets on December 19, 1957, were as follows:

Canada

Crude, in bulk, f.o.b. shipping point	$11 per long ton
Ground, in bags	$16.50 per short ton

Georgia

Crude, jig and lump	$18 per net short ton
Beneficiated	
In bulk	$21 per net short ton
In bags	$23.50 to $25 per net short ton

Missouri

Water-ground and floated, bleached, car lots f.o.b. works	$45 to $49 per short ton
Crude, minimum 94% $BaSO_4$, less than 1% iron	$16 to $18 per short ton
Crude, oil well drilling, minimum specific gravity 4.3	
Bulk	$18 per short ton
Some restricted sales	$11.50 per short ton
Ground, oil well grade	$26.75 per short ton

There was a slight increase in prices for some grades of barite in Missouri during 1957.

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. Canadian tariffs are reviewed periodically, and the current ones may be obtained from the Tariff Board, 70-74 Elgin Street, Ottawa.

BENTONITE

by
R. M. Buchanan

The term 'bentonite' is applied to clay materials in which the principal constituent is a member of the montmorillonite group of clay minerals, i. e., montmorillonite, beidellite, nontronite, hectorite, or saponite. The name was originally applied to a clay material with peculiar properties found in Wyoming, in the Fort Benton formation of Upper Cretaceous age.

Bentonitic materials, as defined by modern usage, can usually be shown to have been deposited as volcanic ash, although the term is also applied to montmorillonite clay of supposed hydrothermal origin. Not all bentonites possess the properties of the clay from the type locality and there is considerable variation in composition, swelling properties, thixotropy and cation-exchange capacity. In general, they are classified as either swelling (sodium) bentonite or non-swelling (calcium) bentonite. It is likely, however, that there is a continuous variation in composition and properties and that the distinction is artificial.

For some uses certain properties of bentonite are enhanced by cation exchange, usually of sodium for calcium, or by treatment with strong acids (acid activation).

This loose definition of bentonite includes those clays which, in some other countries, are referred to as fuller's earth. In the United States the distinction is usually made on the basis of the absorbent properties, fuller's earths being those montmorillonite clays which decolourize animal, vegetable or mineral oils without acid activation. In England calcium bentonites are referred to as fuller's earth.

Canadian Occurrences

Bentonite deposits occur in many places in the western provinces. None are known to exist east of Manitoba. The favourable rocks appear to be those of Cretaceous age or younger.

Manitoba

The bentonite horizon in which the Pembina Mountain clays deposit is located has been traced from the United States border northward to Miami, a distance of 35 miles. It varies in thickness, purity and depth of cover, but a favourable deposit has been reported in a publication of the Mines Branch of

Manitoba's Department of Mines and Natural Resources as occurring on Deadhorse Creek (twp. 2, range 6, W 1st meridian). Other occurrences have been noted as far to the northwest as Swan River. One, for example, is on Henderson Creek about 6 miles west of Laurier (twp. 22, range 16, W 1st meridian).

Saskatchewan

Several deposits of bentonite are known to exist in Saskatchewan. Results of diamond-drilling on some of them and of mechanical and chemical improvement tests have been published by the Saskatchewan Department of Mineral Resources. It has been shown that, although in the natural state none of the known material is suitable for oil-well drilling mud, improved material, in some cases, performed satisfactorily in drilling tests.

The largest known deposits of non-swelling calcium bentonite occur in the Vermilion River formation (Upper Cretaceous) in the northeastern part of the province, on the Swan River, north of Pelly. When activated, the material is a good oil decolourizer. Similar material is found in the Riding Mountain formation (later Upper Cretaceous) that underlies a large area in the eastern part of the province. Small deposits are known to lie south of Moosomin, but they are not considered to be of economic size. Other non-swelling bentonites, of Tertiary age, are found in the Ravenscrag formation west of Rockglen, in the south-central part of the province.

It is known that there is a large deposit of 'semi-bentonite' of Upper Cretaceous age at Knollys, along the Frenchman River valley in the Butler formation.

Swelling bentonites are found in the St. Victor-Pickthall area, in the southern part of the province, from Twelve Mile Lake eastward along the Big Muddy Valley. These are also in the Ravenscrag formation.

British Columbia

Tertiary formations containing bentonite deposits are widely distributed in the interior plateau of British Columbia. A 14-foot bed, the thickest known deposit in Canada, is exposed in a cut on the Copper Mountain branch of the Canadian Pacific Railway about 1 mile from Princeton. Test work has shown that it is a non-swelling (calcium) bentonite that possesses decolourizing properties comparable to those of other raw bleaching clays but is not amenable to acid activation.

Other deposits are located about 5 miles from Princeton on the same railway and at Quilchena, 15 miles east of Merritt. Occurrences have also been reported at the mouth of Gorge Creek in the Deadman River valley, northwest of Kamloops; at 17 Mile House on the Cariboo Highway and in the banks of the Nechako River west of Prince George.

Bentonite - Production, Imports and Consumption, 1947-57

	Production[1] ($)	Imports[2] ($)	Consumption[3] (short tons)
1947	258,327	242,483	
1948	339,713	272,586	
1949	367,868	265,793	
1950	534,873	335,971	31,544
1951	499,556	374,200	30,670
1952	388,542	460,734	30,622
1953		443,510	35,167
1954		835,433	23,844
1955		1,247,355	28,821
1956		1,484,124	30,562
1957		1,536,512	26,105

(1) Value of producers' shipments not available after 1952.
(2) Value of imports of activated clay for oil-refining only.
(3) Available data on consumption not compiled prior to 1950.

Production

Statistics on the production of bentonite in 1957 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. The non-swelling (calcium) bentonite is mined in the Morden-Miami area of Manitoba, 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. The stratigraphic horizon from which the bentonite is being mined is near the bottom of the Pembina member of the Vermilion River formation of Upper Cretaceous age.

In previous years G. L. Kidd shipped a swelling bentonite from near Drumheller, Alberta, in lump form, to the Alberta Mud Company Limited at Calgary, where it was dried, ground and bagged. However, this plant was dismantled late in 1956 and the only material sold by the company in 1957 was from the supply on hand. Most of this product was used as the dusting agent in insecticides and other pesticides, although significant amounts were used for diamond-drilling through overburden, in foundry moulding sand and for sealing irrigation channels.

Imports and Consumption

The following table gives the latest available figures for bentonite consumption and imports. Some of the smaller industrial users are not included, and some of those included may not be completely covered. Estimates of the real consumption range as high as 50,000 tons a year.

Most of the swelling bentonite used in Canada is imported, chiefly from the United States, and a large proportion of the Canadian production of activated bentonite is exported to the United States.

Bentonite - Imports and Consumption

	1957	1956
	($)	($)
Imports*		
United States	1,529,912	1,477,604
West Germany	6,600	6,520
Total	1,536,512	1,484,124
	(short tons)	(short tons)
Consumption (available data)		
Steel foundries	6,593	6,701
Soaps and cleaning preparations	396	826
Pulp and paper	69	188
Petroleum-refining	2,621	5,111
Vegetable-oil mills	305	292
Oil-well drilling	11,751	11,321
Polishes and dressings		1
Asbestos products		528
Iron castings		2,019
Miscellaneous non-metallic mineral products		976
Miscellaneous chemicals	170	199
Pelletizing	4,200(e)	2,400(e)
Total	26,105	30,562

* Activated clays for oil-refining. Includes also kaolin used in oil-refining.
(e) Estimated.

Uses

The non-swelling 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 to coat 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 greases 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 concentrates and of pyrite concentrates for sulphuric-acid manufacture, about 0. 5 to 0. 6 per cent of a swelling bentonite is used as a binder.

Prices

The prices of bentonite vary within wide limits depending upon the grade and amount of processing required.

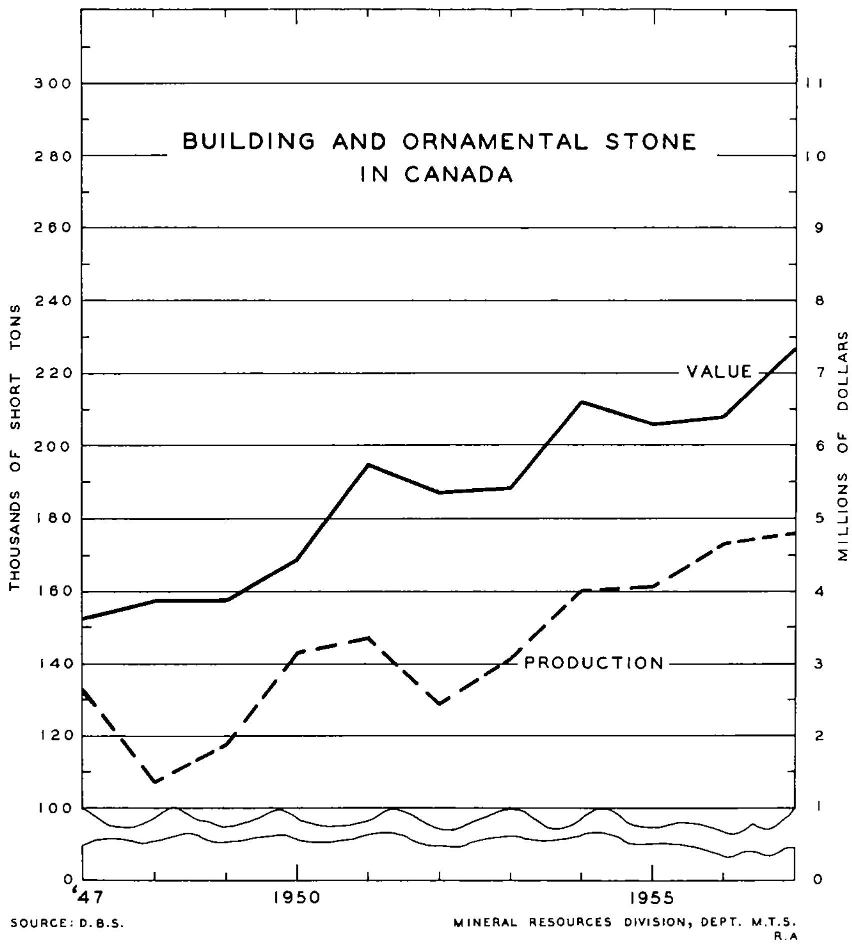
The prices of Alberta bentonite remained unchanged at $40 a short ton (90 per cent minus 200 mesh, f. o. b. Calgary), and activated bentonite delivered to points in Ontario and Quebec sold at from $60 to $80 in carload lots.

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).

BUILDING AND ORNAMENTAL STONE

by
F.E. Hanes

Production of building and ornamental stone increased in value by 15 per cent over that of 1956 to an all-time high of $7,424,172. The increase was attributed mainly to a rise in prices rather than to growth of volume. Granite and sandstone were up in value by 40.1 and 26.8 per cent respectively, while limestone decreased by 11.7 per cent and marble by 81.7 per cent. Although higher in value than it was in 1956, sandstone was 6.5 per cent lower in volume.



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PRODUCTION OF BUILDING AND ORNAMENTAL STONE, 1956

	GRANITE		LIMESTONE		MARBLE		SANDSTONE		SLATE		TOTALS	
	S. Tons	$	S. Tons	$	S. Tons	$	S. Tons	$	S. Tons	$	S. Tons	$
Building stone												
Rough	6,781	129,458	41,612	416,007	76	608	29,481	231,223	-	-	77,950	777,296
Dressed	21,461	1,732,260	38,085	2,245,736	854	80,319	1,092	92,994	-	-	61,492	4,151,309
Total	28,242	1,861,718	79,697	2,661,743	930	80,927	30,573	324,217	-	-	139,442	4,928,605
Monumental and ornamental												
Rough	8,988	224,699	-	-	8	800	-	-	-	-	8,996	225,499
Dressed	5,841	869,882	12	4,500	170	60,000	-	-	-	-	6,023	934,382
Total	14,829	1,094,581	12	4,500	178	60,800	-	-	-	-	15,019	1,159,881
Flagstone	425	5,000	3,495	33,339	-	-	8,291	149,383	-	-	12,211	187,722
Curbstone	5,767	167,785	4	76	-	-	-	-	-	-	5,771	167,861
Paving blocks	-	-	-	-	-	-	253	8,875	-	-	253	8,875
Total	6,192	172,785	3,499	33,415	-	-	8,544	158,258	-	-	18,235	364,458
Grand Total	49,263	3,129,084	83,208	2,699,658	1,108	141,727	39,117	482,475	-	-	172,696	6,452,944

PRODUCTION OF BUILDING AND ORNAMENTAL STONE, 1957*

	GRANITE		LIMESTONE		MARBLE		SANDSTONE		SLATE		TOTALS	
	S. Tons	$	S. Tons	$	S. Tons	$	S. Tons	$	S. Tons	$	S. Tons	$
Building stone												
Rough	7,734	136,344	45,851	531,672	-	-	10,417	121,204	-	-	64,002	789,220
Dressed	23,368	2,440,610	41,535	2,159,572	856	80,476	871	75,908	-	-	66,630	4,756,566
Total	31,102	2,576,954	87,386	2,691,244	856	80,476	11,288	197,112	-	-	130,632	5,545,786
Monumental and ornamental												
Rough	9,372	275,978	3	6	-	-	-	-	-	-	9,375	275,984
Dressed	6,482	909,796	-	-	180	60,394	-	-	-	-	6,662	970,190
Total	15,854	1,185,774	3	6	180	60,394	-	-	-	-	16,037	1,246,174
Flagstone	580	5,675	2,821	16,856	-	-	19,771	367,995	260	4,320	23,432	394,846
Curbstone	5,550	161,300	-	-	-	-	112	5,618	-	-	5,662	166,918
Paving blocks	-	-	-	-	-	-	-	-	-	-	-	-
Total	6,130	166,975	2,821	16,856	-	-	19,883	373,613	260	4,320	29,094	561,764
Grand Total	53,086	3,929,703	90,210	2,708,106	1,036	140,870	31,171	570,725	260	4,320	175,763	7,353,724

* Preliminary figures based on 86.5% final returns and remainder estimated on basis of 1956 final figures.

PRODUCTION OF BUILDING AND ORNAMENTAL STONE, BY PROVINCES, 1957

	GRANITE		LIMESTONE		MARBLE		SANDSTONE		SLATE		TOTAL	
	S. Tons	$	S. Tons	$	S. Tons	$	S. Tons	$	S. Tons	$	S. Tons	$
Nova Scotia	440	95,040	3	6	-	-	1,385	37,241	-	-	1,828	132,287
New Brunswick	2,562	79,061	561	1,683	-	-	480	48,600	-	-	3,603	129,344
Quebec	45,776	3,604,457	26,698	1,424,040	1,026	140,476	67	1,842	-	-	73,567	5,170,815
Ontario	1,296	36,145	57,749	864,920	10	394	29,165	482,635	-	-	88,220	1,384,094
Manitoba	-	-	5,199	417,457	-	-	-	-	-	-	5,199	417,457
Alberta	-	-	-	-	-	-	74	407	260	4,320	334	4,727
British Columbia	3,012	115,000	-	-	-	-	-	-	-	-	3,012	115,000
Total	53,086	3,929,703	90,210	2,708,106	1,036	140,870	31,171	570,725	260	4,320	175,763	7,353,724

IMPORTS OF BUILDING, ORNAMENTAL AND MONUMENTAL STONE

	1957		1956	
	Quantity	$	Quantity	$
Granite				
Rough, not hammered or chiselled	...	299,681	...	253,344
Sawn	...	107,923	...	102,812
Manufactures	...	349,932	...	299,395
Total	...	757,536	...	655,551
Marble				
Rough, not hammered or chiselled	...	79,092	...	129,910
Sawn or sand-rubbed, not polished	...	600,753	...	384,001
Not further manufactured than sawn, for the manufacture of tombstones	...	38,511	...	41,836
Ornamental or decorative	...	255,228	...	76,000
All other marble manufactures	...	92,524	...	114,000
Total	...	1,066,108	...	745,747
Slate				
Roofing (squares)	1,475	32,766	1,967	41,552
Manufactures	...	42,157	...	57,021
Total		74,923		98,573
Building stone other than marble and granite (short tons)	36,029	720,185	27,302	596,343
Total building, ornamental and monumental stone		2,618,752		2,096,214
Granite and marble, unwrought (short tons)	7,081	126,694	10,544	217,196
Freestone, limestone and other building stone, unwrought (short tons)	585	21,622	475	16,404
Stone of all kinds, dressed	...	29,597	...	112,599
Total		177,913		346,199

... means not available.

Distribution - Producing Areas

Six provinces produce practically all the building and ornamental stone obtained in Canada. Quebec and Ontario are far in the lead. In output value Quebec leads in granite, limestone and marble and Ontario is first in sandstone. To a lesser but important extent Nova Scotia and New Brunswick produce granite and sandstone, Manitoba produces limestone, and British Columbia turns out granite.

Imports

The value of imported stone for building and monumental use increased by 25 per cent over that of 1956 to $2,618,752. Marble increased in value by $320,000 to $1,006,108, granite by $100,000 to $757,536, and limestone and sandstone by $124,000 to $720,185.

In value, 61 per cent of the imports of marble came from Italy, 32 per cent from the United States, and the remainder from eight European countries. Imports of limestone, mainly 'Indiana', came from the United States. A variety of granites were imported from the United States, Sweden and Finland in the form of 'rough', sawn and manufactured products.

Building Stones by Types

The production of granite for building and ornamental stone in Canada has developed into a $4-million-a-year industry. Vast resources of suitable rock are available. However, the remote location of many otherwise fine deposits is an inhibiting factor in the development of the industry. Stone for both building and monumental use is obtainable in a wide variety of colours and textures throughout the Dominion. Granites from many areas compare favourably with imported stone and are successfully competing with lower-priced imports.

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.

Canadian limestone used in the building and ornamental industry is recognized for its fine qualities of hardness and texture. Structural, or 'dimension', limestone is used for exterior facings, sills, lintels, entrances, etc. Common practice in dressing plants is to cut and shape slabs and blocks to specified sizes and thus to eliminate further dressing after they leave the plant. Facing slabs may be as large as 2 by 4 feet and may vary from 4 to 8 inches in thickness. Supplying large numbers of slabs, particularly for use in one building, requires the production of a uniformly textured and coloured stone, free from cracks or flaws, and with good durability. A heavily bedded deposit is therefore required. Facing slabs, lintels, etc., are usually dressed with a matte finish. However, some limestones take an excellent polish, such as the St-Marc-des-Carrières stone (Deschambault). This medium-dark brown fossiliferous limestone takes a high polish with pleasing and attractive results.

Canadian marble is quarried principally in the Philipsburg area on Lake Champlain, and some minor production comes from the Stukely township area in Shefford county, Quebec. Some black marble is quarried southeast of Ottawa, near St. Albert. These quarries produce only a small fraction of all the marble used in Canada for building and ornamental purposes. Numerous other marble deposits are available for production in British Columbia, Manitoba, Ontario, Quebec and Newfoundland. Most of the producing marble companies sell chips for terrazzo and artificial-stone manufacture.

Sandstone used as building stone is quarried principally in Ontario and the Maritime Provinces. Ontario accounts for most of this production, while a few small operations in other provinces furnish stone for local consumption.

General Requirements

In prospecting for raw materials, the first requirement is that blocks of sufficient size must be obtainable. In sedimentary rocks (limestones, sandstone and marbles), the beds must be thick, i.e., at least 18 inches for marble and 2 feet for building stone, and free from other structural features in order to allow for the removal of sound durable blocks 5 feet or more in length. In granites, the spacing of joints is likely to be critical, and for this reason the space between other planes of weakness or disfiguring features must be sufficient to give 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 disfiguring 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 conditions - 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 the hammered or sand-blasted surfaces.

Producing Areas

Nova Scotia

Granite - 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. Eighty-five per cent of the granite quarried is used as monumental stone, the remainder being dressed for use as building stone.

Sandstone - Most of the sandstone quarried in Nova Scotia is produced in the Wallace area. The Wallace quarry is one of the oldest and best-known sandstone quarries in operation in Canada. The stone is olive-drab to buff in colour and has been used effectively in the building industry throughout eastern Canada. Some fine-grained dark-brown sandstone is also produced in the Antigonish area.

New Brunswick

Granite - Quarrying operations in New Brunswick are now confined to a coarse-grained, grey granite from St. Stephen (Charlotte county), a light-rose granite from Jacquet River (Antinouri Lake district) and a grey granite from Hampstead (Spoon Island district). Both building and monumental stone are obtained from the two southern areas and only building stone is produced from the Antinouri Lake district. Previous producing areas - the St. George red-granite, the Bocabec black-granite and the Bathurst reddish-grey-granite - are not active at present. Massive granite rocks of diversified colour and textural characteristics occur throughout the province. Granite for nearly all uses can be supplied from one or other of the New Brunswick deposits.

Sandstone - A fine- to medium-grained, olive-green sandstone is produced in the Shediac area. The stone is dressed in a plant near the quarry and small amounts are sold as rock face ashlar.

Limestone - Rough building stone quarried in the Saint John area supplies a limited local market.

Quebec

Granite - Quebec produced 6 1/2 times the volume of all other provinces together in 1957. South of the St. Lawrence River, many quarries and dressing plants produce building and monumental stones, both rough and dressed, in all shades of grey from the lightest grey-white to the darkest blue-grey. Granites from the Eastern Townships are well known and are used as building and decorative stones throughout eastern Canada.

North of the St. Lawrence River a wider variety of coloured granites is available. The Lake St. John region supplies black, pink, red and brown granite. The Rivière-à-Pierre district produces blue-grey, rose-grey and deeper pink-grey granites. A pink granite is produced in the Guenette area and an attractive banded gneiss is quarried in the St. Raymond area. Brown reds to green browns, along with mahogany and chestnut-coloured granites, are quarried in the Grenville area, and pink and black granites are produced in the Rouyn area.

Limestone - Three companies produce dimension stone from the Trenton formation of Ordovician age in the St-Marc-des-Carrières area. This brownish-grey, medium-grained, high-calcium limestone is used extensively in building construction. All three companies have dressing plants in the area.

Several small to medium-sized companies produce building stone in the Montreal area from the Chazy formation of Ordovician age. Dressed building and ornamental stone is produced from the Chazy formation in the Sorel area. A small amount of building stone is produced near Trois Rivières and some production is obtained south of Lake St. John for use as rough and dressed building stone.

Marble - Almost all of the Canadian marble produced for building and monumental stone is quarried in the Philipsburg area. Shades of green, black and grey are obtained. The producing company dresses imported and other marbles, as well as its own material. No marble was quarried in the Stukely area in 1957. Several marble quarries in the Philipsburg and St. Joseph (Beauce) areas and in the township of Stukely produce terrazzo chips.

Sandstone - A small quantity of rough and dressed grey-sandstone building stone was quarried in the Montebello area.

Ontario

Granite - 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 red and blue tints, quarried by two companies in the Parry Sound area, is sold as rough building stone and flagstone. A black granite is produced in the River Valley area, and there is sporadic quarrying of a coarse, red granite in the Lyndhurst area.

Sandstone - Most of Canada's sandstone production for building stone is quarried in Ontario. All of the rock is sold as rough or dressed building stone and flagstone slabs. A medium-grain, buff to cream-coloured stone is quarried near Ottawa from the Nepean formation. A fine to medium-grained stone ranging in colour from red to grey to white is quarried in southern Ontario from the Medina formation.

Limestone - A large quantity of limestone is produced in the Queenston area for use as a building stone. It is a silver-grey to variegated buff-and-grey, medium-grained dolomite from the Lockport formation of Silurian age. One third of Ontario's production is dressed for residential construction and the remainder is sold as rough building-stone and flagstone material.

Marble - A small volume of black marble was produced near St. Albert, southeast of Ottawa, for use in monuments and as terrazzo chips. Terrazzo chips are also produced in the Marmora-Madoc area. Marble quarried in the Haliburton area is being used in the preparation of artificial stone and stucco dash.

Manitoba

Limestone - Three quarries are operating in the Tyndall area, where a very popular and distinctive buff limestone mottled with grey is produced for use as a building stone. Both rough and polished blocks have been used effectively in building construction in western Canada and Ontario.

British Columbia

Granite - The greatest production of building stone quarried on the West Coast comes from Haddington Island. The stone, a bluish-grey to greyish-yellow fine-grained andesite, is used extensively as a building stone. A light grey and blue-grey granite, quarried on Nelson Island, is also a popular building stone. The Nelson Island granite also makes an exceptionally fine ornamental stone.

CEMENT

by
V.A. Haw

The Canadian cement industry produced more cement in 1957 than in any previous year. Dominion Bureau of Statistics figures indicated an increase of more than a million tons over the production of 1956.

The increase resulted from enlarged kiln facilities at existing plants. Year-end annual plant capacity, at about 39 million barrels, was 5 million barrels greater than at the end of 1956. Moreover, two new companies, one in Ontario and the other in British Columbia, are expected to start production early in 1958. Completion of these projects will raise Canada's annual production capacity to some 42 million barrels and will climax a program of industry-wide expansion that began shortly after World War II. Since then, annual production has increased three and a half times (graph on page 294), and the number of establishments has doubled.

Until last year cement shortages were frequent and, in a period of nation-wide growth, were a serious handicap to the construction industry. Because of recent plant expansion, there should be adequate supplies of cement for some time to come.

During the year the Inland Cement Company Limited acquired all assets of the Saskatchewan Cement Corporation, which included a plant at Regina and a limestone quarry at Mafeking, Manitoba.

Production

At the end of the year there were 16 establishments producing cement clinker in Canada and two more were under construction. As shown in the map on page 292 cement plants are located in all provinces excepting Nova Scotia and Prince Edward Island. During the year four companies increased plant capacity: Canada Cement Company Limited placed in operation a second 12' by 450' kiln at its No. 4 plant near Woodstock, Ontario; St. Lawrence Cement Company Limited completed construction at Clarkson, Ontario, by installation of a second kiln; Inland Cement Company Limited doubled the size of its plant near Edmonton with a second kiln; and British Columbia Cement Company Limited, at Bamberton, added a 350-foot kiln.

Lake Ontario Portland Cement Company Limited was approaching the production stage at its new, 1.8-million-barrel-a-year plant near Picton, Cement - Production and Trade

	1957		1956	
	Short Tons	$	Short Tons	$
Production (shipments)				
Ontario	2,211,887	33,505,994	1,450,437	21,455,019
Quebec	2,051,201	30,267,092	1,797,128	25,696,957
Alberta	556,962	8,802,914	602,163	9,258,016
British Columbia	443,469	7,078,108	396,138	6,339,071
Manitoba	412,998	6,820,383	523,924	8,324,520
New Brunswick	163,640	2,646,293	165,482	2,439,676
Saskatchewan	150,664	2,861,615	2,509	59,762
Newfoundland	58,277	1,185,078	83,902	1,660,300
Total	6,049,098	93,167,477	5,021,683	75,233,321
Exports				
Portland cement				
United States	333,874	5,959,536	124,428	1,982,298
Jamaica	3,938	79,200	-	-
Other countries	504	13,755	138	2,610
Total	338,316	6,052,491	124,566	1,984,908
Cement manufactures and cement n.o.p.				
United States		81,111		62,917
Jamaica		7,166		10,681
India		4,943		19,302
Iran		3,600		212
Other countries		36,443		42,992
Total		133,263		136,104
Imports				
Portland cement				
United States	41,121	934,844	102,338	2,343,702
United Kingdom	27,233	450,143	84,528	1,240,183
Japan	12,308	142,998	-	-
West Germany	4,632	116,573	75,408	1,107,794
Belgium	4,353	141,717	15,560	227,121
Other countries	2,733	84,043	321,790	3,159,534
Total	92,380	1,870,318	599,624	8,078,334
Portland cement clinker				
United States	13,941	292,912	14,957	295,733
Belgium	-	-	77,992	714,878
Total	13,941	292,912	92,949	1,010,611
Cement manufactures and cement n.o.p.				
United States		826,413		239,705
France		69,239		-
Other countries		36,463		14,308
Total		932,115		254,013

Cement - Production, Trade and Consumption, 1947-57
(short tons)

	Production*	Exports	Imports	Apparent Consumption
1947	2,088,843	15,405	218,509	2,291,947
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

* Shipments plus amounts used by producers.

Ontario. A subsidiary at Rochester, New York, was expected to take a large portion of the company's production. Lafarge Cement of North America Limited is well on the way to completion of its plant on Lulu Island on the Fraser river, 10 miles southeast of Vancouver. This will provide British Columbia with its second producer. The company is to obtain its limestone from Texada Island, 70 miles away, and clay from 24 miles upriver. One kiln with a capacity of 1,250,000 barrels a year is to be operated for the present.

Besides plants producing cement clinker, two separate clinker-grinding plants are operated - one by the Canada Cement Company at Edmonton using clinker from Exshaw, the other at Paris, Ontario, where Medusa Products Company of Canada Limited grinds clinker from York, Pennsylvania, for the production of white portland cement.

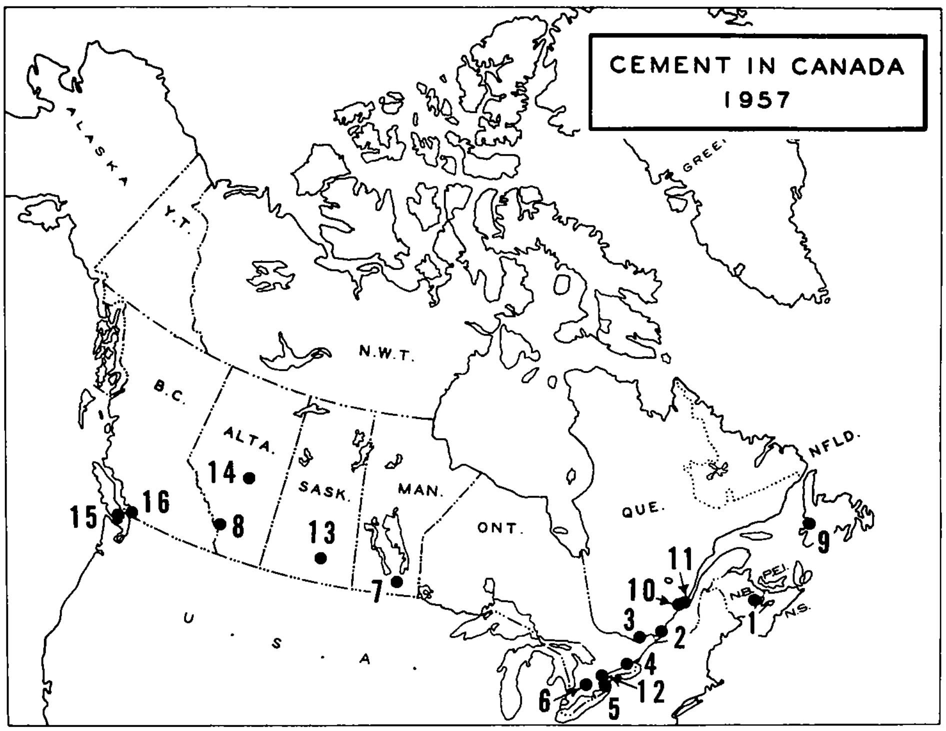
Consumption

The 5,803,162 tons of cement consumed in Canada in 1957 exceeded 1956 consumption by 5.6 per cent. This reflects a continuing high level of activity in the construction industry in spite of soft spots in other sectors of the economy. Statistics published by the Department of Trade and Commerce (Private and Public Investment in Canada, Outlook 1958 and 1959) show that in 1957 capital expenditure for construction increased in value by 9.1 per cent - to $5,784 million from the $5,301 million of 1956. The present figures, like those of the past, indicate that cement consumption closely parallels general investment in capital construction - housing, engineering, institutional and industrial. Non-residential construction accounts for the increase, which amounted to $628 million, thus more than offsetting the drop of $145 million in the value of the year's housing construction. Adjusted on a seasonal basis, however, the number of housing starts in the last quarter was equivalent to 140,000 a year - a higher annual rate than any previously attained.

Plant Capacities

Company*	Number of Kilns	Approximate Capacity (end 1957)	Under Construction (end 1957)
		bbl /yr	
Canada Cement Company Limited			
(1) Havelock, N.B.	1	800,000	
(2) Montreal, Que.	7	7,500,000	
(3) Hull, Que.	1	1,100,000	
(4) Belleville, Ont.	3	4,000,000	
(5) Port Colborne, Ont.	1	1,200,000	
(6) Woodstock, Ont.	2	3,000,000	
(7) Fort Whyte, Man.	3	3,000,000	
(8) Exshaw, Alta.	3	3,000,000	
North Star Cement Limited			
(9) Cornerbrook, Nfld.	1	600,000	
Ciment Quebec Incorporated			
(10) St. Basile, Que.	2	700,000	
St. Lawrence Cement Company Limited			
(11) Villeneuve, Que.	1	1,500,000	
(12) Clarkson, Ont.	2	3,500,000	
St. Mary's Cement Co. Limited			
(6) St. Mary's, Ont.	4	3,000,000	
Saskatchewan Cement Corp. Ltd.			
(13) Regina, Sask.	1	800,000	
Inland Cement Company Limited			
(14) Edmonton, Alta.	2	2,200,000	
British Columbia Cement Company Limited			
(15) Bamberton, B.C.	5	3,300,000	
Lake Ontario Portland Cement Company Limited			
(4) Picton, Ont.	1		1,800,000
Lafarge Cement of North America Limited			
(16) Lulu Island, B.C.	1		1,250,000
Totals	41	39,200,000	3,050,000

* Numbers in brackets refer to locations on map.



In addition to the cement used directly in engineering and building-construction, large amounts are consumed by the concrete-products industry - in block, brick, pipe and ready-mix concrete. In 1957, the last year for which statistics are available, the total value of concrete products was $162,897,684, and the value of the cement used by the industry was $39,399,147. In 1957 the production volume of block and brick was 8.1 per cent less than in the previous year. Production of ready-mix concrete was up 7.2 per cent.

Trade

The increase in the production capacity of the Canadian cement industry resulted in a favourable export balance for the year. Since 1946 Canada has imported substantially more cement than she has exported. In 1957 the value of imports amounted to $1,870,318; in 1956 it was $8,078,334. Exports for the two years were valued at $6,052,491 and $1,984,908 respectively. As already indicated, clinker for the production of white cement is still imported.

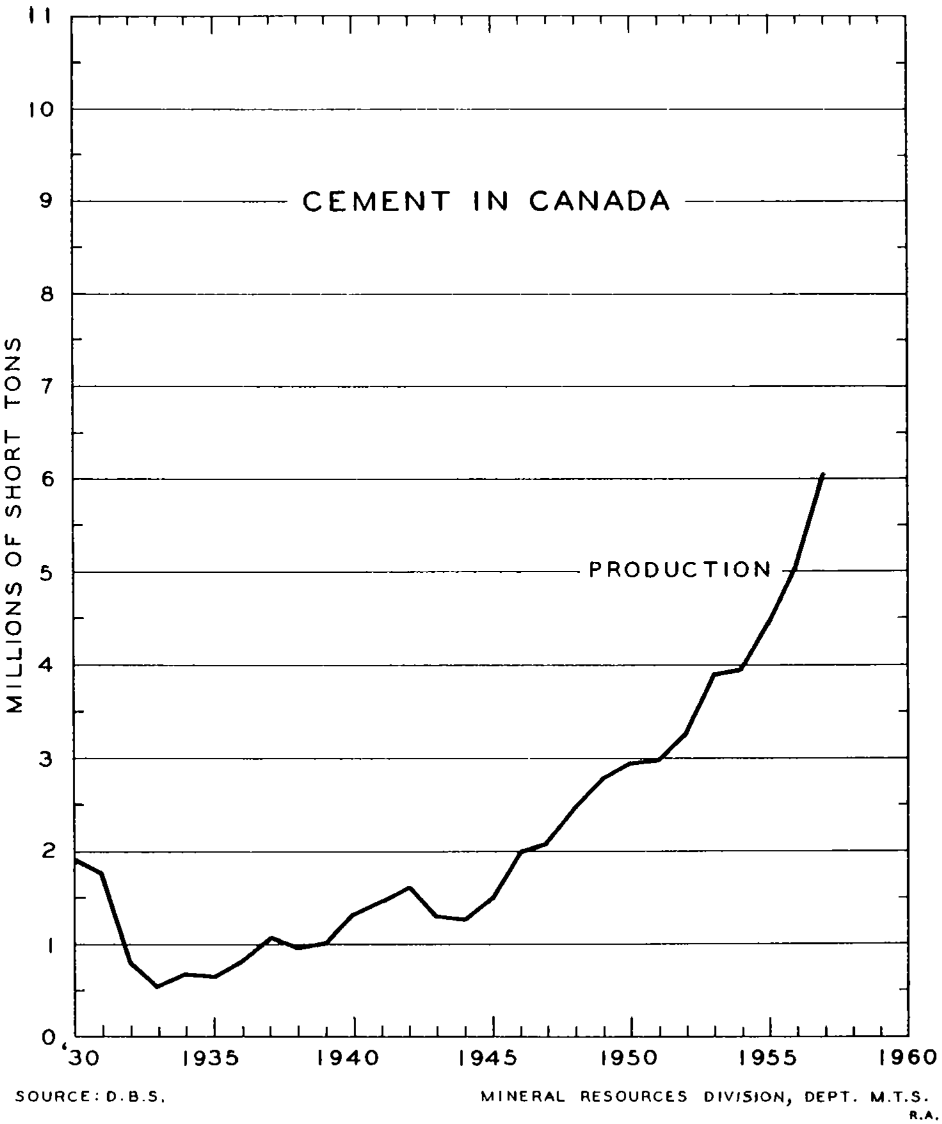
World production of cement in 1957 has been estimated at 253,117,000 tons, the United States leading with 58,986,000 tons, Russia being second with 29,756,000 tons, and Germany third with 19,754,000 tons.

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 cement (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.

Prices are reported to have remained essentially unchanged during the year, except for slight regional variations. In the United States a general price increase of about 5 per cent was noted.

Cement


CEMENT IN CANADA
PRODUCTION
MILLIONS OF SHORT TONS
11
10
9
8
7
6
5
4
3
2
1
0
'30
1935
1940
1945
1950
1955
1960
SOURCE: D.B.S.
MINERAL RESOURCES DIVISION, DEPT. M.T.S.
R.A.

CLAYS AND CLAY PRODUCTS

by
S. Matthews

Canadian-produced clays and clay products made in Canada from domestic and imported clays reached a value of $55,854,946 for 1957. This value was exceeded only by that of 1956, which amounted to $58,735,494. Most of the decline was in the value of wares made from domestic common clays, which consist chiefly of structural clay products such as building brick, structural tile, sewer pipe, flue-liners, etc. Production of refractories from domestic fireclays in 1957 was valued at $913,559 and in 1956 at $902,005.

Despite the downward trend in demand for structural-clay products during 1957, the capacities of plants producing building brick, structural tile and sewer pipe continued to expand. Several new tunnel kilns in various parts of Canada and a new sewer-pipe plant in Regina, Saskatchewan, were brought into production. Construction of a new sanitary-ware plant in British Columbia was under way and a start was made on the erection of a new tunnel kiln in Newfoundland.

Producers of fireclay refractories in Ontario and Quebec import their raw materials. Special types of refractory products not made in Canada are imported, chiefly because suitable raw materials from domestic sources are not available. China clay is imported for use in whiteware, which comprises tableware, sanitary ware, electrical porcelain, floor and wall tile, etc. About 70 per cent of the imported china clay is used by the pulp and paper industry, 12 per cent by the ceramics industry, 9 per cent by the rubber industry and the remainder by other industries. Large quantities of ball clay for use in whiteware bodies, particularly in eastern Canada, are also imported. Quantities of bleaching clays and bentonites are imported for use in oil refineries and drilling operations.

The ceramic industries continued to show a keen interest in making higher-grade products. This was indicated by the large number of requests directed to the Mines Branch for technical assistance. Further research in the Mines Branch on kyanite from an extensive deposit near Sudbury, Ontario, has led to the development of improved methods of processing the concentrate into special types of refractories hitherto not made in Canada. The deposit is a potential source of high-grade material for production of super-duty and mullite types of refractories.

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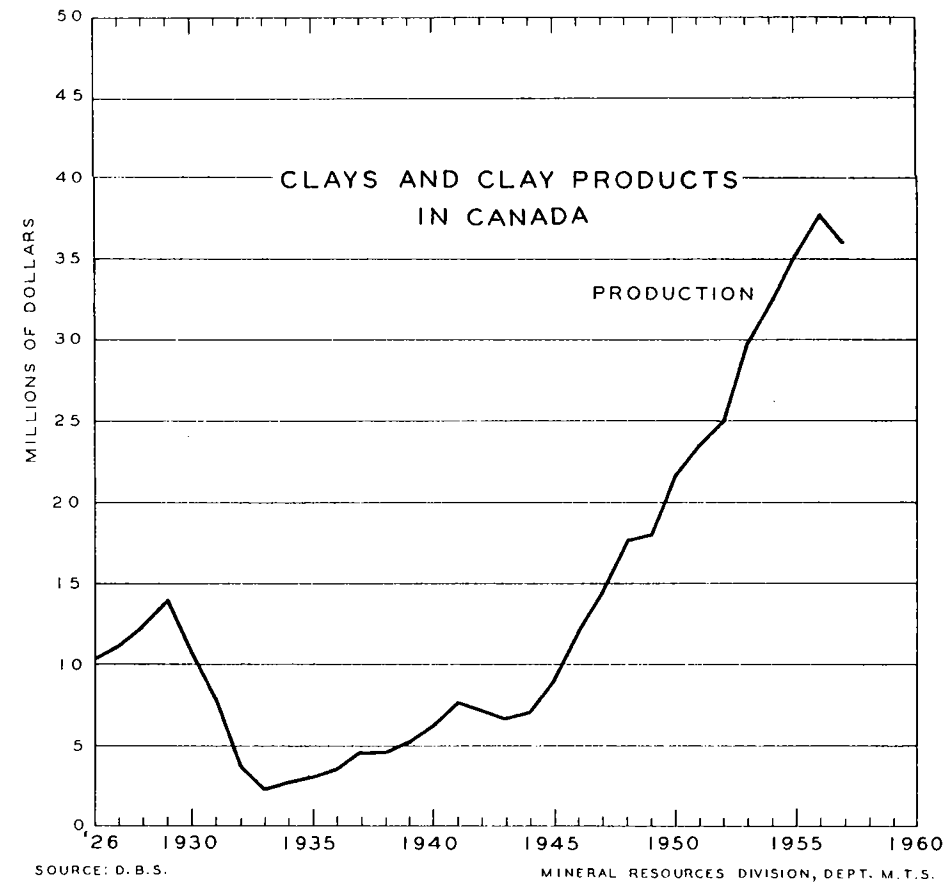
Clays and Clay Products - Production and Trade

	1957 ($)	1956 ($)
Production from domestic clays		
Clays including bentonite	569,000	457,638
Clay products		
From: Common clay	29,232,455	31,001,923
Stoneware clay	4,355,352	4,553,847
Fireclays	913,559	902,005
Other products	865,158	869,567
Total	35,922,158	37,784,980
Production from imported clays		
From: Stoneware clays	740,700	919,697
Fireclays	2,909,514	3,131,137
China clay	16,282,574	16,899,680
Total	19,932,788	20,950,514
Grand total	55,854,946	58,735,494
Imports		
Clay		
Fireclay, ground	475,147	542,167
China clay, ground	2,068,242	2,002,154
Pipe clay, ground	39,552	33,295
Clays n.o.p., ground	528,876	563,641
Activated clay for the refining of oils	1,536,512	1,484,124
Total	4,648,329	4,625,381
Clay products		
United States	26,225,378	28,801,890
United Kingdom	12,840,999	15,263,875
Other countries	3,672,741	3,693,882
Total	42,739,118	47,759,647
Exports		
Clay		
United States	280,224	146,736
Other countries	107	2,025
Total	280,331	148,761
Clay products		
United States	2,335,402	2,304,911
West Germany	287,273	221,178
Brazil	190,905	67,949
Rhodesia and Nyasaland	170,393	19,046
Pakistan	133,462	8,260
Other countries	944,403	719,588
Total	4,061,838	3,340,932

Clays and Clay Products - Production and Trade, 1947-57
($ millions)

	Production			Imports	Exports
	From Domestic Clays	From Imported Clays	Total		
1947	14.5	9.6	24.1	22.1	1.2
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



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Clays and Clay Products

Common Clays and Shales

Clays or shales of the type generally used in the manufacture of building brick and tile occur in all provinces, but the better grades are not plentiful. Raw materials of this type cannot be transported economically over long distances, and their proximity to the more thickly populated areas is an important consideration. Sources of new or better raw materials are continually being sought, as is indicated by the large number of samples submitted annually to the Mines Branch for evaluation.

Common clays and shales having suitable characteristics are used extensively in the production of lightweight aggregate. Output in 1957 of the nine plants in Canada producing lightweight aggregate from clay or shale was valued at $1,333,700.

Stoneware Clays

Southern Saskatchewan is the main Canadian source of stoneware clay. The clay is selectively mined and shipped to Medicine Hat, Alberta, for making sewer pipe, brick, crockery, etc. The ware is fired with natural gas from local wells.

Deposits of stoneware clays or semi-fireclays which occur in Sumas Mountain near Vancouver are associated with the fireclays of that area. Clays from this source are utilized on a large scale for making sewer pipe, flue-liners and other stoneware products. This type of clay is also found in British Columbia near Williams Lake and Chimney Creek bridge. Deposits of clay suitable for making stoneware products, sewer pipe and buff-face brick occur in Manitoba near Swan River and Pine River. Ontario and Quebec import their requirements of stoneware clay.

The stoneware clays that occur near Shubenacadie and Musquodoboit, Nova Scotia, have been used on a limited scale for the production of pottery, certain stoneware products and low-temperature refractories. Clay from the Shubenacadie deposit is being used on a large scale in the production of buff-face brick.

Fireclays

A plant near Vancouver manufactures firebrick and other refractory products on a large scale from the moderately plastic fireclay extracted by underground mining from the clay beds in Sumas Mountain. Several smaller producers of fireclay refractories in the Vancouver area derive all or part of their raw materials from this source.

A large plant at Claybank, Saskatchewan, utilizes the highly plastic refractory clays from the Whitemud beds in that area by selective open-pit mining. A wide range of fireclay refractories is produced.

The extensive deposits of plastic fireclays in the James Bay basin on the Mattagami, Missinaibi, Moose and Abitibi rivers in northern Ontario have not been developed commercially owing to their remoteness and to difficulties encountered in extracting uniform, high-quality material.

Clay at Musquodoboit, Nova Scotia, is suitable for the production of stove linings and for certain foundry purposes. Several seams in the recently opened deposit at Shubenacadie have been found suitable for the manufacture of moderately high temperature refractories.

Fireclays from the United States enter Canada duty-free if not processed beyond grinding.

China and Ball Clay

Canada imports all its requirements of china clay from the United States and the United Kingdom. China clay is used in the paper industry for coating and filling and is an essential ingredient in such ceramic products as electrical insulators, sanitary ware, tableware and floor and wall tile. There is no production of china clay at present from Canadian deposits. China clay was produced several years ago, from a deposit at St. Remi d'Amherst, Papineau county, Quebec, but the project was abandoned because of operational difficulties. Several other deposits of kaolinized material occur in Quebec, one being at Point Comfort, near Thirtyone Mile Lake, and the others near Brebeuf, Lac Labelle and Chateau Richer. Exploratory work, however, indicates that none of these is of sufficient size and uniformity to warrant development.

Deposits containing rather high grade clay of the china-clay type occur about 25 miles north of Prince George, British Columbia. The beds vary in quality, however, and the extent and uniformity of the high-grade material present have not been definitely established.

The largest known deposits of ball clay in Canada are in southern Saskatchewan and the provincial government has carried out extensive exploration of the clay resources. It investigated methods of recovering kaolin from the kaolinized sand in the Whitemud formation, but so far no production from this source has been reported. Additional markets are being sought for Saskatchewan ball clay and arrangements for the erection of a new processing plant have been announced.

DIATOMITE

by
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 chalklike 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 West Germany approximately 10 per cent followed by France and Denmark. United States diatomite reserves appear adequate for many years.

Canada has been dependent upon imports essentially from the United States, which reached a new high in 1957, increasing 20 per cent in quantity over those of 1956. 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 but increased 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.

Diatomite - Production, Imports and Consumption

	1957		1956	
	Short Tons	$	Short Tons	$
Production (shipments)	120	2,400	2	40
Imports				
United States............	25,256	1,076,891	21,047	887,454
Denmark	30	637	30	636
West Germany	2	129	-	-
Total	25,288	1,077,657	21,077	888,090
Consumption*				
Fertilizer dusting			8,650	
Filtration			8,000	
Fillers			3,000	
Insulation...............			175	
Miscellaneous...........			100	
Total			19,925	

*Estimated from information supplied to the Mines Branch by distributors and consumers.

All occurrences of Tertiary age are in the interior of British Columbia in the Quesnel mining division. Those of recent age are in the 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 has been 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. Its high porosity is indicated by the fact that it can retain up to 90 per cent voids even when subjected to maximum compression and can 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 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.

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

by
J. E. Reeves

Canadian production of feldspar in 1957, all from the Province of Quebec, increased about 13 per cent in tonnage and 8 per cent in value over that of 1956. Export figures for the year show a considerable increase in both tonnage and value. These increases were brought about by Spar-Mica Corporation's first shipment, which consisted of glass-grade feldspar and was sent to the United States. The lower unit value of this grade compared with grades used in pottery and whiteware accounts for the relatively low increase in value.

Although Canadian consumption has been rising gradually since 1954, it is still below the highs recorded during the last 10 years. Competition from nepheline syenite has been the main limiting factor both in the domestic market and in Canada's chief export market, the United States.

Producers

Canadian Flint and Spar Department of International Minerals & Chemical Corporation (Canada) Limited, Ottawa, was again the largest single producer of high-grade crude feldspar, operating a grinding mill at Buckingham, Quebec, about 20 miles northeast of Ottawa. The ground spar is produced mainly for the manufacture of domestic pottery, glass, enamel and cleansers. Mill feed was drawn from the company's own and several smaller mines in Derry, Buckingham and Portland East townships of Quebec, all within a few miles of the mill.

Spar-Mica Corporation Ltd., Montreal, commenced production in mid-year from a pegmatite deposit near Baie Johan Beetz, on the north shore of the Gulf of St. Lawrence opposite Anticosti Island. The mill, capable of producing 100,000 tons of glass-grade feldspar annually, employs the principle of electrostatic separation to remove the associated quartz. The first shipment was made in November by water to Camden, New Jersey.

Bon Ami Limited, Montreal, purchased crude feldspar and produced ground material for use in its own brand of cleanser.

In the concentration of the lithium mineral, spodumene, from granitic pegmatite, a large amount of associated feldspar is encountered. Quebec Lithium Corporation has installed milling equipment for the production of feldspar as a flotation by-product at its plant near Barraute, Quebec, about 20 miles north of Val d'Or.

Feldspar - Production, Trade and Consumption

	1957		1956	
	Short Tons	$	Short Tons	$
Production				
Quebec	20,450	393,284	18,153	364,849
Imports				
Ground				
United States	241	5,562	191	4,530
Crude				
United Kingdom	-	-	5	228
Total	241	5,562	196	4,758
Exports				
United States	4,017	69,738	1,771	45,464
West Germany	20	1,600	33	2,904
Netherlands	10	860	-	-
Total	4,047	72,198	1,804	48,368
Consumption (available data)*				
Glass	5,316		4,993	
Scouring powders, cleansers	1,371		1,385	
Abrasives	15(e)		13	
Clay products (pottery, tile, insulators, etc.)	6,297		6,356	
Enamelling	974		941	
Electric apparatus	750(e)		743	
Miscellaneous chemicals	-		1	
Total................	14,723		14,432	

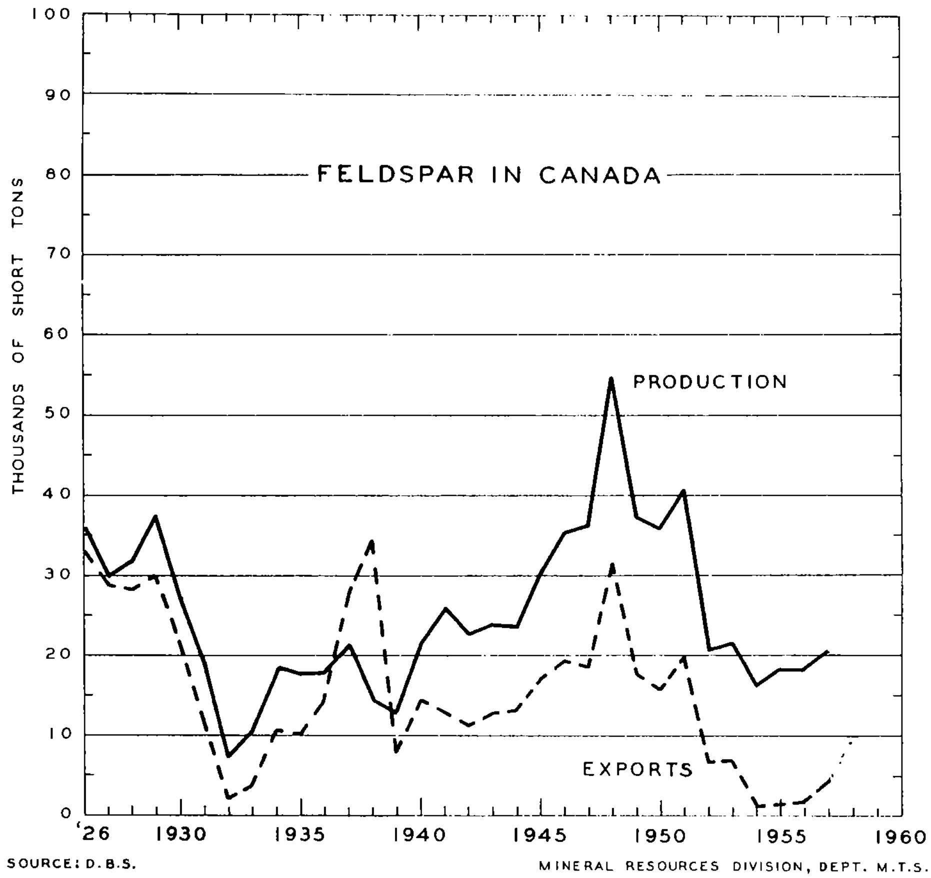
* Partially estimated.
(e) Estimated.

Feldspar

Feldspar - Production, Trade and Consumption, 1947-57

(short tons)

	Production	Imports	Exports	Consumption
1947	36,104	321	18,311	16,013
1948	54,851	207	31,467	16,861
1949	36,948	228	17,570	15,158
1950	35,548	144	15,465	15,886
1951	40,749	194	19,832	13,320
1952	20,267	155	6,360	12,622
1953	21,246	336	6,848	11,909
1954	16,096	398	1,056	11,273
1955	18,152	137	1,426	13,690
1956	18,153	196	1,804	14,432
1957	20,450	241	4,047	14,723



History and Occurrences

The name "feldspar" refers to a group of rock-forming minerals which are essentially aluminum silicates of potash, soda and lime. The potash member and, to a lesser extent, the soda member are of economic importance. They are extremely common and occur in significant concentration only in granitic pegmatites.

Almost all of the feldspar mined in Canada to date has come from the southeastern part of Ontario and the southwestern part of Quebec, where there is an abundance of these pegmatites. Higher-quality feldspar is hand-cobbed from the richest concentrations in these deposits.

Hundreds of properties have been operated in Canada since 1890, when production,from a deposit 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 and has come mostly from the southwestern part of the province. Small shipments were made in the early 1920s from the vicinity of the present site of Spar-Mica Corporation's operation, but, because of the intimate association of quartz with the feldspar, hand-cobbing on a large scale was not practical. The mechanical means being used by Spar-Mica to concentrate the feldspar introduces a new method of preparing Canadian feldspar for market. 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, 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 and in the Yellowknife-Beaulieu area in the Northwest Territories. The latter area is beyond the reach of markets, but southeastern Manitoba could conceivably supply feldspar, especially as a by-product of an operation producing spodumene, beryl or other economic minerals of pegmatite origin. Between 1933 and 1939, more than 5,000 tons were produced in the vicinity of Pointe de 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 commercial production has not resulted.

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

In glass, feldspar is important as a source of alumina. In addition, it supplies alkalis and thus reduces the quantity of soda ash required in the batch. The iron-oxide content should not exceed 0.1 per cent. Glass-grade feldspar is used in a relatively coarse, minus 20 mesh grain size.

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.

In the manufacture of porcelain enamels potash feldspar is used as a source of alumina, potassium 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 potash feldspar of high purity, selected by the trade according to its firing characteristics. As much as 0.1 per cent iron oxide is tolerated but no tourmaline or biotite, or any other dark mineral that would leave specks in the product.

For cleansers, the material should be grit-free and approach a good white colour. Either potash or soda feldspar is acceptable.

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.

United States prices per short ton at the end of 1957, according to E & M J Metal and Mineral Markets, were:

200-mesh, f.o.b. point of shipment, North Carolina	\$18.50
325-mesh	\$22.50
Glass, No. 18 grade	\$12.50
Semi-granular	\$11.75

FLUORSPAR

by
C. M. Bartley

Canadian production and shipments of fluorspar dropped from 140,071 tons in 1956 to 66,245 tons in 1957 owing to decreased domestic consumption by the aluminum industry and lower exports to the United States. Imports, largely from Mexico, dropped from 28,148 in 1956 to 14,547 in 1957. In Canada, the quantity consumed by steel plants, foundries, glass and other industries decreased more than 25 per cent. The drop in consumption and the consequent decreases in production reflect the decline in industrial activity.

While the Canadian fluorspar industry is at present experiencing difficulty because of foreign competition and lack of markets, the long-term outlook for fluorspar appears promising. Consumption for normal industrial purposes has been increasing consistently, and certain new uses, such as that of hydrofluoric acid in the rapidly expanding uranium-processing industry, suggest a larger future market. Efforts, particularly in the United States, to increase both the production of fluorine raw materials (fluorspar and other materials) and the facilities for processing them to hydrofluoric acid and fluorine chemicals, indicate that a future demand is expected. This trend was highlighted in Canada when The Nichols Chemical Co. Limited constructed a hydrofluoric-acid plant at Valleyfield, Quebec.

Fluorspar is a non-metallic mineral, calcium fluoride (CaF_2), containing 51.1 per cent calcium and 48.9 per cent fluorine. It sometimes occurs in pure crystals or in a crystalline form, and such material can be used in its natural state as a metallurgical flux simply by removing adhering waste rock. In such cases hand-sorting or simple gravity separations provide an acceptable product. Where the mineral occurs intimately associated with other minerals, such as quartz, calcite and barite, more complicated and expensive milling processes are necessary to recover a useful product. This applies in particular when the end use is for ceramics or chemicals since these require a relatively pure material and both physical and chemical specifications require close control. It is for end use in chemicals that most of the new demand is foreseen.

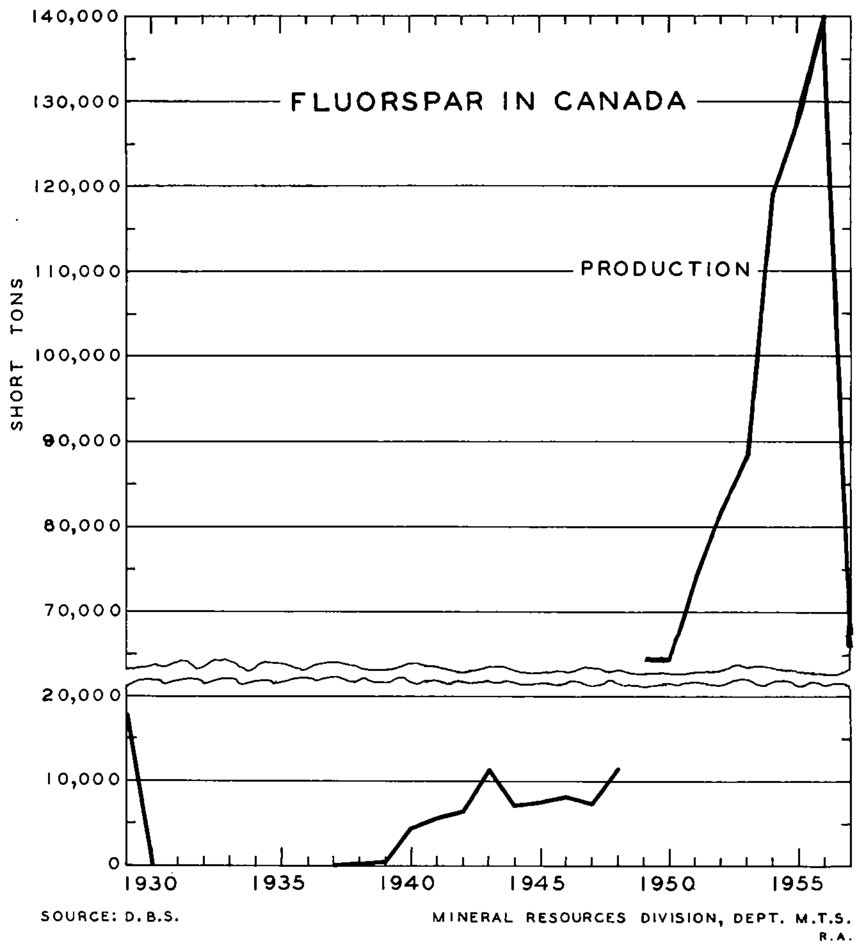
Fluorspar occurs and is produced in many countries throughout the world. Individual deposits are usually small in terms of modern mining operations, and the commercial possibilities of any deposit depend to a large

Fluorspar - Production, Trade and Consumption

	1957		1956	
	Short Tons	$	Short Tons	$
Production (shipments)				
Newfoundland.............	*	1,662,602	*	3,395,061
Ontario..................	*	94,239	*	12,521
Total....................	66,245	1,756,841	140,071	3,407,582
Exports				
United States.............	23,630	590,750	78,380	1,941,500
Imports				
Mexico..................	11,514	270,196	26,523	644,741
United States.............	1,578	71,824	1,566	43,431
Union of South Africa......	1,091	20,916	-	-
United Kingdom...........	364	14,770	59	2,607
Total....................	14,547	377,706	28,148	690,779
Consumption				
Steel furnaces............	16,935		18,979	
Glass....................	628		669	
Heavy chemicals..........	53,198		76,452	
White-metal alloys.......	-		26	
Total....................	70,761		96,126	

* Tonnages not now available for publication.

extent on the cost of getting the production to market rather than on the size and grade of the deposit itself. For example, a deposit of 40 per cent fluorspar may be in production in the United States at a time when shipment to United States markets from a deposit of 80 per cent fluorspar in Mexico is too costly. In recent years the major producers of fluorspar have been the United States, Mexico, Germany, Canada and Russia.



Canadian Occurrences

A great many fluorspar occurrences have been located in Canada - in five provinces and two territories - but most are of no economic value. Production has been confined to Newfoundland, Ontario and British Columbia, although token shipments from occurrences in Nova Scotia and Quebec have been reported. Present production in Newfoundland and Ontario could be expanded if markets were available, and at least two known deposits are potential producers, given higher prices and improved transportation.

Fluorspar

Newfoundland

The major Canadian occurrences of fluorspar are situated in the Burin Peninsula of southeastern Newfoundland. They consist of at least 40 known veins in granite and have been found to be quite consistent in fluorine content and persistent along strike and to depth. Only a few have been developed and only one has been mined out. Fluorspar reserves in Newfoundland have never been officially published and probably are not accurately known, but they are undoubtedly large. Unofficial estimates have been as high as 10 million tons. Reserves of this magnitude would be classed among the most important in the world. Heavy flows of water in Newfoundland fluorspar mines are the most serious mining problem and a considerable factor in the cost of production.

In Newfoundland two companies - St. Lawrence Corporation of Newfoundland Limited and Newfoundland Fluorspar Limited, a subsidiary of Aluminum Company of Canada Limited - produced fluorspar in 1957.

St. Lawrence Corporation of Newfoundland Limited holds a large property with numerous veins in various stages of development. Production has been drawn from mining operations on several veins to feed a heavy media separation mill from which a concentrate (submetallurgical grade) has been shipped to an affiliated company, St. Lawrence Fluorspar Incorporated, of Wilmington, Delaware, for further beneficiation in a flotation mill. In recent years production by St. Lawrence Corporation of Newfoundland has been under contract to the United States Government, but the contract was completed and terminated in mid-1957; and because of marketing difficulties the company suspended mining operations. Some exploration has been carried out on the Rosy Ridge prospect, and shaft-sinking and some lateral work have been done at the Hare's Ears vein. Vein width and grade exposed by the underground work were better than expected.

Newfoundland Fluorspar Limited operated normally for most of 1957 but closed down in August for plant change-over and expansion. These improvements included a new underground crusher and conveyors, new skips, and underground excavation for these installations. Major changes were also made in the surface plant to increase both the capacity and the efficiency of the operation. All output was milled at the property, and the concentrate produced was shipped to Aluminum Company of Canada Limited at Arvida, Quebec.

Ontario

Huntingdon Fluorspar Mines Limited, at Madoc in eastern Ontario, is the only other producer of fluorspar in Canada. Because the individual mines in the Madoc area have engaged only in small operations and have had limited capital and equipment, it has not been possible to build up ore reserves sufficient for the planning of long-term consistent operations. Production has been significant only in periods of heavy demand, such as wartime.

In May 1957 Huntingdon Fluorspar Mines Limited resumed operations at the old Kilpatrick property, mining a vein on the 80-foot level. In spite of a serious underground water problem solved only after considerable trouble and expense, the mine produced more than 2,000 tons in 1957, a very substantial increase over the output of recent years. The vein being mined is largely of green crystal fluorspar, and it has been possible to produce a satisfactory grade of metallurgical fluorspar simply by screening out fines and picking waste rock. All production has gone to Canadian steel plants and foundries.

For many years the production of the Madoc fluorspar area has been variable, ranging from nothing to the 10,500 tons turned out in 1943. Although the area is generally considered to be worked out, it is noted that the main zone has produced fluorspar over a length of about 5 miles and that the mines have been worked to shallow depths (250 feet) only. Exploration in the area might lead to the development of enough ore reserves to justify efforts to solve local mining problems and result in continuous and more efficient mining and milling.

Other Canadian Occurrences

Three fluorspar occurrences of potential importance are known to exist in British Columbia.

The Rock Candy mine near Grand Forks, which is owned by The Consolidated Mining and Smelting Company of Canada Limited, produced up to 1929. Production ceased when the company obtained necessary fluorine as a by-product of other operations and United States tariffs prevented fluorspar exports. Total production amounted to more than 42,000 tons, and large reserves are believed to remain at the mine.

Rexspar Uranium & Metals Mining Co. Limited, at Birch Island, British Columbia, has outlined a zone containing a large tonnage of low-grade fluorspar which may be valuable in the future. At present, however, the low grade and fine mineralization of the occurrence make economic recovery difficult.

A large deposit of fluorite and witherite with some barite has been known for many years to exist on the lower Liard River in northern British Columbia. Recent work has indicated a large tonnage of recoverable fluorspar, but the remote location and the cost of transportation make the deposit unattractive.

Numerous other occurrences of fluorspar are known in Yukon, Ontario, Quebec, New Brunswick and Coast of Labrador, but none appear to be of economic interest.

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Uses and Specifications

In Canada fluorspar is consumed chiefly by the aluminum industry. The fluorspar is used to make hydrofluoric acid, which in turn is used to make a flux (artificial cryolite). The flux, together with a small amount of fluorspar, dissolves alumina, and from this solution aluminum is recovered electrolytically. Fluorspar finds its other major use as a flux in the steel industry. In smaller but increasing amounts, fluorspar is used in the heavy-chemical, glass, enamelling, glazing, white-metal alloy and metal-refining industries.

In the United States the largest consumer is the steel industry, which is followed by the hydrofluoric-acid manufacturers. Hydrofluoric acid is used in large amounts by the aluminum, fluorine, chemical and uranium industries. It is worth noting that despite the steel-production increase of recent years, the rate of fluorspar consumption is growing faster in the manufacture of hydrofluoric acid than in the use of fluorspar as a flux in steel plants.

Standard fluxing gravel or lump grade for metallurgical purposes is usually sold on a specification of a minimum of 85 per cent CaF_2 and a maximum of 5 per cent SiO_2 (silica) and 0.3 per cent sulphur. Fines should not exceed 15 per cent.

Ceramic, or glass and enamel, grades call 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 has the most rigid specifications. It must be over 97 per cent CaF_2 and not over 1 per cent SiO_2. Like ceramic grade, it is used in powdered form.

Tariffs

During the period covered by this review, fluorspar entered Canada duty-free.

Prices

Canada

At the end of 1957, prices per net ton f.o.b. Arvida, Quebec, as quoted by Aluminum Company of Canada Limited, were as follows: ceramic grade, coarse (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 as quoted in E & M J Metal and Mineral Markets for December 19, 1957, were as follows: metallurgical grade, effective CaF_2 content, f. o. b. Illinois and Kentucky, per short ton--72 1/2%, $37 to $41; 70%, $36 to $40; 60% plus, $33 to $36.50; pellets, 65%, $33; acid grade, concentrates, bulk, carload lots, per short ton--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.

European fluorspar

Prices, c. i. f. U. S. ports, duty paid, per short ton, 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, f. o. b. border, all rail, duty paid, per short ton, was as follows: metallurgical grade, 72 1/2% effective CaF_2 content, $25.

GRAPHITE

by

J. E. Reeves

Since the closing of the Black Donald mine in 1954 there has been no graphite production in Canada. The mine, about 65 miles southwest of Ottawa, near Calabogie, Ontario, was the most important Canadian producer.

During the last few years several companies have undertaken the exploration of properties containing deposits of graphite in southern Ontario or southern Quebec, relatively near to the principal markets, but no production has resulted.

The value of imports of graphite and articles manufactured from graphite was down appreciably in 1957. However, there was a considerable increase in imports of unmanufactured graphite from Mexico, which supplies a low-grade, amorphous-type graphite, while imports of this material from the United States declined by well over 50 per cent from those of 1956. Thus Mexico became the largest single exporter of unmanufactured graphite to Canada for the first time since 1953.

The value of exports of artificial graphite electrodes, chiefly to the United Kingdom, rose considerably.

Artificial graphite is produced by Electro Metallurgical Company, Welland, Ontario, by the electric-furnace treatment of petroleum coke. Previous production of natural graphite in Canada was mostly of the small-flake and amorphous grades, derived from relatively small and widely separated deposits in the crystalline limestones and gneisses of southeastern Ontario and southwestern Quebec.

The earliest mining operations are reported to have been conducted in 1846 in Grenville township, Argenteuil county, Quebec, about 60 miles east of Ottawa. In later years a number of properties came into production in Quebec, many of them in the vicinity of Buckingham, about 20 miles east of Ottawa, but production was small and sporadic and had ceased by 1936.

Graphite mining in Ontario commenced in 1870 in North Elmsley township, Lanark county, about 50 miles southwest of Ottawa. Other relatively small producers were in Cardiff township, Haliburton county, and Monteagle township, Hastings county, about 100 to 120 miles west of Ottawa. In 1897 the first shipments were made from the famous Black Donald mine, Canada's largest and for many years its only graphite producer. The ore consisted of fine- to coarse-grained, disseminated to massive graphite in strongly folded, silicated crystalline limestone, and yielded various grades from low-quality amorphous material to high-quality lubricating flake. Whereas deposits that were mined in Quebec are associated with crystalline limestone and gneiss, the Ontario deposits are all in crystalline limestone.

Graphite - Trade and Consumption

	1957 Short Tons	1957 $	1956 Short Tons	1956 $
Imports				
Unmanufactured				
Mexico		42,459		22,449
United States		16,888		42,248
Norway		6,372		10,389
Ceylon		5,074		11,498
Other countries		3,296		1,342
Total		74,089		87,926
Ground and manufactured				
United States		697,621		730,741
United Kingdom		31,132		39,699
West Germany		17,931		36,946
Other countries		2,048		7,998
Total		748,732		815,384
Crucibles				
United Kingdom		122,277		119,755
United States		114,910		140,245
Switzerland		146		-
Total		237,333		260,000
Exports, carbon and artificial graphite electrodes				
United Kingdom		3,366,300		2,258,832
Norway		164,962		385,062
India		66,994		-
United States		65,542		58,327
Other countries		2,772		100,771
Total		3,666,570		2,802,992

Graphite - Trade and Consumption (cont'd)

	1956		1955	
	Short Tons	$	Short Tons	$
Consumption (domestic)*				
Polishes, dressings and paints	97		66	
Brass and copper products	23		20	
Electrical apparatus	308		685	
Heavy-chemicals industry	377		344	
Iron and steel industries	1,717		1,260	
Railway rolling stock	128		39	
Machinery	38		89	
Asbestos products	17		14	
Explosives	2		1	
Miscellaneous non-metallics	244		210	
Petroleum-refining	-		31	
Machine tools	2		3	
Clay products	125		100	
Other uses	-		1	
Total	3,078		2,863	

* Available data.

In the latter part of the nineteenth century some amorphous-grade material was produced from impure graphite shales and slates near Saint John, New Brunswick.

World Situation

Principal world sources are: Mexico, Austria and Korea for amorphous (very fine grained)graphite; Ceylon, especially for the coarsely crystalline variety (sometimes referred to as plumbago because it occurs in massive form in veins); and Madagascar for large-flake. There is a considerable amount of world trade, particularly in high-quality graphite. Most industrial nations that have deposits are not able to compete with these sources because of higher production costs, relatively low-grade deposits and flake inferior to that from Madagascar. It is expected, however, that technological advances in the use of lower grades may lessen the dependence on these sources for high-quality material.

Uses and Specifications

The iron and steel industries, the largest users, employ natural graphite in the form of foundry facings and other refractories. Non-ferrous plants use graphite crucibles for handling the molten alloys. Graphite is also used widely as a lubricant, particularly under high-pressure and corrosive

Graphite - Production, Trade and Consumption, 1947–57

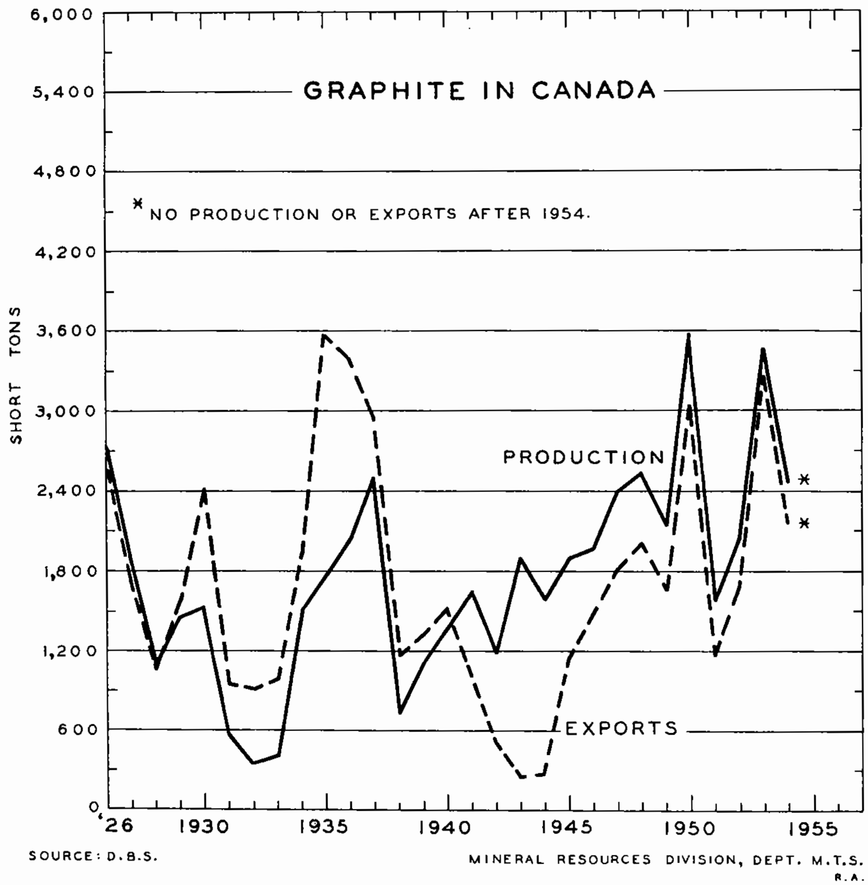
	Production (1) (short tons)	Exports: Crude(2) and Refined (short tons)	Exports: Carbon and Graphite Electrodes ($)	Imports (3): Unground ($)	Imports (3): Crucibles ($)	Imports (3): Ground and Manufactured ($)	Consumption: Domestic (short tons)
1947	2,398	1,814	1,657,222	75,780	135,894	379,425	1,626
1948	2,539	2,014	1,260,696	81,899	116,999	333,679	2,688
1949	2,147	1,651	1,158,499	83,301	128,696	293,267	1,996
1950	3,586	3,044	1,194,964	71,440	164,142	330,442	2,219
1951	1,569	1,152	1,805,834	96,725	215,297	476,511	2,556
1952	2,040	1,686	2,824,885	97,658	213,429	434,650	2,845
1953	3,466	3,253	1,383,851	125,740	217,066	481,982	2,820
1954	2,463	2,156	1,251,411	54,385	156,516	548,824	2,326
1955	-	-	2,945,511	64,798	202,864	561,394	2,863
1956	–	–	2,802,992	87,926	260,000	815,384	3,078
1957	–	–	3,666,570	74,089	237,333	748,732	

(1) Producer's shipments of natural graphite.
(2) Shipments of natural graphite.
(3) Natural and artificial graphite and graphite products. Dollar value only available.

conditions; in the paint industry as a pigment and anti-corrosive element in protective coatings; in lead pencils; in corrosion-resistant pipes and fittings for the chemical industry; for impregnating wood and metal surfaces in oilless bearings; in the manufacture of stove and other polishes; and as a polishing agent for lead shot, explosives and fertilizers. In addition, a wide range of close-tolerance graphite products are manufactured for various mechanical and electrical uses. Such products include electric brushes, pistons and rings for some engines, bearings for hot and corrosive applications, and many others.

Of more recent interest is a use for graphite as a constituent in the refractory lining of the nozzles and other parts of rocket propulsion units. The high melting point, low density and machinability of graphite are desirable. However, because it is soft and relatively easily oxidized under such operating conditions, it must have a protective coating of more resistant material.

Artificial graphite is used chiefly in the manufacture of electrodes for metallurgical plants and certain chemical plants and of brushes, refractory bricks and other special shapes, and has been used more recently as a



moderator in some atomic reactors. In powdered form it competes to only a minor extent with natural graphite. It is granular rather than flaky, but of high purity, and offers competition chiefly as carbon addition to steel.

Carbon content, mesh size, and type are the principal factors which govern the selection of graphite for its various uses. The different types of graphite are interchangeable to some extent and are frequently blended according to formulae developed and protected by the manufacturers.

No universal code of specifications is recognized, but those for No. 1 crucible flake usually require 85 per cent or 90 per cent carbon, through 20-mesh on 50-mesh. For lubricants, the requirement is usually a minimum of 95 per cent carbon. In general, the demand is for material containing at least 70 per cent carbon, although lower-grade material is potentially saleable.

Markets

Buyers of crude and finished graphite in the United States include Joseph Dixon Crucible Company, Jersey City, New Jersey; Charles Pettinos, 1 East 42nd Street, New York, N.Y.; and George F. Pettinos Inc., 1206 Locust Street, Philadelphia 7, Pennsylvania.

Prices

United States prices of graphite according to E & M J Metal and Mineral Markets of December 19, 1957, were:

Per lb, carload lots, f.o.b. shipping point:			
Crystalline-flake, natural			
85-88% C, crucible grade		13 ¢	
96% C, special and dry usage		22 ¢	
94% C, normal and wire drawing		19 ¢	
98% C, special for brushes, etc.		26 1/2¢	
Amorphous, natural, for foundry facings, etc.			
Up to 85% C		9 ¢	
Madagascar, c.i.f. New York			
"Standard grades 85 to 87% C", per ton	$235		
Special mesh	$260		
Amorphous graphite, Mexican, f.o.b. point of shipment (Mex.)			
Per metric ton, according to grade	$ 12	to	$ 18

GYPSUM AND ANHYDRITE

by
R. K. Collings

GYPSUM

Gypsum, a hydrous calcium sulphate, is one of the most useful of the non-metallic minerals. Large quantities are produced annually at numerous locations throughout Canada. The production of gypsum in 1957 dropped to 4,577,492 short tons, an amount 6.5 per cent below that of 1956, the record year. This was a direct result of a decrease in the demand for gypsum for use in the building-construction industry.

Exports of crude gypsum amounted to 3,410,684 short tons in 1957, this being over 74.5 per cent of production for the year. 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 in British Columbia, totalled 92,139 short tons.

Exports of finished gypsum products amounted to only 23 short tons in 1957; imports totalled 17,424 short tons.

The production of gypsum in Canada increased remarkably during the period 1926 to 1957 as indicated by the graph on page 324. Minor recessions occurred during the early thirties and again during World War II. However, the postwar construction boom greatly increased the demand for gypsum for use in the building-products industry. This resulted in a striking increase in crude-gypsum production.

Occurrences

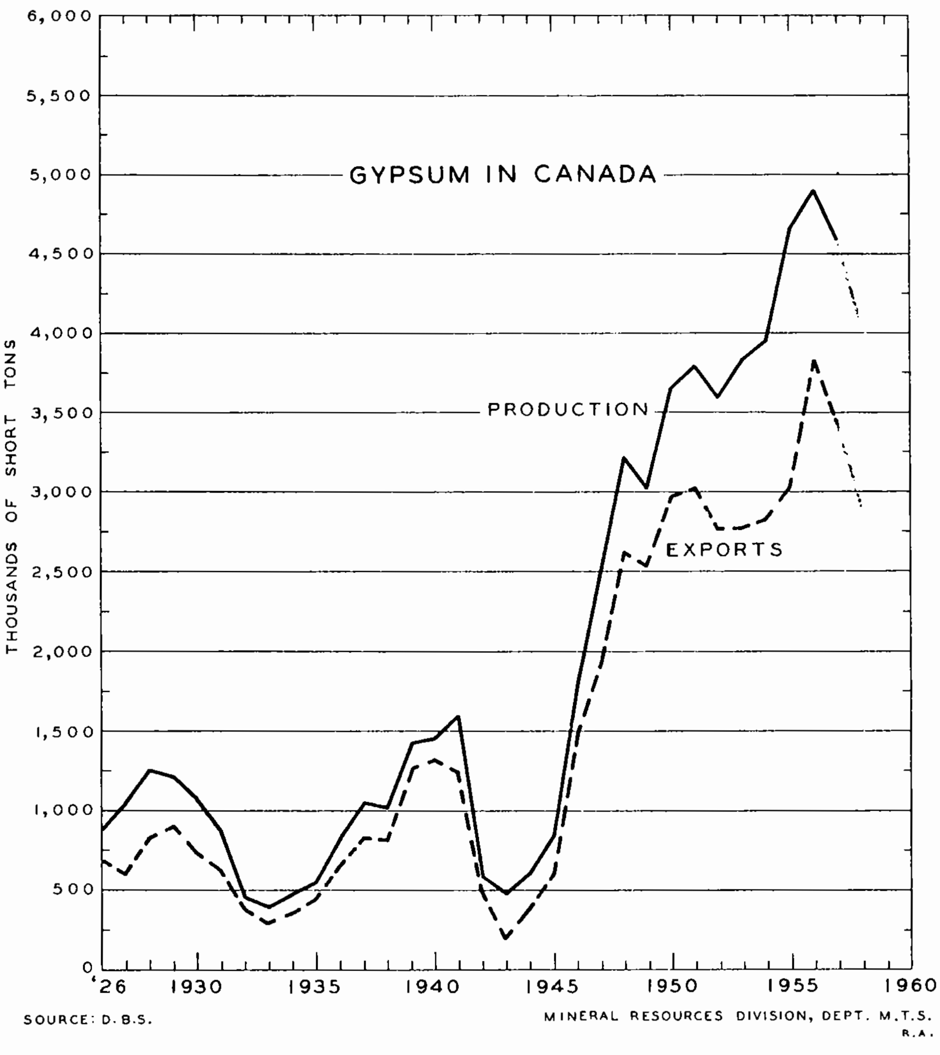
Gypsum deposits occur at numerous locations throughout Canada. Some of these deposits are impure; others are too far from markets to be of economic importance. Many, however, are very pure and well situated with respect to transportation facilities and centres of population. Deposits suitable for use in the gypsum-products industry occur in all provinces except Prince Edward Island and Saskatchewan. However, gypsum recovery operations are carried on in only six provinces, namely, Nova Scotia, New Brunswick, Newfoundland, Ontario, Manitoba and British Columbia.

The largest gypsum deposits occur in the Maritime Provinces. These are flat-lying and generally have 10 to 15 feet of overburden. Those in Nova Scotia occur throughout the central and northern portion of the mainland and on Cape Breton Island. In New Brunswick, the chief occurrences are in the south-eastern portion of the province near Hillsborough. The Newfoundland deposits are confined to the St. George's Bay area in the western section of the island.

Gypsum - Production and Trade

	1957		1956	
	Short Tons	$	Short Tons	$
Production (shipments)				
Crude gypsum				
Nova Scotia	3,842,027	6,005,640	4,144,147	5,250,883
Ontario	379,621	853,199	366,956	840,829
Manitoba	183,708	458,368	185,986	365,840
New Brunswick	93,249	163,146	86,104	224,038
British Columbia	49,422	142,952	75,618	391,919
Newfoundland	29,465	121,800	37,000	186,727
Total	4,577,492	7,745,105	4,895,811	7,260,236
Exports				
Crude gypsum				
United States	3,410,684	5,905,051	3,840,521	6,987,225
New Zealand	-	-	200	312
Total	3,410,684	5,905,051	3,840,721	6,987,537
Plaster of paris, wall plaster				
United States	18	1,165	132	4,748
New Zealand	5	156	14	297
Bermuda	-	-	2	52
Total	23	1,321	148	5,097
Total exports	3,410,707	5,906,372	3,840,869	6,992,634
Imports				
Crude gypsum				
Mexico	91,856	348,723	61,001	211,668
United States	248	9,790	9,386	89,311
United Kingdom	35	1,102	47	1,530
Other countries	-	-	2	130
Total	92,139	359,615	70,436	302,639
Plaster of paris, wall plaster				
United States	17,401	456,459	22,358	552,141
United Kingdom	6	210	424	8,331
Other countries	17	1,769	12	2,018
Total	17,424	458,438	22,794	562,490
Total imports	109,563	818,053	93,230	865,129

Gypsum


GYPSUM IN CANADA
PRODUCTION
EXPORTS
THOUSANDS OF SHORT TONS
6,000
5,500
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
'26
1930
1935
1940
1945
1950
1955
1960
SOURCE: D.B.S.
MINERAL RESOURCES DIVISION, DEPT. M.T.S.
R.A.

Gypsum - Production and Trade, 1947-57
(short tons)

	Production(1)	Exports(2)	Imports(2)
1947	2,496,984	1,938,413	18,946
1948	3,216,809	2,628,807	10,984
1949	3,014,249	2,544,782	9,297
1950	3,666,336	2,970,076	23,287
1951	3,802,692	3,028,506	17,378
1952	3,590,783	2,763,819	13,316
1953	3,841,457	2,770,077	22,578
1954	3,950,422	2,831,116	24,140
1955	4,667,901	3,039,289	42,040
1956	4,895,811	3,840,869	93,230
1957	4,577,492	3,410,707	109,563

(1) Producers' shipments. These tonnage figures include both crude and calcined up to the end of 1951. Beyond 1951 only crude-gypsum tonnages are included.

(2) Includes both crude and calcined.

The only known occurrences of gypsum in Quebec are on the Magdalen Islands in the Gulf of St. Lawrence. The deposits outcrop over wide areas and measure up to 50 feet or more in thickness.

Gypsum occurs in the Moose River area of northeastern Ontario and in the Grand River area south of Hamilton. The Moose River deposits measure 15 to 20 feet in thickness and have 10 to 30 feet of overburden, whereas the gypsum in the Grand River area occurs as narrow underground seams at depths up to 200 feet.

Large gypsum deposits occur in Manitoba and Alberta. In Manitoba, the main occurrences are at Gypsumville, where thick beds of undetermined size occur at shallow depths, and at Amaranth, where a 40-foot seam is found at a depth of 100 feet. In Alberta, the chief occurrences are in the McMurray and Peace River districts. The McMurray gypsum deposits, ranging from a few feet to 50 feet in thickness, occur interbedded with anhydrite and shale at a depth of 500 feet. The Peace River deposits, also measuring up to 50 feet in thickness, outcrop along the banks of the Peace River between Peace Point and Little Rapids.

The main deposits of British Columbia occur at Windermere, Mayook and Canal Flats in the southeastern portion of the province, and at Falkland, near Kamloops.

Producers*

Nova Scotia

Nova Scotia, the chief producer, accounted for over 84 per cent of the Canadian output of crude gypsum in 1957. Most of the gypsum quarried is exported to the United States; the remainder is used in the manufacture of plaster and wallboard in Montreal, and for the manufacture of plaster at Windsor, Nova Scotia.

Canadian Gypsum Company, Limited, a subsidiary of United States Gypsum Company of Chicago, Illinois, and the largest producer of gypsum in Canada, operates quarries for export purposes at Wentworth and at Miller Creek, near Windsor.

National Gypsum (Canada) Limited, a subsidiary of the National Gypsum Company of Buffalo, New York, is the second largest producer. It obtains gypsum from quarries at Walton in Hants county and Milford Station, 30 miles north of Halifax. Most of the output is exported to the United States.

Little Narrows Gypsum Company Limited, a subsidiary of United States Gypsum Company of Chicago, Illinois, quarries gypsum at Little Narrows in Cape Breton Island. Crude gypsum is shipped to the United States and to 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 Brooklyn, near Windsor, is calcined at the Windsor plant and shipped to consumers in Nova Scotia, eastern Quebec and Ontario.

The Bestwall Gypsum Company (Canada) Ltd., a subsidiary of Bestwall Gypsum Company, Ardmore, Pennsylvania, is continuing the investigation of a number of deposits in the southern portion of Cape Breton Island. Rock from this area will be used to supply gypsum-product plants in the eastern United States.

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.

* See map on page 328.

Manitoba

Gypsum is obtained from an underground deposit at Amaranth by Western Gypsum Products Limited and is shipped to Winnipeg, where it is used in the manufacture of plaster and wallboard at a company-owned plant. This company 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 wallboard at a company-owned plant at Winnipeg.

British Columbia

Near Windermere, in southeastern British Columbia, Western Gypsum Products Limited operates a gypsum quarry,which supplies crude gypsum to the company's gypsum-products plant at Calgary and to cement plants in British Columbia and Alberta. This quarry, formerly owned by Columbia Gypsum Co. Ltd., was purchased, along with all the assets of Columbia Gypsum, by Western Gypsum Products Limited in 1957.

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.

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, 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,both operate gypsum-product 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.

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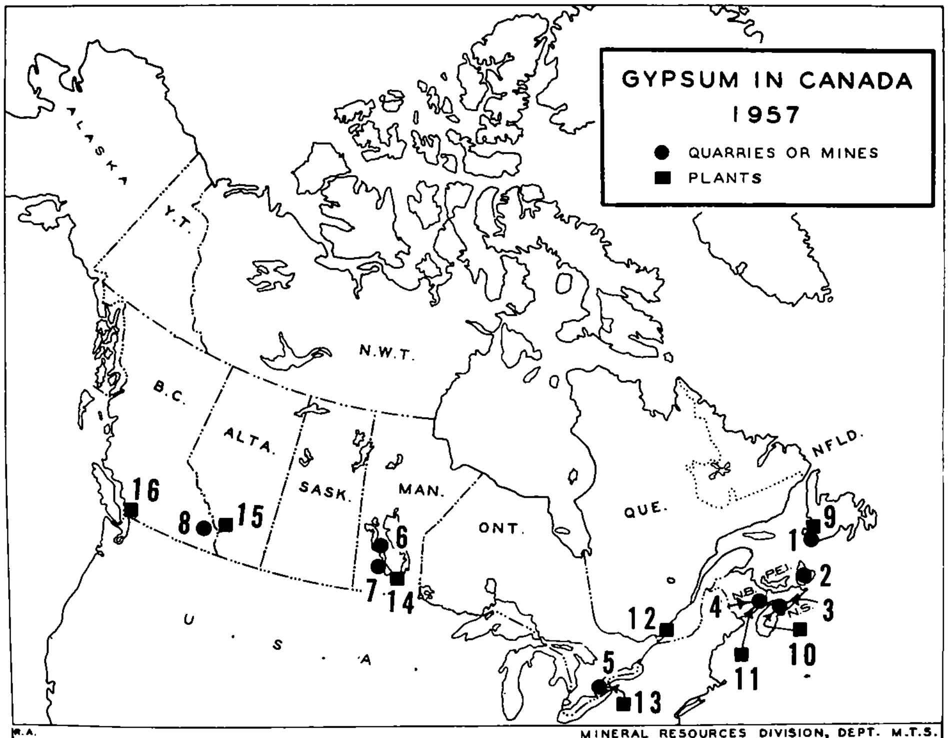

Quarries or Mines

1. Atlantic Gypsum Limited, Flat Bay
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

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. 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 a wall finish in buildings. 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 added to portland cement during its manufacture. The gypsum, acting as a retarder, is used to control the set of the cement. Crude gypsum, reduced to 40-mesh or finer is used as a filler in paint and paper. Powdered gypsum is used also as a soil conditioner to offset the effect of black alkali and restore impervious, dispersed soils, and as a fertilizer for peanuts and other leguminous crops.

Prices

The nominal price of crude gypsum in 1957 was $3 to $5 a ton f. o. b. quarry or mine. However, large contracts with seaboard quarries were at much lower prices.

ANHYDRITE

The mineral anhydrite is anhydrous calcium sulphate. It usually occurs in the massive form and is commonly associated with gypsum. Small amounts are produced at one or two gypsum quarries in Nova Scotia, where its removal is occasionally necessary to facilitate the recovery of associated gypsum.

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Gypsum

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.

INDUSTRIAL WATERS

by
J. F. J. Thomas

Water is the most used and important industrial mineral in Canada, and appreciation of its importance is growing even more rapidly than the industrialization of the nation. This is reflected in the rapid growth of federal, provincial and private agencies concerned with the utilization and conservation of these water resources.

Water is used in a multitude of ways and the quality requirements vary widely with use. These requirements - for example in atomic reactors and in steam generation and the preparation of superior products - are becoming more and more stringent in many industries. On the other hand the country's expanding growth and industrialization tend to deteriorate the quality of the readily available water resources.

The employment of water for domestic, municipal, irrigation, water-power, and industrial and similar purposes is classed as withdrawal use while its employment in navigation, waste disposal, recreation, wildlife conservation and the like is non-withdrawal use. Both are important but the former is perhaps the more demanding in quality requirements.

Industrial users require waters of many types. Some must get rid of all impurities for satisfactory use. Larger industries such as the textile, pulp and paper, chemical and steel use enormous quantities of water varying widely in quality and must therefore depend on the larger surface-water supplies. Colouring matter or a high content of heavy metals, especially of iron and manganese, may adversely affect the final product of an industry, and expensive treatment is often required to adapt the water for use. Even the users of large quantities of water for cooling, transportation, and power development may be seriously affected if the waters are excessively scale- or slime-forming, or are corrosive.

Large quantities of water are also required by the mineral industries in cleaning, screening, classification, flotation and separating minerals. The trend toward wet or chemical methods of purification and the use of ion-exchange methods of mineral separation are increasing the demand for Canada's water resources. Quality requirements for water for the various mineral-processing operations are variable. In many cases inferior-grade water may be satisfactory while in others high-quality water is demanded. Quantity requirements also vary widely and re-use of water is economic in many areas and operations. Controlled injection of water into oil sands to increase the flow of oil is now a recognized practice in many countries and will no doubt become important in oil-producing areas of Canada. This would increase the need for water in such areas, in many of which water is at present somewhat deficient in both quantity and quality. Brines and waters of lesser quality are satisfactory, if not preferable, in such water-flooding.

Most of Canada has a plentiful supply of surface waters low in dissolved minerals and soft to medium-hard in character. The waters of the streams and lakes of that major portion of Canada included in the Canadian Shield and the Cordilleran and Appalachian Regions are of this type, the principal impurities being the bicarbonate salts of calcium and magnesium, i. e. those causing carbonate hardness. In the Cordilleran Region, waters are often more mineralized and harder than in the Shield because many rise in the calcareous mountains. Some, like those of the Fraser River, also carry much sediment and are turbid and are consequently unfit for most industrial uses. Coastal waters in British Columbia and the Atlantic Provinces are very soft, carrying very little dissolved matter.

In all these more rugged parts of Canada there are small areas, such as the clay belts of northern Ontario and Quebec and certain valleys in the interior of British Columbia, where local geological and climatic conditions give rise to more mineralized and turbid waters. Most of the waters of the Shield and the Cordilleran and Appalachian Regions have a corrosive tendency and rather high colour and thus require treatment for many uses. Seasonal variation in most of these waters is not great and turbidity is troublesome only during the short period of spring run-off.

The waters of the other large geological region of Canada, the Interior Plains, have neither the quantity nor the quality available in the more rugged regions. However, the major river systems - North and South Saskatchewan, Churchill and Mackenzie - whose headwaters are in either the Cordilleran Region or the Canadian Shield, do supply a considerable part of the Plains with satisfactory waters. These, although generally classed as hard to very hard, are still not excessively mineralized. They show somewhat greater seasonal variations, particularly in turbidity, than waters of the Shield. Many of the small rivers of these systems have a relatively high proportion of non-carbonate hardness and alkali salts because of the variable inflow from small local drainage basins and sloughs in semi-arid alkali regions. The remainder of the Plains Region, particularly the southern portions of Alberta, Saskatchewan and Manitoba, is drained by rivers rising within it, such as the Assiniboine, Milk, Souris and Red. Their waters are highly mineralized, very hard and often high in alkali salts; turbidity may be excessive and flow at times inadequate. The wide seasonal variation in quality and flow and the large proportion of sulphate and chloride salts make treatment of many of these waters uneconomical for most uses.

The remainder of Canada, the St. Lawrence Lowlands of Ontario and Quebec, which are heavily populated and industrialized, is to a large extent supplied with water from the huge St. Lawrence River system. The waters of this system are at first soft and very similar to the waters of the Canadian Shield but increase continually in hardness and total mineralization down to Lake Ontario. Thereafter, the inflow of softer tributary waters from both the Shield and the Appalachian Region maintains the river as a clear, medium-hard, highly satisfactory water for most industrial uses. However, in some of these lowland areas, particularly in southwestern Ontario, the tributary streams are heavily contaminated with sediment and run-off from cultivated lands and are very hard, highly mineralized and generally unsatisfactory. In some cases, contamination from industrial and municipal wastes has seriously affected water quality. Rapid run-off and excessive demand have resulted in shortages in some areas.

Ground waters vary widely across Canada and within geological regions. In the productive areas of the St. Lawrence Lowlands and the Interior Plains, these waters are generally very hard or, if soft, have a high content of alkali salts, and are seldom satisfactory for industrial use without extensive treatment. In other regions, ground waters may be satisfactory or may be high in salt or sulphur compounds. Many smaller municipalities and industries do, at present, use ground waters, but for many major users such waters require excessive treatment or are in short supply.

Except in the productive and industrialized Lowland and Plains Regions, water quantity and quality are still generally satisfactory. However, in these areas, careful conservation, efficient use and adequate planning for the future are required if greater problems of deteriorating water resources and quality are not to occur. Such planning involves the decision as to whether land and water resources may more economically be applied to industry or to agriculture and whether it is more desirable to transport more suitable supplies from the Shield and other regions to the more populated and productive areas or to locate industries where water is plentiful. The need for a national policy for the utilization of this resource so that all competing users may be fairly served and future needs met is now growing. Organizations of the United Nations as well as other world agencies and associations are concerned with this problem on an even wider scale. In this regard, the Mines Branch is now co-operating with the International Association of Scientific Hydrology in a study of the amount of dissolved salts carried by major rivers to the oceans.

In Canada information is needed on the actual use of water by competing users, particularly by industrial users, and on their future water demands in relation to national growth. Plans have been made for securing such statistics, and the co-operation of many agencies, both governmental and private, will be required.

The Mines Branch has almost completed the initial survey of the quality of Canada's major water resources. It will continue its efforts to maintain such information, particularly in areas of expanding growth and industrialization. Study of seasonal and long-term variations in quantity and quality is essential if efficient use of the country's water resource is to be achieved, and such studies on quality are being implemented.

Industrial Waters

The efficient use of water requires continued study to overcome problems of waste, corrosion, scaling, and degradation of quality. The problem of corrosion by the many soft, aggressive waters of Canada is under increasing study in the Mines Branch. Assistance in treatment and control and basic studies on the efficient use of water in a considerable number of governmental heating plants are also under way.

Co-operative work of considerable magnitude with international organizations on more efficient and sensitive methods of water analysis, on studies of dissolved trace elements and on the standardization of water-analysis methods is also being carried out in the Branch.

World-wide studies on water conservation, water re-use, ground-water recharge, conversion of saline and brackish waters, industrial waste water disposal and sewage treatment are being closely followed for application wherever possible to problems connected with the utilization of Canada's water resources.

The following reports on the industrial water resources of Canada are available from the Mines Branch, Department of Mines and Technical Surveys, or from the Queen's Printer, Ottawa.

Water Survey Report No. 1 - Scope, Procedure and Interpretation of Survey Studies, by J. F. J. Thomas, Mines Branch No. 833. 75 cents.

Water Survey Report No. 2 - Ottawa River Drainage Basin, 1947-48, by J. F. J. Thomas, Mines Branch No. 834. 75 cents.

Water Survey Report No. 3 - Upper St. Lawrence River-Central Great Lakes Drainage Basin in Canada, by J. F. J. Thomas, Mines Branch No. 837. $1. 50.

Water Survey Report No. 4 - Columbia River Drainage Basin in Canada, 1949-50, by J. F. J. Thomas, Mines Branch No. 838. 75 cents.

Water Survey Report No. 5 - Skeena River Drainage Basin, Vancouver Island, and Coastal Area of British Columbia, 1949-51, by J. F. J. Thomas, Mines Branch No. 839. 75 cents.

Water Survey Report No. 6 - Fraser River Drainage Basin, 1950-51, by J. F. J. Thomas, Mines Branch No. 842. 75 cents.

Water Survey Report No. 7 - Saskatchewan River Drainage Basin, 1951-52, by J. F. J. Thomas, Mines Branch No. 849. 75 cents.

Interim Report - Hardness of Major Canadian Water Supplies, by J. F. J. Thomas, Memorandum Series No. 132. 1956. 25 cents.

IRON OXIDE PIGMENTS

by
H. M. Woodrooffe

Of the naturally occurring pigments referred to as the mineral-earth group, those composed essentially of oxides of iron are the most important. From earliest recorded time they have been used as a source of yellow or red colour and are today processed into pigments for industry. Since early in this century pigments of similar chemical composition manufactured from other materials have increased in importance. Consequently natural oxide pigments have been supplying a declining share of the market.

Natural iron-oxide pigments vary in quality with occurrence but generally have colour stability and good covering power and are opaque to ultra-violet light. Paint processed from them develops a hard film resistant to weathering. Artificially prepared iron-oxide pigments are characterized by uniformity of particle size, improved covering and tinting power.

Naturally occurring red pigments owe their colour to an anhydrous ferric oxide, whereas yellow pigments are a variety of limonite, a hydrated oxide of iron. The latter is often calcined to produce various shades of red. Pigments of this type occur in many countries and large deposits are found where tropical or semi-tropical conditions have caused alteration of iron formations.

Known deposits of pigment-grade iron oxide in Canada are of the bog iron ore type found in swamps, small lakes and sluggish water courses. They are believed to have been formed by the precipitation of iron oxide leached from iron-bearing rocks. Usually some clay, sand and organic matter are deposited with the oxide.

Production

The decrease in the production of natural iron oxide during 1957 resulted from a smaller demand for the purification of artificial gas. The change-over in eastern Canada to natural gas is expected to decrease this market still further.

The Sherwin-Williams Co. of Canada, Limited, operates a processing plant for the production of iron-oxide pigments at Red Mill, 7 miles east of Three Rivers, Quebec. Production has been almost continuous since 1888, when Canada Paint Company established a plant at this location.

The raw oxide is recovered from two deposits nearby in Champlain county, calcined to remove moisture and organic matter and to develop the

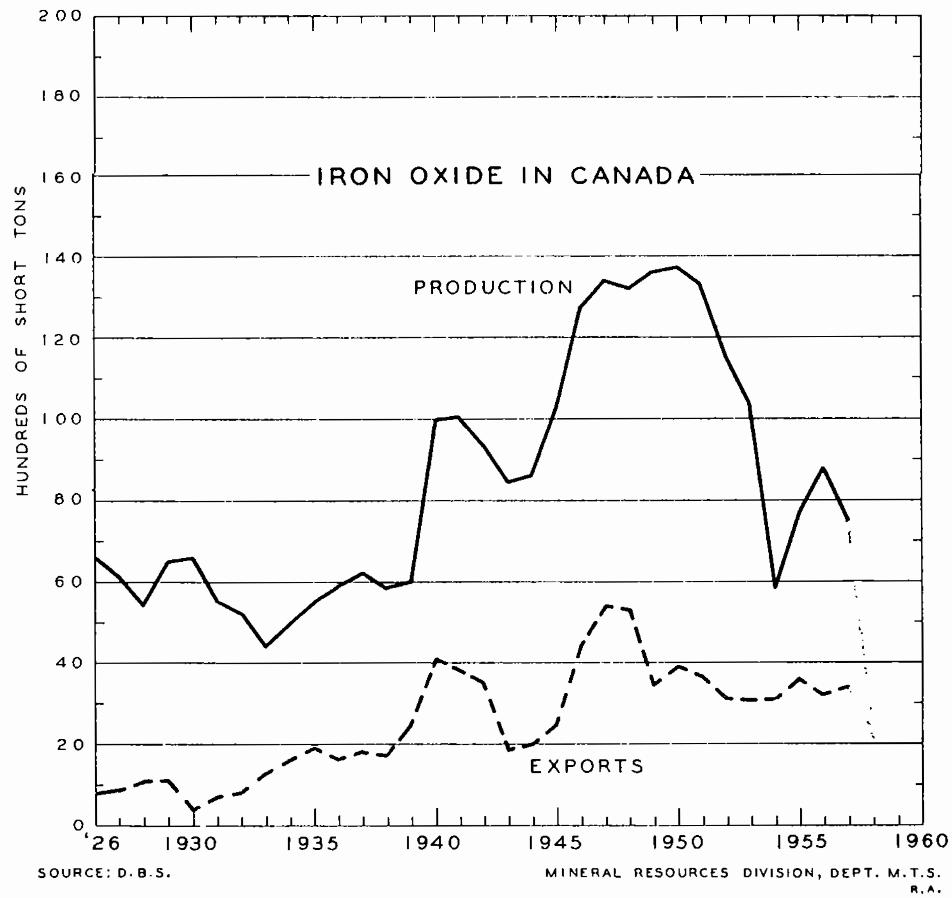
Iron Oxides - Production, Trade and Consumption

	1957		1956	
	Short Tons	$	Short Tons	$
Production (shipments)				
Natural (crude and calcined)..	7,518	187,211	8,803	186,225
Imports				
Ochres, siennas and umbers				
United States	837	64,774	1,095	86,853
United Kingdom............	69	4,450	46	2,854
Sweden	23	1,256	10	571
Other countries	17	4,829	11	455
Total	946	75,309	1,162	90,733
Exports				
Natural and synthetic iron oxides				
United States	3,208	356,753	2,974	409,191
France	105	18,409	143	21,537
Belgium	42	7,594	29	4,677
Other countries	85	14,728	57	13,027
Total	3,440	397,484	3,203	448,432
Consumption				
Coke and gas industry	5,999	64,854	8,745	89,107
Paint industry (calcined and synthetic iron oxide).....	1,895	427,289	2,166	430,797
Ochres, siennas and umbers .	263	88,103	220	52,053

Iron Oxides - Production, Trade and Consumption, 1947-57

(short tons)

	Production	Imports		Exports	Consumption		
						Paint Industry	
	Natural	Ochres Siennas Umbers	Oxides Fillers Colours etc.	Natural and Synthetic	Coke and Gas Industries	Natural and Synthetic	Ochres Siennas Umbers
1947	13,418	1,236	4,104	5,387	10,105	2,865	404
1948	13,181	1,462	3,891	5,250	9,157	2,222	306
1949	13,625	1,580	3,406	3,388	8,189	2,049	260
1950	13,696	1,544	4,096	3,934	11,624	2,453	268
1951	13,342	1,470	4,552	3,646	10,310	2,946	249
1952	11,487	998	4,215	3,060	8,302	2,441	227
1953	10,308	1,171	5,258	3,048	7,989	2,456	243
1954	5,798	1,052	4,443	3,111	9,167	2,190	212
1955	7,702	986	5,707	3,623	6,835	2,298	221
1956	8,803	1,162	6,237	3,203	8,745	2,166	220
1957	7,518	946	4,826	3,440	5,999	1,895	263



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.

Synthetic Iron-oxide Pigments

All synthetic iron-oxide pigments produced in Canada in 1957 came from the New Toronto, Ontario, plant of Northern Pigment Company, Limited, one of the world's largest producers of iron-oxide pigments manufactured by the ferrite process. Scrap iron, usually barrel cuttings, is digested in acid. Ferrous sulphate or chloride is precipitated from the resulting solution by alkali (lime, soda ash, sodium hydroxide, etc.) and oxidized with air to the hydrated ferric oxide stage. The resulting colloidal gel is allowed to crystallize into a yellow hydroxide. The changes taking place in the gel during crystallization are extremely complicated and depend on surface phenomena, internal structure and chemical composition. The colour depends on the crystal size and passes through a series of successive stages - blue, green, yellowish brown and finally yellow to yellow-orange. The crystals are filtered off at the proper stage and then calcined or blended to give the full range of colours.

Pigments are also prepared from copperas (ferrous sulphate) by calcination to establish the desired shade of red.

Crude Oxide for Gas Purification

Almost the entire Canadian output of crude, air-dried iron oxide for gas purification in 1957 was produced by Charles Girardin of Yamachiche, Quebec, from a deposit in Champlain county, about 5 miles north of Three Rivers. In past years there were a number of small-scale operations for crude iron oxides in this area.

A small annual production of oxides for gas purification was recorded in British Columbia during the period 1923 to 1949. The deposit at Alta Lake near New Westminster has been worked out.

Non-producing Occurrences

Atlantic Provinces

Minor deposits of pigment-grade iron oxide occur in Nova Scotia and New Brunswick, and a small amount has been produced in Colchester county, Nova Scotia.

Quebec

Many bog deposits occur near the north bank of the St. Lawrence River close to Three Rivers. Other deposits of considerable size have been reported from the south shore. These are relatively thin and do not show much economic promise. Deposits occur also in Portneuf, Montmorency and Labelle counties. In the last-mentioned, near Annonciation, the deposits are reported to be 12 feet thick and are 25 to 30 acres in extent.

Ontario

Small, thin beds have been reported on the east bank of the Abitibi River, in Kennedy township, near Cochrane, and in Monmouth township, Haliburton county.

Western Canada

Iron-oxide deposits of considerable size occur near Grand Rapids and Cedar Lake, north of Lake Winnipegosis, Manitoba, and at Loon Lake, about 32 miles from St. Walburg, Saskatchewan. There are several occurrences in British Columbia and material that may be suitable for gas purification occurs in the Peace River area of northeastern 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 influenced the wide use of iron-oxide pigments in outside paints to protect large surfaces, such as 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 passing it 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 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.

Iron Oxide

Prices

Ochres

E & M J Metal and Mineral Markets of December 19, 1957, quotes United States ochre prices per ton as follows:

100-lb paper bags, f.o.b. Georgia mines	\$26.50 to \$32
300-mesh, dark yellow, 60% ferric oxide, f.o.b. Virginia mines	\$24.50 to \$25.50

Iron Oxides

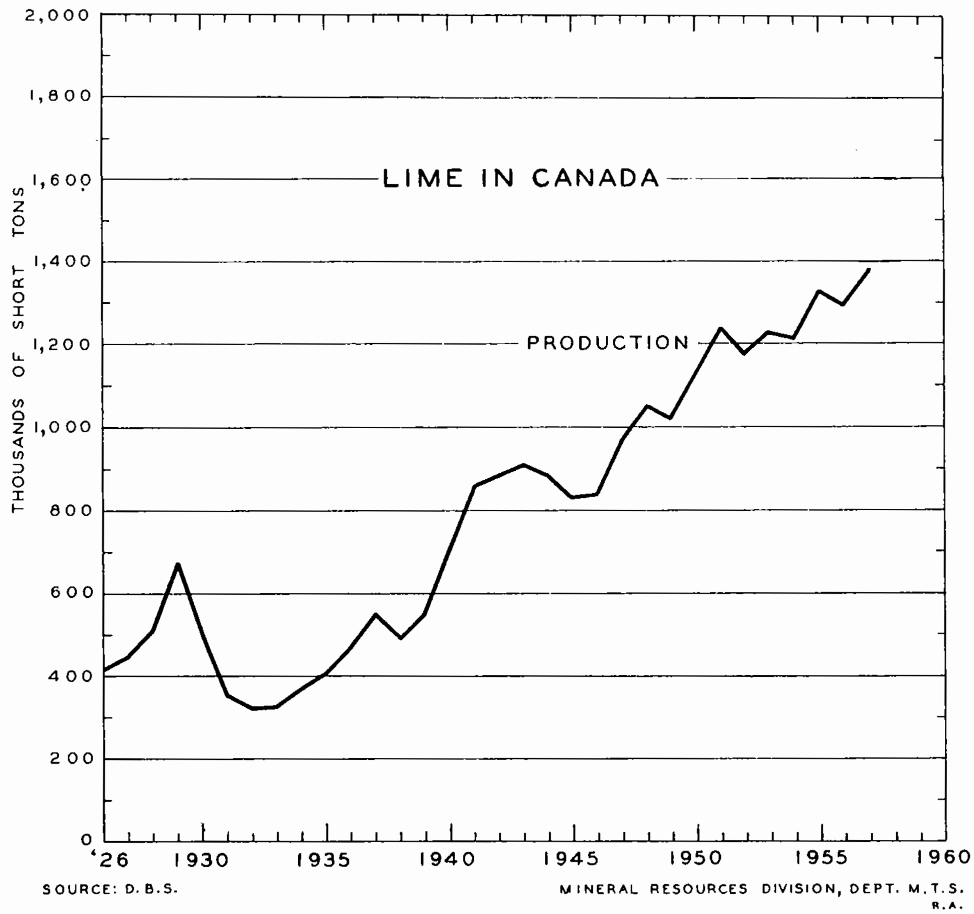
The Oil, Paint and Drug Reporter of December 30, 1957, quotes the following prices per lb:

Black	13 1/4¢
Brown	14 1/4¢
Yellow	11 1/2¢
Red, 75 to 85% ferric oxide	6 3/4¢ to 8¢

LIME

by
J.S. Ross

Lime is the most common and cheapest of the alkali chemicals and has numerous uses. In many uses it has no substitute. Lime is a product of the complete calcination of limestone or dolomite and is sold as either quicklime, the oxide, or as a hydrated lime, the hydrated oxide. Except from 1929 to 1932 the production of lime in Canada has risen continuously since 1906. Production in 1957 was more than twice that of 1939.



Lime - Production and Trade

	1957 Short Tons	1957 $	1956 Short Tons	1956 $
Production (shipments)				
By product				
Quicklime	1,074,338	13,048,505	947,316	11,852,860
Hydrated lime	304,279	3,630,109	348,383	3,814,738
Total	1,378,617	16,678,614	1,295,699	15,667,598
By province				
New Brunswick	14,895	342,054	18,432	408,338
Quebec	443,964	4,295,102	452,779	4,506,430
Ontario	766,143	9,416,868	673,357	8,258,857
Manitoba	64,922	1,089,728	64,286	1,066,704
Alberta	42,223	678,237	41,309	624,060
British Columbia	46,470	856,625	45,536	803,209
Total	1,378,617	16,678,614	1,295,699	15,667,598
Imports				
United States	27,865	338,576	46,893	545,655
United Kingdom	318	4,305	385	4,987
Total	28,183	342,881	47,278	550,642
Exports				
United States	36,179	741,804	31,897	622,713
St. Pierre	5	165	4	191
Sweden	-	-	6	125
Total	36,184	741,969	31,907	623,029

The 6.4 per cent increase over the lime production of 1956 was due mainly to the increased demand for lime in Ontario and essentially to the needs of the expanding uranium industry, which is expected to increase its lime consumption at a similar rate during 1958. This excess demand was met by the output of two new rotary kilns.

At greater output from the existing kilns in British Columbia accounted for most of the increase shown by the year's exports over those of 1956.

Lime is manufactured in six provinces although all except Prince Edward Island have undeveloped deposits of limestone suitable for the production of lime. However, many high-calcium occurrences are some distance from centres of industry. Because lime is low-priced, it is commonly manufactured in or near those industrialized areas containing limestone of desired purity. Most Canadian lime plants are in the populated areas of each province and most of the output is from the industrialized provinces. Thus, more than 87 per cent of the lime production is from Ontario and Quebec.

Canada is essentially self-sufficient in lime although, because of the locations of a few areas, minor but decreasing amounts are imported into eastern Canada. The low price normally restricts international trade.

Approximately 2,562,700 tons of limestone were used for making lime in Canada during the year.

High-calcium lime is a product of British Columbia, Alberta, Manitoba, Ontario, Quebec and New Brunswick, and dolomitic lime is manufactured in Ontario, Manitoba and New Brunswick. In 1957, 39 plants containing 151 kilns, were in operation, 25 of the kilns being of the rotary variety.

Producers

New Brunswick

Bathurst Power and Paper Company Limited burns limestone from Quebec in two kilns at Bathurst for use in its pulp and paper mill. Snowflake Lime Limited operates its own quarry and three kilns at Saint John for the production of quick and hydrated lime, mainly for the pulp and paper, building, and metallurgical industries.

Quebec

High-calcium lime is manufactured at St. Paul de Joliette and St. Marc des Carrières by Standard Lime Company Limited for use in the pulp and paper and building industries.

At Shawinigan, Shawinigan Chemicals Limited burns high-calcium limestone from near Bedford, Quebec, for use in the manufacture of calcium carbide.

Dominion Lime Limited, Lime Ridge, produces lime from high-calcium limestone for building and industrial uses.

At Wakefield, Aluminum Company of Canada Limited manufactures quick and hydrated lime from brucitic limestone for industry, agriculture and the building trade.

Four small lime plants were also in production to supply local markets.

87875-1—23

Lime

Ontario

Gypsum, Lime and Alabastine, Canada, Limited, completed construction of a second rotary kiln at its Beachville plant. The expansion was made mainly to supply lime to the Blind River area. The company supplies high-calcium and dolomitic quick and hydrated lime from its plants at Beachville, Hespeler and Milton to the industrial, chemical and building industries.

Cyanamid of Canada Limited, formerly North American Cyanamid Limited, produces lime at Niagara Falls, Ontario, for use as a main constituent in the manufacture of calcium carbide and cyanamide at the company's Niagara plant. Construction of a new plant containing one 350-foot rotary kiln was completed at the quarry during 1957. The quarry at Ingersoll, which was changed extensively during the year to meet increased production, supplies high-calcium limestone to both plants. This recent expansion program resulted from an increased demand for lime by the uranium industry. The company has a five-year contract to supply Northspan Uranium Mines Limited with lime.

Brunner Mond Canada, Limited, burns high-calcium limestone near Amherstburg for the manufacture of alkali.

Near Beachville, Chemical Lime Limited manufactures high-calcium lime mainly for iron and steel plants.

Dolomitic lime is produced in Guelph township for the building industry by Canadian Gypsum Company, Limited.

Seven other lime plants were in operation during 1957.

Manitoba

The Winnipeg Supply and Fuel Company Limited makes high-calcium lime at Spearhill mainly for use in pulp and paper mills and non-ferrous smelters and also 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 and Gypsum, Lime and Alabastine, Canada, Limited, hydrate purchased lime at Winnipeg.

Alberta

Canada Sugar Factories Limited operates three kilns in conjunction with its sugar refineries at Raymond, Picture Butte and Taber.

Summit Lime Works Limited and Loder's Lime Co. Ltd. manufacture high-calcium lime for various uses near Crowsnest Pass and at Kananaskis respectively.

British Columbia

High-calcium limestone is burned for lime at Blubber Bay, Texada Island and Vancouver by Gypsum, Lime and Alabastine, Canada, Limited, formerly Pacific Lime Company Limited.

Crown Zellerbach Canada Limited produces lime at Ocean Falls for its own use in the manufacture of pulp and paper.

Uses

Lime is consumed in numerous uses and in most industries. In some industries it is employed as a raw material and in others it has indirect applications. Because of its low cost, its use and the fact that in many uses it has no substitute, its outlook seems bright. As shown in the accompanying table, the consumption of lime falls into three main groups.

The largest group, which consumed more than 82 per cent of the lime used in Canada in 1956, comprises the chemical and other industrial users. Its largest item of consumption is captive-tonnage lime (see "other industries" in table). This lime, produced by companies for their own uses and for which separate figures are not available, includes in this case lime used in the manufacture of calcium carbide and calcium cyanamide. Other uses of lime are noted in the table in the order of importance. Chemical and industrial processes require lime for neutralization, causticization, coagulation and precipitation.

High-calcium lime is a main raw material for the manufacture of such chemical compounds as calcium carbide, calcium cyanamide, soda ash, precipitated calcium carbonate, calcium hydroxide, sodium bicarbonate, ethylene glycol, calcium hypochlorite and calcium arsenate as well as for most of the organic and inorganic calcium compounds.

Mainly high-calcium lime is being used in the uranium industry to neutralize tailings. It is estimated that uranium mills in Canada will be consuming 950 tons of lime a day before the end of 1958. The uranium industry will then become the second largest consumer of lime in Canada and most will be produced and consumed in Ontario.

87875-1—23½

Consumption of Lime

(producers' shipments, by usage)

	1957		1956	
	Short Tons	$	Short Tons	$
Chemical and other industrial uses				
Pulp and paper mills......	200,162	2,635,663	222,752	2,825,484
Non-ferrous smelters.....	118,146	671,154	157,695	796,523
Iron and steel plants......	126,568	1,547,359	113,605	1,364,700
Sugar refineries..........	31,363	403,489	25,931	337,442
Cyanide and flotation mills	17,997	222,205	17,929	215,345
Glass works	18,693	220,927	15,723	174,295
Sand-lime brick..........	9,960	117,393	13,973	162,393
Tanneries	7,269	89,355	5,905	69,994
Fertilizer plants	4,423	42,501	4,752	48,605
Insecticides, fungicides...	571	10,447	77	689
Uranium mills	75,577	926,140	-	-
Other industries	578,918	6,383,229	491,891	5,878,152
Building trades				
Mason's lime	93,528	1,399,039	101,962	1,535,247
Finishing lime	83,851	1,804,298	97,328	1,951,027
Agricultural uses	3,181	52,638	6,251	77,476
Other uses	8,410	152,777	19,925	230,226
Total....................	1,378,617	16,678,614	1,295,699	15,667,598

In the pulp and paper industry lime is used in the processing of dissolving liquors in the sulphite, sulphate and soda processes and as a raw material in the manufacture of the bleaching agent, calcium hypochlorite.

Lime is used mainly as a flux in the smelting and refining of non-ferrous ores.

In steel plants it is used extensively as a flux and desulphuring agent, and in the manufacture of steel products it has many uses, including the neutralization of waste pickle liquors.

Sugar refineries employ high-calcium lime to form 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.

As dolomitic lime, it 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.

More than 12 per cent of the lime used in Canada in 1957 was consumed by the building trade, where it is a constituent of plaster, stucco, mortar and sand-lime brick.

The agricultural industry employs lime to control soil acidity, as a source of calcium and magnesium,as a soil conditioner and in insecticides and fungicides.

Quick lime is marketed in Canada in lump bulk form or crushed in bulk or containers. Hydrated lime is sold as a finely ground product in containers.

Prices

Prices of lime vary according to the type of product and location. During 1957 the over-all average price increased slightly and in the Toronto area carload lots were in the range of $10.50 to $14 a ton.

LIMESTONE

J.S. Ross

In industry, the term 'limestone' includes all rocks of sedimentary and metamorphic origin that consist mainly of calcite (calcium carbonate) and dolomite (the double carbonate of calcium and magnesium). Occasionally varying amounts of magnesite (magnesium carbonate) and brucite (magnesium hydroxide) may partly replace limestone and dolomite to form such rocks as brucitic limestone and magnesitic dolomite. When composed completely or almost completely of brucite or magnesite, the rock is known as brucite or magnesite, respectively. Limestone may vary in colour, texture, hardness and chemical composition depending on the type and amount of impurities and the geological history.

On the basis of chemical composition, limestone may be divided into four classes: high-calcium limestone with more than 95 per cent calcium carbonate, as much as 3 per cent total impurities and not more than 2 per cent magnesium carbonate; calcium limestone with less than 10 per cent magnesium carbonate; magnesian limestone intermediate in composition between calcium limestone and dolomite; and dolomite with 40 to 45.65 per cent magnesium carbonate.

Because occurrences of the rock are widespread in the more populated areas of Canada, limestone is generally a low-priced commodity. It is used widely in the construction, chemical, agricultural and other industries.

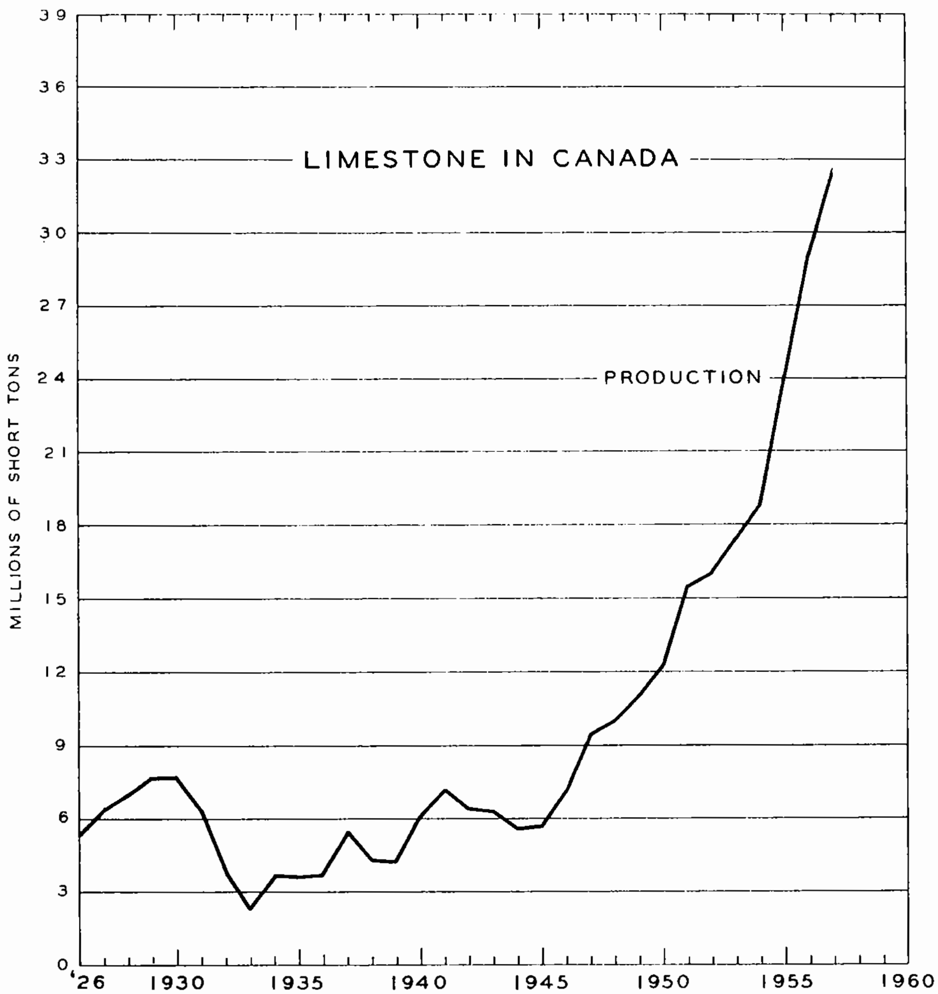
Limestone has been produced in Canada since the beginning of its recorded history. The rock is quarried in all provinces except Saskatchewan and Prince Edward Island. The 389 limestone quarries in operation in 1956 produced more than 90 per cent of the total amount of stone quarried in Canada. Although production reached a new peak in 1957, it was only slightly greater than that of 1956. The output from Quebec and southern Ontario accounts for 90 per cent of the total. The production of stone quarried for use in the manufacture of lime and cement is not included in these figures. However, the estimated consumption (and therefore the production) of all limestone used in Canada in 1957 increased 14 per cent over that of 1956. Since 1946 the production of the commodity for all purposes has increased more than 259 per cent. Over 22 per cent more limestone was used for the production of cement in 1957 than in the previous year.

Limestone - Production and Consumption

	1957		1956	
	Short Tons	$	Short Tons	$
Production				
By provinces				
Newfoundland	348,143	581,224	319,261	573,304
Nova Scotia	124,672	240,615	109,142	211,765
New Brunswick	496,411	771,34[illegible]	502,232	633,575
Quebec	12,615,250	16,298,291	10,448,278	14,793,410
Ontario	16,592,404	19,748,013	15,207,534	18,941,565
Manitoba	391,796	829,618	262,557	956,708
Alberta	35,427	134,341	30,863	111,165
British Columbia	2,014,679	2,677,539	2,226,110	3,084,323
Total	32,618,782	41,280,990	29,105,977	39,305,815
By uses				
Structural*	85,770	2,383,287	83,208	2,699,658
Metallurgical	1,694,241	1,912,480	1,944,444	2,415,247
Glass-making	23,269	69,141	17,098	45,454
Sugar-refining	11,227	14,391	4,400	8,627
Pulp and paper........	382,875	1,177,478	421,652	1,224,996
Other chemical uses...	181,575	252,319	66,476	74,582
Pulverized for agricultural and fertilizer uses	608,912	1,468,670	474,903	1,229,300
Pulverized for other uses.................	82,231	311,183	171,287	620,538
Rubble and riprap	1,601,109	1,745,518	606,755	596,090
Concrete aggregate....	9,338,334	11,886,706	10,081,389	12,628,014
Road metal	15,506,951	16,122,595	13,835,618	16,233,750
Rail ballast...........	1,593,946	2,102,131	809,078	793,586
Other uses............	1,508,342	1,835,091	589,669	735,973
Total.................	32,618,782	41,280,990	29,105,977	39,305,815
Consumption				
In the manufacture of cement............	8,741,863		7,152,693	
In the manufacture of lime..............	2,562,740		2,276,836	
Miscellaneous	32,618,782		29,105,977	
Total.................	43,923,385		38,535,506	

* Includes building, monumental and ornamental stone, flagstone and curbstone.

Limestone



SOURCE: D.B.S.

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

International trade is negligible but is increasing, some stone being 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 a metallurgical flux. High-calcium stone is shipped from Beachville, Ontario, to Ohio for use as a flux in an iron-and-steel plant. A minor amount of limestone for fluxing purposes was imported into southern British Columbia from a near-by source in the United States.

Uses

Except for the relatively small output of structural stone, rubble and riprap, Canadian limestone is marketed in the crushed form in various sizes. The employment of the 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 stone; the thickness and extent of the beds and formation; and the depth of overburden, dip and drainage.

Most Canadian limestone is used for construction purposes - mainly in road construction and concrete aggregate. It is a raw material employed in the production of cement. Limestone is also used as railway ballast, rubble, riprap, flagstone, curbstone, and building, monumental and ornamental stone.

High-calcium limestones low in impurities have chemical qualities making them important raw materials for the chemical industry. They are the source of lime for certain chemical processes and of fluxing stone in the blast-furnace reduction of iron ore and in the smelting of non-ferrous ores. High-calcium limestone is consumed by the pulp and paper industry in the preparation of calcium-bisulphite dissolving liquor. It is also employed in sugar-refining.

Dolomitic limestones containing low impurities are employed as fluxes in the blast-furnace reduction of iron ore, 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. Marl, an unconsolidated form of calcium carbonate, is also used for this purpose, mainly in British Columbia and Quebec.

Dominion Magnesium Limited, near Haley Station, Ontario, produces magnesium from dolomite by the ferrosilicon process. It is also derived from magnesia obtained from brucitic limestone by Aluminum Company of Canada Limited near Wakefield, Quebec.

Magnesitic dolomite is mined by Canadian Refractories Limited at Kilmar, Quebec, for use in the production of a number of basic refractory products. Steetly of Canada Limited dead-burns dolomite near Dundas, Ontario, for use as a refractory material in the steel industry.

Prices

Prices of limestone products vary according to the geographical location, the local supply of a given product, and the type, quality and preparation of the stone. Crushed stone for concrete aggregate may sell for \$1.50 a ton or more at the quarry.

LITHIUM MINERALS

by
J.E. Reeves

There was little change during 1957 in the Canadian lithium-mineral industry. Canada continued as an important source, with Quebec Lithium Corporation still the sole producer. This company completed its second full year of operations, producing a spodumene concentrate from very large deposits of spodumene-bearing pegmatite in Lacorne township, about 20 miles north of Val d'Or in western Quebec. Some companies maintained a high level of interest in lithium minerals, but there was little exploration or development during the year. Despite the fact that world markets have expanded greatly in the last decade, the expansion has not nearly kept pace with the development of potential ore and most properties are now inactive pending further market changes.

Production and Trade

Quebec Lithium Corporation increased its production by more than 7 per cent to 5,140,257 pounds of lithia in the form of a spodumene concentrate. All production was exported to Lithium Corporation of America Inc., at Bessemer City, North Carolina, under a five-year contract which call for 165 tons a day with a minimum content of 4 1/2 per cent lithia. The 1957 portion of the contract was readily fulfilled.

The company's mine production was maintained at the designed capacity of at least 1,000 tons a day and the mill operated at a somewhat lower rate owing to the hand-sorting of waste. The capacities of both can be readily increased. The spodumene is concentrated by froth flotation to a grade in excess of 5 per cent lithia. Equipment has been installed for the production of a ceramic grade of spodumene containing a very low iron content and for the production of by-product feldspar. In addition, the company has announced its intention of going ahead with the construction of a plant to produce lithium chemicals from spodumene concentrate in excess of contract commitments. A site for this plant has been selected at Rouses Point in New York State just south of the Quebec border.

Consumption of lithium products in Canada is not large. The value of estimated imports from the United States in the form of lithium carbonate and lithium hydroxide amounts to more than $50,000 annually.

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, all 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 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 known as the Lacorne batholith. They occur both within the intrusive 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 bands and patches. Beryl and tantalite-columbite are common 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 south of Lake Nipigon. Many occurrences of spodumene 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 and all are inactive pending market improvement.

Manitoba

In southeastern Manitoba, numerous lithia-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 - as well as amblygonite and petalite also occur. The company closest to production in this area is Montgary Explorations Limited, whose property is on the north shore of Bernic Lake. The company's most recent estimate indicates reserves 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 (a cesium-aluminum silicate) approximates 150,000 tons. This concentration of lepidolite and a reportedly substantial tonnage of amblygonite-bearing material are the only known non-spodumene 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, 70 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 extending about 50 miles northeast of Yellowknife 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

Four principal companies produce lithium chemicals, metal and alloys in the United States. Raw material for this production is imported from Canada, Southwest Africa, Southern Rhodesia, Brazil and Mozambique and some is obtained from domestic sources. Large reserves of spodumene in North Carolina are being mined by two companies. The Black Hills of South Dakota have been a source of spodumene for many years and are still being mined on a small scale. The salt brine of Searles Lake, California, is a source of lithium compounds from dilithium phosphate obtained as a by-product of the production of potash and other salts.

Lithium-mineral production in Africa consists mainly of lepidolite (lithium-potassium-aluminum silicate), petalite (lithium-aluminum silicate) and amblygonite (lithium-aluminum phosphate). Very large reserves of lepidolite and petalite exist in Southern Rhodesia and Southwest Africa and make up the great bulk of production, although amblygonite is produced on a relatively small scale. A chemical-processing plant recently constructed in Texas uses lepidolite from Southern Rhodesia as raw material. These African sources supply lithium requirements of the United Kingdom and European countries also.

Other countries too numerous to mention 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 recently reported large deposits containing lithium in the Kola peninsula.

Uses and Specifications

Lithium compounds find their most important applications in the ceramic industry and in the manufacture of lubricating greases. Practically all lithium concentrates are converted chemically to lithium carbonate or hydroxide, the usual basic compounds used in industry. For chemical processing, 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 developed 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 multi-purpose greases, simplifying both manufacture and application.

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 ultravoilet 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 in refrigeration systems; of lithium fluoride as a flux in the welding and brazing of aluminum; and of compounds in the production of single-crystal optical units, in the control of reactions leading to the formation of alkyd resins for use in paints and in the manufacture of dry-cell batteries that will function at extremely low temperatures, at which normal cells are inoperative.

Lithium

Lithium as a metal has so far had limited application. It appears to find its principal use as a scavenger of impurities in the refining of non-ferrous 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 announced during the year 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. Lithium associates with solid fuels in the form of lithium hydride. The chemical compound furnishes a readily available source of hydrogen, which is a high-energy fuel.

Prices

Lithium concentrates are not traded in the open market and prices published in trade journals are therefore purely nominal. The one exception is the price of spodumene concentrate established in the contract between Quebec Lithium Corporation and Lithium Corporation of America Inc. - $11 per unit of lithia ($Li_2O$).

Nominal prices for lithium concentrates quoted in trade journals are as follows:

Spodumene	$ 9.00 - $9.50/unit Li_2O
Lepidolite	$ 6.65 - $7.35/unit "
Petalite	$ 6.65 - $7.35/unit "
Amblygonite	$73.50 per short ton

A reduction effective January 1, 1958, lowered the price of lithium hydroxide about 20 cents to 55 cents a pound, and of lithium carbonate 6 cents to 67 cents a pound.

Prices of lithium chemicals from Chemical and Engineering News Quarterly Report on Current Prices are:

	Per lb*		
Lithium metal, 98%	$11.50	-	$13.15
" bromide	$ 1.80		
" chloride	$ 1.45		
" carbonate	$ 0.67		
" hydroxide	$ 0.55		
" stearate	$ 0.49	-	$ 0.50
" fluoride	$ 2.17 1/2	-	$ 2.40
" citrate	$ 1.60		
" hydroxystearate	$ 0.71	-	$ 0.72
" salicylate	$ 1.60	-	$ 1.62

* For quantities normally involved in commercial transactions.

MAGNESITE AND BRUCITE

by
H.M. Woodrooffe

Although magnesite and sea water are usually the principal sources of magnesia for chemical, industrial and refractory uses, primary production in Canada is in the form of calcined brucitic granules and magnesitic dolomite. The only deposits of minerals of this type now being worked in Canada are in western Quebec near the Ottawa River. The value of production in 1957 amounted to $3,046,298, or 9 per cent more than in the previous year. The Canadian product is used as a source of magnesium metal, basic refractories and other industrial and chemical requirements.

In Argenteuil county, at Kilmar, 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 sink-float 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, ramming mixtures and other specialized refractory products. These products are prepared from dead-burned magnesitic dolomite and brucitic magnesia and other refractory raw materials.

At Farm Point, near Wakefield, Quebec, 22 miles north of Ottawa, Aluminum Company of Canada Limited quarries a brucitic limestone for the recovery of magnesia. In this rock the mineral brucite, a hydroxide of magnesia, occurs as spheroid-like granules in a matrix of calcium carbonate. The rock is crushed, sized, calcined and further processed into marketable forms of magnesia and lime. Part of the magnesia is shipped to the company's plant at Arvida, Quebec, for conversion to magnesium chloride and recovery of magnesium metal by an electrolytic process. The remainder is used in the manufacture of high-magnesia basic refractories, for other industrial and chemical applications and as a soil additive. As co-products from this operation, hydrated and quick lime are recovered.

The other known occurrences of brucitic limestone in Canada are in the vicinities of Wakefield, Bryson and Lake St. John, Quebec; at Rutherglen, Ontario; and on West Redonda Island, British Columbia.

Magnesite and Brucite - Production and Trade

	1957		1956	
	Short Tons	$	Short Tons	$
Production*				
Magnesitic dolomite and brucite		3,046,298		2,783,181
Imports				
Dead-burned and caustic calcined magnesite				
United States	6,696	570,414	6,507	727,223
Yugoslavia	4,933	262,787	15,133	731,148
United Kingdom	43	8,630	133	11,758
Other countries	38	2,798	2,287	119,896
Total	11,710	844,629	24,060	1,590,025
Magnesite fire-brick				
United States		404,580		676,416
West Germany .:.......		20,357		3,937
United Kingdom		5,992		-
Total		430,929		680,353
Magnesium carbonate and magnesium oxide				
United States	1,976	152,894	5,704	540,589
United Kingdom	476	67,213	671	98,713
Total	2,452	220,107	6,375	639,302
Magnesium salts or compounds				
United States	4,138	250,630	7,052	324,282
United Kingdom	148	92,410	165	104,763
Other countries	61	8,292	39	9,701
Total	4,347	351,332	7,256	438,746
Magnesium sulphate or Epsom salts				
West Germany	1,524	27,935	1,605	29,085
United States	994	40,514	837	35,608
Other countries	40	2,846	172	4,824
Total	2,558	71,295	2,614	69,517
Magnesia pipe covering				
United States		74,916		128,947
United Kingdom		68,725		29,627
Total		143,641		158,574

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Magnesite and Brucite - Production and Trade (cont'd)

	1957		1956	
	Short Tons	$	Short Tons	$
Exports				
Dolomite and brucite				
United States		1,520		-
Basic refractory materials, dead-burned				
United States	(not now available		10,256	715,179
United Kingdom	as separate		2,106	97,987
Brazil	classification)		1,354	94,633
Other countries			1,110	55,809
Total			14,826	963,608

* Includes the value of brucite shipped, dead-burned magnesitic dolomite and a small quantity of serpentine.

Magnesitic Dolomite and Brucite - Production and Trade, 1947-57

		Exports	Imports					
	Production	Magnesite Dead-burned	Magnesite Dead-burned	Magnesite Fire-brick	Magnesia Pipe Covering	Magnesia Carbonate and Oxide	Magnesium Sulphate	Magnesium Compounds
	$	Short Tons	Short Tons	$	$	Short Tons	Short Tons	Short Tons
1947	1,167,484	4,867	9,339	465,041	201,391	546	2,908	424
1948	1,587,709	4,357	7,713	431,421	385,352	695	2,797	493
1949	1,536,200	2,037	4,683	486,671	164,752	988	2,783	429
1950	1,717,879	2,602	5,987	414,335	24,716	1,677	2,793	615
1951	2,148,940	4,902	6,520	493,016	120,016	4,385	3,065	955
1952	2,161,472	2,960	10,278	657,040	231,094	3,815	2,185	1,344
1953	2,016,640	4,601	6,801	954,861	187,053	6,305	2,761	3,354
1954	1,909,163	7,887	6,116	397,573	139,556	6,027	2,365	6,098
1955	2,151,820	3,255	13,937	554,071	92,397	5,497	2,376	5,277
1956	2,783,181	*	24,060	680,353	158,574	6,375	2,614	7,256
1957	3,046,298	*	11,710	430,929	143,641	2,452	2,558	4,347

* Not now available as separate classification.

Although magnesite and hydromagnesite deposits occur at several locations in western Canada, mostly in British Columbia and Yukon, they are generally not extensive or are remote from transportation and are not worked. The more important of these are at Marysville, near Cranbrook, British Columbia, and are owned by The Consolidated Mining and Smelting Company of Canada Limited. Magnesite impure in silica also occurs in two areas of central Newfoundland.

Hydromagnesite occurrences near Atlin and Clinton, British Columbia, have been worked intermittently.

Uses

Magnesia is a raw material used for the production of magnesium metal and basic refractories and for the preparation of oxysulphate and oxychloride cements. The last, a durable cement used principally as a floor covering, is obtained by the reaction of active magnesia with a solution of magnesium chloride. Magnesia is also used in processes for the recovery of uranium from its ores.

The pulp and paper industry uses magnesia in the preparation of magnesium-bisulphite dissolving liquor for chemical treatment of wood pulp. In this process it is possible to recover much of the magnesia and sulphur for re-use.

Magnesia also finds application in the preparation of a number of magnesium chemicals and compounds for use in the pharmaceutical trade, in industry, in soil additives and in the control of acidity. An example of the last is its use in neutralizing sulphuric-acid solutions, in which it forms a compound more soluble than that obtained with lime.

87875-1—24½

MICA

by
J. E. Reeves

Since the immediate postwar period there has been a substantial decline in Canadian mica production, and that of 1957 continued at the low level of the last few years.

Exports in 1957 increased considerably over those of 1956, the chief recipient of the higher-valued sheet mica being Japan. In recent years that country has provided a relatively steady market for small untrimmed and trimmed phlogopite sheet, the value of which increased in 1957 to 89 per cent of the total export market for unmanufactured mica.

Exports have always been important to Canada's mica industry. The United States was formerly the major consumer of Canadian mica and the loss of most of this market, particularly for high-quality trimmed mica, has been the prime reason for the industry's decline in Canada. Under present conditions, the high cost of Canadian labour makes it difficult to compete with countries such as India for muscovite and Madagascar for phlogopite.

Production

The mica produced in Canada consists mainly of phlogopite from southeastern Ontario and southwestern Quebec. A small amount of muscovite was produced during the year from the former Purdy property near Eau Claire, Ontario, and from a deposit in the Parry Sound district of Ontario. There was no production of ground mica schist in British Columbia in 1957, but the industry expressed the hope that operations might be revived.

Quebec

Mica production in 1957 - all phlogopite - came from several small, scattered deposits in the Gatineau-Lièvre area north of Ottawa, particularly from the townships of Hull, Templeton, Portland West and Amherst. Although there was a considerable amount of rough and trimmed sheet, chiefly of small sizes for export to Japan, most of it was scrap phlogopite both for export and for local grinding. The major contributors were: E. Wallingford Limited, Perkins; Conrad Poirier, Wilson's Corners; W.R. Côté, Ville St. Laurent; and Cameron and Sons, Buckingham. Blackburn Brothers Limited operated a custom grinding mill at Cantley, mined sheet from a nearby mine and recovered scrap from a property near Perkins.

Mica – Production, Trade and Consumption

	1957 Pounds	1957 $	1956 Pounds	1956 $
Production				
By primary sales				
Trimmed	40,165	47,231	22,355	26,641
Sold for mechanical splittings	65,612	17,946	16,000	4,160
Splittings	16,385	3,568	2,000	3,480
Rough, mine-run or rifted	2,577	1,085	40,826	841
Ground or powdered	911,138	37,226	1,493,410	58,083
Scrap and unclassified	246,539	4,527	269,220	2,461
Total	1,282,416	111,583	1,843,811	95,666
By types				
Phlogopite (amber mica)	1,265,929	107,642	1,663,803	94,396
Muscovite and mica schist	16,487	3,941	180,008	1,270
Total	1,282,416	111,583	1,843,811	95,666
By provinces				
Quebec	1,191,500	105,300	1,617,276	93,761
Ontario	90,916	6,283	46,535	645
British Columbia	-	-	180,000	1,260
Total	1,282,416	111,583	1,843,811	95,666
Imports				
Unmanufactured				
India	419,400	195,274	275,700	151,642
United States	67,200	34,895	27,000	38,377
Brazil	4,300	2,080	2,300	2,391
Other countries	11,000	1,755	19,900	8,369
Total	501,900	234,004	324,900	200,779
Manufactured				
United States		409,979		505,501
United Kingdom		27,338		32,726
West Germany		1,250		-
Mexico		215		-
Total		438,782		538,227

Mica

	1957 Pounds	1957 $	1956 Pounds	1956 $
Exports				
Unmanufactured				
Rough				
Japan	87,500	28,666	20,200	5,526
United States	-	-	4,000	500
Sweden	-	-	300	33
Total	87,500	28,666	24,500	6,059
Trimmed				
Japan	63,900	74,135	40,800	37,412
Switzerland	900	2,363	-	-
United States	900	1,980	500	1,231
Other countries	300	788	500	1,338
Total	66,000	79,266	41,800	39,981
Scrap				
Belgium	183,200	5,878	80,000	2,400
Japan	1,500	525	-	-
Other countries	-	-	39,500	836
Total	184,700	6,403	119,500	3,236
Ground				
United States	23,000	1,380	92,000	5,520
Venezuela	1,000	75	-	-
Total	24,000	1,455	92,000	5,520
Total unmanufactured	362,200	115,790	277,800	54,796
Manufactured				
Brazil		11,400		1,880
Jamaica		-		39
Total		11,400		1,919

Consumption (domestic)*	1957	1956
Paints	2,196,612	1,652,031
Electrical apparatus	642,608	515,960
Rubber goods	574,706	543,940
Roofing	518,000	1,220,000
Paper goods	500,000(e)	494,000
Asbestos products	16,000(e)	16,800
Non-metallic mineral products	79,000	79,719
Miscellaneous	-	2,360
Total	4,526,926	4,524,810

* Available data. Partially estimated.

(e) Estimated.

Mica - Production, Trade and Consumption, 1947-57

(pounds)

	Production (1)	Imports (2)	Exports (2)	Domestic Consumption
1947	8,318,755		3,220,300	4,754,000
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	4,526,926

(1) Producer's shipments.
(2) Unmanufactured mica.

Ontario

Phlogopite production comes from the Stanleyville area, North Burgess township, about 50 miles southwest of Ottawa, near Perth. J.C. Donnelly, of Stanleyville, was the chief contributor in 1957. In the past considerable phlogopite was mined in the area between Perth and Kingston, but present production is small.

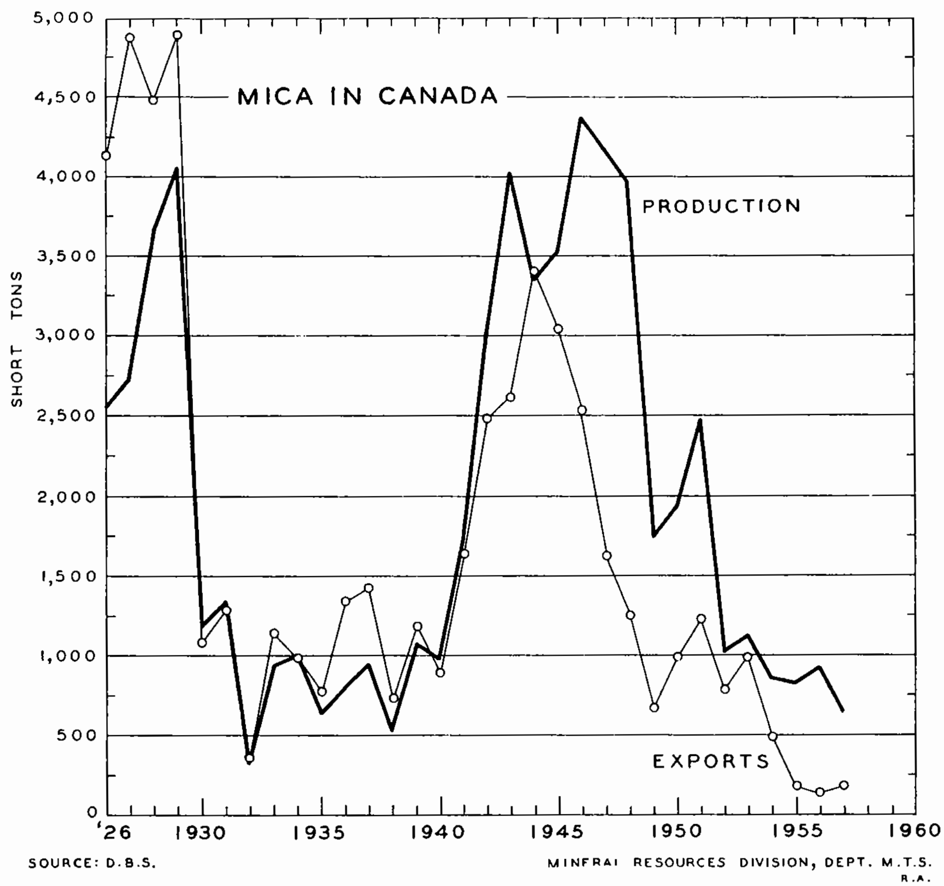
Muscovite sheet was mined in a small way in two localities. Mid-Bay Mica Syndicate, in production since early 1956, continued for a brief period in 1957 and operated a trimming shop in North Bay for a large part of the year. Its property was made famous during World War II when, as the Purdy mine, it yielded considerable quantities of large, high-quality sheet. The second source was near Dunchurch, in the Parry Sound district, mined by Percy Armstrong.

British Columbia

For a number of years Geo. W. Richmond Co. Limited and Fairey & Company Limited, both of Vancouver, have been grinding mica schist mined near Albreda, about 290 miles northeast of Vancouver, for use by the local roofing industry as a dusting agent. No production took place in 1957.

Uses and Properties

Mica is used in three principal 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 compass dials, boiler gauges, furnace observation holes, and lamps.

Sheet mica is sold commercially according to variety, size and quality and is selected by the manufacturer according to its intended application.

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 of use 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, flat-irons, 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. 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.

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 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, phlogopite and sometimes biotite - 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 and 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 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, in general, the soft, light-coloured varieties are regarded as having the best electrical qualities. These grade down to the darker, more brittle varieties in the lower grades. The terms 'light amber', 'medium amber' and 'dark amber' have been used in reference to quality.

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 8-mesh to under 200-mesh according to individual requirements.

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, with 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 having 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

Mica purchasers in Canada and the United States include the following:

Canada

All grades

Blackburn Brothers Limited, 85 Sparks St., Ottawa, Ont.
Walter C. Cross & Co., 209 Eddy St., Hull, Que.

Block

Canadian Wilbur B. Driver Co. Limited, 85 King St. E., Toronto 1, Ont.
Mica Company of Canada Ltd., 4 Lois St., Hull, Que.

United States

All grades

Hal Delphin & Co., 880 Bergen Ave., Jersey City 7, N.J.
F.D. Pitts Company Incorporated, 85 Chestnut Hill Rd., Newton 67, Mass.

Block

American Mica Insulation Co., 235 Parker Ave., Manasquan, N.J.
Asheville Mica Company, Box 318, Newport News, Va.
Blanchard Mica, Inc., 2315 Broadway, New York 24, N.Y.
Farnam Manufacturing Co., Inc., Sweeten Creek Rd., Asheville, N.C.
Ford Radio & Mica Corp., 536 63rd St., Brooklyn 20, N.Y.
Gillespie-Rogers-Pyatt Co., Inc., 75 West St., New York 6, N.Y.
Industrial Mica Corporation, 223 South Van Brunt St., Englewood, N.J.
Manchard Trading Corporation, 2315 Broadway, New York 24, N.Y.
Micacraft Products Inc., 710 McCarter Highway, Newark 5, N.J.
Minerals & Insulation Co., 53 Central Ave., Rochelle Park, N.Y.
Reliance Mica Co., 341 39th St., Brooklyn 32, N.Y.
Spruce Pine Mica Co., Spruce Pine, N.C.

Splittings

Continental-Diamond Fibre Co., Valparaiso, Ind.
The Macallen Company, Bay Rd., Newmarket, N.H.
New England Mica Company, Inc., 66 Woerd Ave., Waltham, Mass.

Scrap

Hayden Mica Company, Wilmington, Mass.
U.S. Mica Company, Inc., Jordan and VanDyke Sts., East Rutherford, N.J.

Prices

Prices offered by Canadian purchasers for sheet phlogopite vary with the quality and with the degree of trimming and grading. In 1957 prices for well-graded good quality sheet were approximately as follows:

Size Inches	$ Per Pound
1 x 1	0.30 to 0.70
1 x 2	0.50 to 0.80
1 x 3	0.75 to 0.85
2 x 3	1.30 to 1.40
2 x 4	1.60 to 1.70
3 x 5	2.15 to 2.50
4 x 6	2.50 to 2.75
5 x 8	3.00 to 3.50

Clean scrap phlogopite sold for as much as $25 a ton delivered at the plant. Scrap muscovite sells for slightly more, f.o.b. shipping point, when available.

NEPHELINE SYENITE

by
J.E. Reeves

The nepheline syenite industry has experienced a remarkable growth since its inception in 1936, especially in the last seven years. Production has increased by more than 200 per cent since 1950. In 1957, shipments were 11 per cent higher in tonnage and 7 per cent higher in value than in 1956. This is a somewhat smaller increase than that which occurred in 1956, when both tonnage and value were about 23 per cent higher than in 1955. Exports increased 18 and 15 per cent in tonnage and value respectively. Most of the exports were again to the United States.

Canada's production of nepheline syenite has all 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. Other Canadian deposits have been investigated, with a certain amount of success in some cases, but no commercial production has resulted.

Nepheline syenite was originally used almost entirely in the manufacture of glass, but more recently many uses have been developed in other facets of the ceramic industry, and the result has been a more diversified and steadily increasing market. With a uniform supply assured for many years from Blue Mountain, it is reasonable to expect that the demand and production will continue to grow.

The year 1957 was significant for two reasons: the new 600-ton milling plant of American Nepheline Limited at Nephton, Ontario, at the southwestern end of Blue Mountain, was operated for the first full calendar year, the milling costs being lower and the efficiency higher than previously; and the Canadian Flint and Spar Department of International Minerals & Chemical Corporation (Canada) Limited, which commenced production at the northeastern end of Blue Mountain in mid-1956, operated its 300-ton plant for the first full calendar year.

Nepheline Syenite

Nepheline Syenite - Production, Exports and Consumption

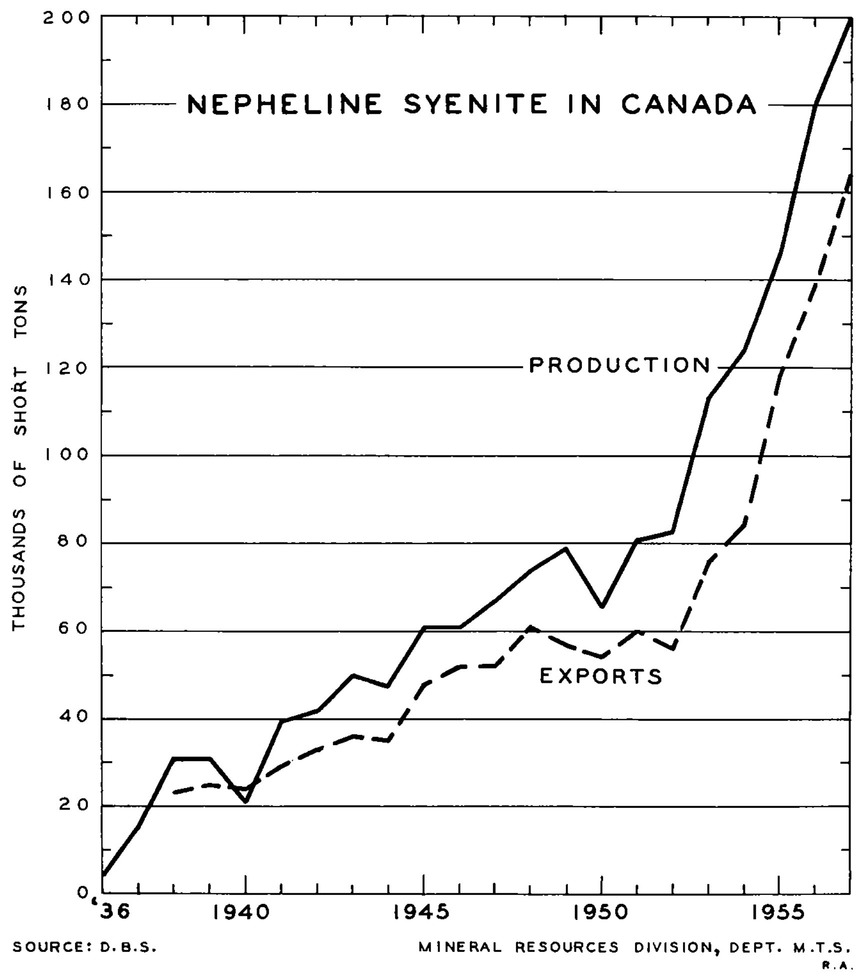
	1957		1956	
	Short Tons	$	Short Tons	$
Production (shipments)...	200,016	2,754,060	180,006	2,574,140
Exports, crude and processed material				
United States	156,379	2,096,587	130,318	1,773,706
Netherlands	3,406	61,350	4,272	76,896
United Kingdom	2,553	42,622	1,951	34,704
Other countries	2,004	35,284	2,764	50,009
Total	164,342	2,235,843	139,305	1,935,315
Consumption (domestic)				
Glass and glass wool...	15,806		16,330	
Clay products.........	2,345		2,008	
Stone products........	6,000 (e)		6,679	
Total	24,151		25,017	

(e) Estimated.

Nepheline Syenite - Production, Exports and Consumption 1947-57
(short tons)

	Production*	Exports	Domestic Consumption
1947	66,995	52,198	9,327
1948	74,386	61,107	11,434
1949	78,783	57,291	13,670
1950	65,638	54,351	13,812
1951	81,108	59,777	15,616
1952	82,681	56,323	12,167
1953	113,345	76,375	15,818
1954	123,669	83,952	15,670
1955	146,068	118,275	18,696
1956	180,006	139,305	25,017
1957*	200,016	164,342	24,000(e)

* Shipments, crude and ground.
(e) Estimated.



Other Occurrences and Production

Other deposits of nepheline syenite occur in Ontario near Bancroft, Hastings county; near Gooderham, Haliburton county; in the vicinity of the French River, Georgian Bay area; and at Port Coldwell, Thunder Bay district. In Quebec, nepheline syenite occurs in the Labelle-L'Annonciation and other areas, and in British Columbia in the Ice River area near Field.

Russia is the only other producer of a ceramic raw material containing abundant nepheline. In the Kola peninsula near the city of Kirovsk a huge deposit of an apatite-nepheline rock is being mined on a large scale for apatite, with nepheline as a by-product. It was announced recently that a process for the production of aluminum from this nepheline has been developed and is being used.

Occurrences of nepheline syenite have been reported in California, New Jersey, Arkansas and other localities in the United States. Deposits also occur in India and Finland, but no production has been reported. Apparently the material does not occur in sufficient tonnage, or its iron content is so high and difficult to reduce that it is not acceptable for ceramic purposes.

Specifications

Nepheline syenite is a quartz-free crystalline rock consisting principally of nepheline (a silicate of alumina, soda and potash), albite (a soda feldspar), and microcline (a potash feldspar). To be of commercial interest it must be amenable to treatment for the removal of iron-bearing impurities such as magnetite, biotite, hornblende and tourmaline, so that the iron-oxide (Fe_2O_3) content can be reduced to about 0. 08 per cent. Finely divided iron impurities frequently cannot be removed by dry milling methods, and render otherwise promising deposits of nepheline syenite useless for commercial operation.

Specifications for glass-grade nepheline syenite call for all material to be minus 30 mesh, U. S. standard, and for higher grades to be minus 200 mesh or finer. High-intensity magnetic separation reduces the iron-oxide content from about 1. 5 to 2 per cent in the feed to about 0. 08 per cent in the finished product. Dry milling methods are used throughout the processing.

Uses

The major uses of nepheline syenite are in the ceramic industry, where it has replaced feldspar to a considerable extent. In glass batches it introduces a higher proportion of alumina than the same amount of feldspar, and a comparatively high alkali content. Its relatively low melting temperature is also important. In the many types of glass in which a low iron content is essential, nepheline syenite easily meets the specification. The particle size for glass-grade is closely controlled and must be coarser than for grades used in whitewares and enamels.

In the whiteware industry (including sanitaryware, floor and wall tile, electrical porcelain, semi-vitreous ware, low-temperature vitreous ware, dental porcelain and others) it is used in both the body and the glaze. It is more fusible and a more active flux than potash feldspar, and this permits either a lower firing temperature or the use of a smaller amount of this vitrifying agent. The use of a lower firing temperature can result in savings in refractory and fuel costs. Although for these uses nepheline syenite must be ground to a very fine size, control of particle-size distribution is very important.

In porcelain enamels, nepheline syenite gives good results as a frit ingredient in ground and cover coats for sheet steel and cast iron, chiefly owing to its low fusion temperature. For ground-coat enamel the lower-grade, higher-iron material achieves a cost saving.

Finely ground material is used as an extender pigment for paint, as a filler for plastics and rubber and as an inert carrier for insecticides.

Lower-grade materials are drawn off at various stages during the milling and differ only in the Fe_2O_3 content, which is up to 0.5 per cent and higher. Apart from ground-coat enamels, one use is as a vitrifying agent in some types of structural-clay products. Recently a minus 200 mesh product containing about 3 per cent Fe_2O_3 was introduced for use as a body and glaze addition in the sewer-pipe industry.

Principal markets are in the United States, to which about 78 per cent of the production was exported in 1957. The glass-making industry is the major user. Four per cent was shipped overseas and most of the remainder was used in Canada. Consumption in Canada has been increasing and in 1956 was about one third higher than in 1955 and about 14 per cent of the total production for 1956.

Prices

Prices vary according to grade and can be obtained upon application to the producing companies.

87875-1—25

PHOSPHATE

by
J.E. Reeves

There has been no production of phosphate minerals in Canada since 1951, when only 6 tons were produced. All requirements are met by imports, chiefly from the United States. Making use of deposits of apatite in Quebec and Ontario, Canadian phosphate-mining flourished during the years 1878 to 1892 and then declined sharply with the development of the large sedimentary deposits in Florida. A peak was reached in 1890, when more than 31,000 tons were produced, but since 1894 production has seldom exceeded 1,000 tons.

In the last few years some attempts have been made to develop properties containing deposits of apatite, but as yet no production has resulted.

There was an increase of 15 per cent in the amount of phosphate rock imported during the year. The value of these imports increased by a similar percentage. Industries in eastern Canada import from Florida and those in the West from the western United States. The Consolidated Mining and Smelting Company of Canada Limited obtains phosphate rock for its large fertilizer operations at Trail and Kimberley, British Columbia, from near Garrison, Montana, about 300 miles southeast of Trail. Here a subsidiary, Montana Phosphate Products Company, operates four mines, removing high-grade sedimentary phosphate rock by underground mining methods.

Imports of phosphate fertilizers declined by a little more than 5 per cent, although imports of triple superphosphate increased slightly. This reflects a trend, established in the United States, toward a greater use of triple superphosphate compared with ordinary superphosphate.

Dominion Fertilizers Limited, a subsidiary of Fertilizer Corporation of America, in New York, is building a large superphosphate plant at Port Maitland, Ontario, to be completed in 1958. The company reports that production will be large enough to eliminate Canada's need for importing superphosphate fertilizers.

Small increases and decreases took place in the imports of phosphorus, phosphoric acid and phosphorous compounds. The total was somewhat higher than in 1956. Electric Reduction Company of Canada, Limited, will commence making phosphoric acid and various compounds at a new plant at Port Maitland, Ontario, scheduled for completion in 1958. Northwest Nitro Chemicals Limited began production of phosphoric acid, ammonium phosphate and other chemicals at Medicine Hat, Alberta, late in 1957.

Phosphate - Imports and Consumption

	1957		1956	
	Short Tons	$	Short Tons	$
Imports				
Phosphate rock				
United States	722,215	5,840,223	616,613	4,863,774
Belgium	1,005	57,561	2,007	105,946
Netherlands Antilles ...	-	-	5,603	155,302
French Africa.........	-	-	3,425	60,575
Total..................	723,220	5,897,784	627,648	5,185,597
Phosphate fertilizers				
Triple superphosphate				
United States..........	45,380	2,004,031	38,487	1,741,268
Superphosphate n.o.p.				
United States..........	163,746	3,131,318	183,991	3,420,818
Phosphate fertilizer n.o.p.				
United States..........	2,574	190,687	1,663	133,407
Belgium	256	14,784	101	5,277
Total..................	2,830	205,471	1,764	138,684
Total, phosphate fertilizers	211,956	5,340,820	224,242	5,300,770
Phosphate acids and compounds				
Soda phosphate disodium				
United States	104	16,258	41	6,363
Soda phosphate trisodium				
United States	399	41,305	470	47,516
Soda phosphate n.o.p.				
United States	3,230	635,665	2,356	486,123
United Kingdom........	7	9,686	6	6,387
West Germany.........	1	381	2	769
Total.................	3,238	645,732	2,364	493,279
Phosphoric acid				
United States	147	18,478	244	41,732

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Phosphate - Imports and Consumption (cont'd)

	1957 Short Tons	1957 $	1956 Short Tons	1956 $
Imports (cont'd)				
Phosphate acid not medicinal				
United States	933	175,231	969	178,931
United Kingdom	12	3,746	66	15,568
Total	945	178,977	1,035	194,499
Phosphorus and compounds n.o.p.				
United States	119	39,681	115	35,598
United Kingdom	42 lb	246	295 lb	998
Total	119	39,927	115	36,596
Total, phosphate acids and compounds	4,952	940,677	4,269	819,985

	1957	1956
Consumption (phosphate rock)		
Fertilizers	584,216	417,910
Chemicals	114,265	109,524
Iron and steel	-	276
Stock and poultry feeds	24,234	24,596
Miscellaneous	-	340
Total	722,715	552,646

Phosphate Rock - Production, Imports and Consumption, 1947-57
(short tons)

	Production	Imports	Consumption
1947	-	485,391	434,971
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

Occurrences in Canada

Almost all the phosphate mined in Canada has consisted of the mineral apatite, essentially a calcium phosphate. It 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 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. Some sedimentary phosphate rock occurs between Banff, Alberta, and the Crowsnest-Fernie area of southeastern British Columbia. In the years 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 comes from secondary deposits called phosphorites. These are, for the most part, limestones that have been altered by solutions containing phosphoric acid derived from the leaching of igneous rocks containing apatite or from bone or guano deposits.

In 1957 world production probably rose to 36,232,000 short tons, of which more than 15 million tons were mined in the United States from sedimentary deposits. Other major producers of sedimentary phosphate rock are: Morocco, Tunisia and Algeria in North Africa; Ocean Island, Nauru and Makatea in the Pacific; Christmas Island in the Indian Ocean; and Russia. Russia, Sweden and Brazil mine apatite deposits.

Uses

Consumption of phosphate rock in Canada in 1957 was higher than in 1956. Its use as fertilizers, chiefly superphosphate, increased 40 per cent. Use in the manufacture of phosphorus, phosphoric acid and phosphorous compounds increased.

Ordinary superphosphate is made by treating the phosphate rock with sulphuric acid and contains 16 to 20 per cent available P_2O_5. The phosphate is thus rendered largely water-soluble and the phosphorus is readily available to plant life. Triple superphosphate is produced by acidulating the phosphate rock with phosphoric acid. It contains 42 to 50 per cent P_2O_5 and is growing in importance, especially where higher freight costs are concerned.

Phosphate

Phosphate rock is the chief source of elemental phosphorus. A high-purity product is obtained by treating the phosphate rock in electric furnaces, and compounds of this phosphorus are widely used by the food, chemical and drug industries in the manufacture of detergents, flame retardants, water softeners, pigments, opacifiers, food preservatives, pharmaceutical preparations, livestock feed supplements, leavening agents, flotation reagents, rodent poisons, fireworks, matches and many other products.

Ferrophosphorus is used in the manufacture of iron castings to increase fluidity in the melt, and in the manufacture of structural steel to increase strength. Phosphorus is used as a deoxidizer and hardening agent in copper alloys.

Specifications

Chemical analyses of phosphate rock are reported as calcium oxide, CaO, and phosphorus pentoxide, P_2O_5, or as tricalcium phosphate, $Ca_3(PO_4)_2$. The latter is commonly referred to as bone phosphate of lime and signified by B.P.L. The relationship is: 1.0 B.P.L. = 0.458 P_2O_5.

Because of its open texture, sedimentary phosphate rock is preferred for acid treatment to compact, crystalline apatite. The B.P.L. content should approach 80 per cent.

Canadian apatite would be quite acceptable for furnace treatment. It contains a higher P_2O_5 content per unit than does sedimentary phosphate, permitting a smaller feed to the furnaces with less slag and lower temperatures. However, the very low price of Florida phosphate 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 six years ago, but is currently not interested unless it can be assured of sizable shipments at a price competitive with that of the Florida phosphate.

Prices and Tariffs

According to E & M J Metal and Mineral Markets of December 5, 1957, prices of phosphate rock in the United States were as follows:

Per long ton f.o.b. mines, Florida land-pebble phosphate rock:

% B.P.L.	$
77 to 76	7.00
75 to 74	6.00
72 to 70	5.00
68 to 66	3.95

Phosphate rock enters Canada duty-free.

POTASH

by
C.M. Bartley

The occurrence of economic deposits of potash in Canada was first suspected in 1943, when the mineral sylvite (KCl) was found in a drill core in southern Saskatchewan. As exploration proceeded, the magnitude and general nature of the occurrences became reasonably clear and it is now certain that the deposits are of great value.

Though the Canadian potash deposits are at greater depths and more difficult to mine than those of the United States and Europe, their size and richness have attracted the attention of a great number of producers. At present some 25 companies, both Canadian and foreign, hold land for potash development. Three companies are sinking shafts to potash deposits, and two are erecting processing plants. The first production of Canadian potash is expected by late 1958 or early 1959.

Origin and Structure of the Deposits

Salt, potash and other soluble minerals resulting from the evaporation and concentration of sea water in closed basins are found in many places. While the process is well known, however, it is often difficult to account for the large volume of salt found in some deposits. It is believed that such accumulation can occur only where evaporation has been continuous over a long period with periodic inundations of the basin by sea water. There is evidence to suggest that such a set of conditions resulted in the formation of the Prairie Evaporites - as Saskatchewan's salt-potash bed has been named.

The Prairie Evaporites were deposited in a basin striking northwest from North Dakota and southwestern Manitoba into eastern Alberta and structurally closed everywhere except to the northwest. A broad flat ridge in west-central Saskatchewan with a northeastern extension east of Biggar may have been the intermittent barrier allowing sea water to enter the basin. Factors such as the location, shape and thickness of the various potash deposits support this interpretation. As potash is more soluble than salt, it would be the last to precipitate and represents the final stage of deposition in a particular period.

Location and Nature of the Occurrences

The potash deposits occur as fairly continuous beds in the upper portion of a vast deposit of rock salt (NaCl) underlying most of central Saskatchewan

Potash - Imports

	1957		1956	
	Short Tons	$	Short Tons	$
For fertilizers				
Potash, muriate of				
United States	76,250	1,684,938	79,650	1,823,775
West Germany	36,159	974,114	34,161	861,932
France	24,236	747,123	11,971	382,532
East Germany	-	-	5,511	170,522
Total	136,645	3,406,175	131,293	3,238,761
Potash, sulphate of				
United States	11,114	362,731	10,581	350,545
France	6,433	242,431	4,006	180,696
West Germany	175	5,175	1,565	52,882
Total	17,722	610,337	16,152	584,123
Sulphate of potash, magnesia				
United States	2,156	28,721	1,838	26,610
West Germany	1,300	38,302	500	10,553
Total	3,456	67,023	2,338	37,163
Other potash fertilizers				
United States	-	-	21	2,275
Total potash fertilizers	157,823	4,083,535	149,804	3,862,322
Potash chemicals and compounds				
Potash and pearl ash	294	49,679	259	44,331
Potash, bicarbonate of	10	2,550	9	2,145
Potash, bichromate of	157	51,702	171	54,855
Potash, caustic	3,651	349,807	2,942	331,520
Potash, chlorate of, no further manufactured than ground	71	19,273	63	16,970
Potash, red and yellow, prussiate of	13	9,353	17	10,131
Potash, nitrate of, or saltpetre	523	57,105	546	61,171
Potash compounds n.o.p.	3,030	760,792	2,097	588,521
Total	7,749	1,300,261	6,104	1,109,644

and adjacent areas in Alberta and Manitoba. The salt body is up to 600 feet thick in the centre and dips gently to the southwest. Its northern edge has been found at a depth of a few hundred feet near McMurray, northern Alberta, and at depths ranging from 2,500 to 3,000 feet in the vicinity of North Battleford, Saskatoon, the Quill Lakes and Yorkton, in Saskatchewan, and extending into the southwest corner of Manitoba. It is believed that the deposit may have extended farther north originally but in some areas was removed by solution.

Southwestward from the northern edge, salt and potash have been encountered at progressively greater depths down to 7,000 or more feet near the international boundary. Throughout this large area, salt, usually containing potash beds, has been found consistently - except in a triangular area with its base on the international boundary and its apex near Saskatoon. Available evidence suggests that the salt and potash originally deposited here were removed by solution.

The stratigraphic horizon containing the salt, potash and anhydrite is Middle Devonian in age and is overlain by structurally incompetent sedimentary rocks. The depths of the potash horizons present no problem in modern mining. However, the weakness of the overlying rocks, through which shafts must be sunk, and the fact that salt and potash are soluble minerals, mean that shafts must be concrete-lined to be structurally sound and to prevent water seepage. Shaft-sinking to the potash horizons is therefore very expensive and has been confined to the best grades of potash at the shallowest depths. The area of interest at present is a belt about 40 miles wide parallel to and just south of the northern limit of the salt deposit. It contains the shallowest occurrences of potash, some of which are under development near North Battleford, east of Saskatoon and near Esterhazy.

At present, potash is known to occur in Manitoba, in a small area along the Saskatchewan boundary. In Alberta, a few minor occurrences of potash minerals have been reported in exploratory drilling, but no deposits of economic interest have been found. Moreover, it is believed that, if any are present, they will be at considerably greater depths than those under development in Saskatchewan.

Potash Minerals

Concentrations of potash minerals have been found in three fairly distinct and continuous zones, or layers, near the top of the Prairie Evaporites and in one lower zone of lesser interest. Each contains one or more beds of potash separated by beds containing lesser amounts or barren salt. The zones can be traced over large areas although the thickness and potash content vary considerably from place to place. In the central parts the zones range from 50 to 80 feet in thickness and taper to zero at the outer edges. Sections of economic interest are those containing a potash bed, or beds, averaging 25 per cent K_2O or more over a minable thickness (5 feet or more).

Potash

The most important mineral found is sylvite. Other potash minerals occurring in the deposits are: carnallite ($KCl.MgCl_2.6H_2O$); Sylvinite, a mechanical mixture of sylvite and halite ($NaCl$); and minor amounts of polyhalite ($2CaSO_4.MgSO_4.K_2SO_4.2H_2O$), and leonite ($MgSO_4.K_2SO_4.4H_2O$).

Economically, sylvite is the most desirable potash mineral since its percentage equivalent of K_2O is almost four times that of carnallite; that is, 63 per cent K_2O equivalent to 17 per cent K_2O equivalent respectively. Nevertheless an area near the Quill Lakes containing high concentrations of carnallite is receiving attention as a possible source of magnesium.

The salts vary in texture from fine to very coarse grained, the latter occurring chiefly in the upper part of the formation.

Development Problems

Development of the potash deposits in Saskatchewan involves many problems new to Canadian mining. Shafts must be sunk through soft rocks such as shales and limestones and, to provide a solid shaft wall, the ground must be frozen artifically until the excavation is completed and a circular shaft-lining constructed. This is of reinforced concrete, both for structural strength and to provide a seal against waterflows encountered in the rocks. The shafts must be supported by concrete bonds connecting them to the rock walls wherever competent rock layers can be found. In addition, care must be taken that water cannot flow down the outside of the concrete shaft, as it would erode the rock wall and weaken the shaft.

Operations

By the end of 1957 some 25 companies had made varying degrees of progress in potash development.

A few years ago Western Potash Corporation Limited, a Canadian company, attempted to recover potash by dissolving it underground and pumping the brine to the surface. This method failed and in 1952 the company sank a shaft to 1,100 feet near Unity, Saskatchewan, but again suspended work. In 1957 the company, now renamed Continental Potash Corporation Limited, resumed shaft-sinking.

After exploration work in Saskatchewan, Potash Company of America, with mines at Carlsbad, New Mexico, formed a Canadian subsidiary, Potash Company of America Ltd., and began shaft-sinking. Located at Patience Lake, 14 miles east of Saskatoon, the shaft, which was sunk through artificially frozen ground, was expected to reach completion during the summer of 1958. A processing plant was scheduled to go into operation late in the year and to attain full-scale production by February 1959. The company expects to produce 600,000 tons of potash a year, of which as much as two thirds will be exported.

Potash Company of America also has rights to 100,000 acres immediately west of the Quill Lakes for the possible production of magnesium. While there are technical difficulties in the separation of magnesium and potash salts, the large available tonnages and the high magnesium content, compared with those of some other sources, make the project attractive.

International Minerals & Chemical Corporation, mining potash at Carlsbad, New Mexico, holds 450,000 acres under permit and is sinking a shaft and building a refining plant at Esterhazy, near the Manitoba boundary. According to the company, exploratory drilling indicates more than 100 million tons of potash minerals of higher grades than any at present being mined. An 18-foot-diameter shaft is being sunk to 3,000 feet which, together with a modern flotation plant, will cost more than $20 million. It is expected that in 1959, when operations begin, the annual production rate will be 720,000 tons and that this will later increase to as much as 2 million tons.

United States Borax and Chemical Corporation, with holdings southeast of Saskatoon and south of the Quill Lakes, is considering plans to sink a shaft and build a plant although definite announcement has not yet been made.

Other companies holding large areas in Saskatchewan are: Duval Sulphur and Potash Company, Southwest Potash Corporation and National Potash Company, all of Carlsbad, New Mexico; and the Canadian companies, Campana Limited, General Petroleums of Canada Limited, Dominion Potash Limited (financed by French capital) and Winsal of Canada, Limited (a subsidiary of Wintershall, A.G., and Salzdetfurth, A.G., of West Germany). Numerous others hold potash rights and are making efforts to find deposits.

S.A.M. Explorations Ltd., of Regina, holds land straddling the Saskatchewan-Manitoba boundary with indications of a deposit of potash averaging about 30 per cent K_2O equivalent and located at depths of 3,000 feet or less. The relatively shallow depth and the fact that in most of this area there is a competent roof of 80 to 100 feet of salt over the deposit make it attractive for development.

World Reserves and Production

World reserves of potash have been estimated by United States agencies at 16 billion* to 55 billion tons, but this includes much material grading as low as 8 per cent K_2O and is mostly in Europe and Asia. Large reserves exist in Russia and East Germany and smaller deposits are being worked in West Germany, France, Spain, the United States and Israel. There are 250 million tons in the United States.

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* 1 billion = 1,000,000,000.

Potash

A conservative estimate has placed Canadian reserves at 6.4 billion tons. This includes only (a) material in one of the three known zones, (b) ore grading 25 per cent K_2O or better, (c) ore with a minable thickness of 5 to 10 feet and (d) recoverable ore - possibly as little as 40 per cent of the material in place. If a grade of 20 per cent K_2O equivalent or better were considered, however, the estimate would be increased to 8 billion tons. It is for this reason that the Canadian deposits have attracted world-wide interest.

World production of potash in 1957 has been estimated at about 8.7 million tons K_2O equivalent and has been increasing at an average rate of 500,000 tons a year since 1952. United States production in 1957 was less than 2.5 million tons, averaging less than 20 per cent K_2O equivalent, a figure surpassed by North America's consumption in the first nine months of 1957 alone. Moreover, the fact that consumption is increasing, not only in North America but in Asia and elsewhere, suggests a promising future for the Canadian potash industry.

Uses

Most potash - about 95 per cent of the total production - is used in fertilizer, of which it is one of the three essential constituents (the other two being nitrogen and phosphate). As world population grows and soil fertility falls, increasing amounts of fertilizer will be needed to maintain and increase food production. Such demands are apparent in the United States and Europe and are expected on an even larger scale as living standards rise in such countries as India and China.

ROOFING GRANULES

by
F. E. Hanes

The consumption of roofing granules in Canada is directly influenced by the progress of residential construction. As housing construction awards increase over those of previous periods, granule consumption increases to meet the demand for roofing shingles and siding. From April 1956 to July 1957 MacLean's building statistics show decreases for each month compared with the corresponding month of the previous year. The decreases shown in granule consumption during this period undoubtedly reflected this trend. Gains in residential construction after July 1957, particularly in the last quarter, when values approximated the 1955 highs, should be reflected in increased granule consumption.

Granule consumption (short tons) was 17 per cent below the 1956 total and 25 per cent less than in the record year of 1955. Dollar values also decreased, though less sharply than tonnage values.

Total consumption of roofing granules in 1957 by manufacturers of asphalt roofing and siding in Canada was 110,543 short tons valued at $3,405,655. Consumption in 1956 amounted to 133,691 short tons worth $3,884,962.

Seventy-eight per cent of total imports was composed of artificially coloured granules, of which 10 per cent were coloured slates. Consumption of imported artificially coloured slates for 1957 shows a 2-per-cent increase over 1956 consumption. Use of imported black slag increased from 14,444 short tons in 1956 to 15,336 short tons in 1957.

Roofing-granule Plants in Canada

Ontario

Building Products Limited is the largest producer of roofing granules in Canada. Granules, of both natural slate and (artificially) coloured rock, are produced from basalt, pink rhyolite, and slate rocks quarried in the vicinity of Havelock and Madoc, Ontario. Artificially coloured rock granules are prepared by the sodium-silicate process and stored in large bins at the company's plant in Havelock. Building Products not only ships to markets across the Dominion but also supplies its roofing and siding plants in Montreal, Hamilton, Winnipeg and Edmonton.

Roofing Granules

Roofing Granules - Consumption and Imports*

	1957		1956	
	Short Tons	$	Short Tons	$
Consumption				
By kind				
Natural colour........	19,931	406,402	20,760	386,436
Artificially coloured ..	90,612	2,999,253	112,931	3,498,526
Total................	110,543	3,405,655	133,691	3,884,962
By colour				
Black and grey-black..	30,152	686,173	33,207	701,649
Green	25,887	865,489	35,611	1,074,697
Red	15,575	452,325	16,966	439,759
Blue.................	8,612	341,738	10,868	415,814
White	14,367	585,823	19,170	746,394
Grey	8,700	216,391	9,564	232,867
Buff.................	937	33,446	1,407	45,400
Brown and tan........	4,366	138,669	4,832	145,232
Coral, cream and yellow..............	1,947	85,601	2,066	83,150
Total................	110,543	3,405,655	133,691	3,884,962
Imports				
United States				
Natural colour........	17,392	366,705	17,748	337,325
Artificially coloured ..	60,241	2,138,201	82,576	2,723,332
Total................	77,633	2,504,906	100,324	3,060,657

* Compiled from figures supplied to the Mines Branch by producers and consumers.

British Columbia

George W. Richmond produces natural-slate granules for local markets in the Vancouver area. Sources and types of rock available for granule manufacture are a dark-grey slate from McNab Creek and Howe Sound and a green siliceous rock from Bridal Falls, near Chilliwack.

Roofing and Siding Plants in Canada

In 1957 granule-coated roofing and siding was manufactured by nine companies in 16 plants across Canada, as follows:

Company	Location
Bishop Asphalt Papers Limited	Portneuf Station, Quebec
Brantford Roofing Company Limited	Brantford, Ontario
	Saint John, New Brunswick
	Lachine, Quebec
Canadian Gypsum Company, Limited	Mount Dennis, Ontario
The Philip Carey Company, Limited	Lennoxville, Quebec
Building Products Limited	Montreal, Quebec
	Hamilton, Ontario
	Winnipeg, Manitoba
	Edmonton, Alberta
Sidney Roofing and Paper Company Limited	Victoria, British Columbia
	Lloydminster, Alberta
Canada Roof Products Limited	Vancouver, British Columbia
The Barrett Company, Limited	Montreal, Quebec
	Vancouver, British Columbia
Canadian Johns-Manville Company Limited	Asbestos, Quebec.

History and Development of the Roofing-granule Industry

Composition roofing was known as early as 1775. At this time only sporadic use was made of asphalt-prepared backing strips for protective roof coverings. The protective quality of an asphalt base, however, had been recognized through the ages, having been used for preserving the mummies of early Egyptian kings. With the coming of the twentieth century, a large amount of asphalt tar was available, and industry devoted time and thought to developing a use for this by-product of the oil and gas industry.

Early in the development of tarred-surface coverings, research verified the value of using tar as a preservative and, more important, discovered that the life of a composition-tar material was extended more than 500 per cent if the material was protected from the elements, particularly from the sun's rays. Thus much industrial effort was applied to the development of protective covering for tar-base roofing strips.

Slate aggregate was one of the first rocks specifically manufactured for use as a roofing granule. From quarry and dressing operations, many slate quarries had on hand large quantities of rubble which could readily be crushed to suitable granule size. These granules also gave colour to roofing strips. Dull slate colours were heightened by the application of heat and oil. Other rock sources were investigated as bases for colour impregnation, and the results were

SALT

by
R. K. Collings

Common salt is a compound composed of two elements, sodium and chlorine. Large quantities occur in solution in the oceans of the world and on many of the continents, as brine deposits and as bedded deposits of rock salt. In Canada salt is produced in Nova Scotia, Ontario, Manitoba, Saskatchewan and Alberta. Production in 1957 rose 11 per cent over that of 1956 to 1,771,559 short tons, the increase being due mainly to increased production of mined rock salt, mostly for export to the United States, and of chemical salt for domestic consumption.

The general trend of production showed an increase during the period 1926 to 1957 as shown by the graph on page 393. A sharp increase occurred in 1955 with the opening of a rock-salt mine at Ojibway, Ontario. The output from this mine resulted in further marked increases in Canada's production of salt in 1956 and 1957.

The exports of salt, amounting to 26 per cent of production in 1957, consisted mostly of rock salt shipped to the United States.

All the salt produced in Canada is obtained from underground deposits of salt or brine by standard mining or evaporation methods. A large part of the total production is in the form of rock salt for ice and dust control on highways and railways and for refrigeration and chemical purposes. Forty-four per cent of the salt produced in 1957 was rock salt, 24 per cent was fine evaporated and 31 per cent was in the form of brine for chemical use. The production of coarse salt by evaporation methods is no longer carried on in Canada.

The production of coarse rock salt from underground deposits can be expected to increase during the next few years as new markets are developed and new deposits exploited. Dominion Rock Salt Company, Limited, is developing a rock-salt mine at Goderich, Ontario, and Midrim Mining Corporation Limited, Toronto, is investigating an occurrence of rock salt near Strathroy, Ontario. Malagash Salt Company Limited, a subsidiary of The Canadian Salt Company Limited, has completed a salt-milling plant at Pugwash, Nova Scotia. Shaft-sinking operations are continuing at Pugwash, with initial production scheduled for 1958.

Salt - Production, Trade and Consumption

	1957 Short Tons	1957 $	1956 Short Tons	1956 $
Production (shipments)				
By types				
Fine vacuum salt......	422,977	8,132,732	428,956	7,061,233
Coarse grainer salt ...	-	-	32	594
Mined rock salt	786,975	4,766,127	640,027	4,066,249
Salt recovered in chemical operations ..	17,211	64,549	14,208	57,332
Salt content of brines used and shipped	544,396	1,026,295	507,581	959,068
Total	1,771,559	13,989,703	1,590,804	12,144,476
By provinces				
Ontario..............	1,538,805	9,478,587	1,347,729	7,932,294
Nova Scotia...........	122,763	1,900,538	132,539	1,652,839
Saskatchewan	43,684	1,069,201	42,814	882,988
Alberta...............	46,935	1,038,346	46,654	1,162,982
Manitoba	19,372	503,031	21,068	513,373
Total.................	1,771,559	13,989,703	1,590,804	12,144,476
Imports (by types)				
Table				
United States	82	34,842	45	28,278
United Kingdom	15	1,446	-	-
Total.................	97	36,288	45	28,278
For fisheries				
Spain.................	51,331	190,629	41,564	263,548
Bahamas	14,379	65,792	12,264	42,326
Italy..................	9,128	29,262	671	5,202
Other countries	5,340	22,398	4,486	18,936
Total.................	80,178	308,081	58,985	330,012
Other, in bulk				
United States..........	248,116	970,817	242,133	962,505
Mexico...............	11,148	11,883	-	-
Bahamas.............	10,417	40,414	-	-
Total.................	269,681	1,023,114	242,133	962,505
Other salt in bags, barrels and other covering				
United States..........	16,276	249,868	16,526	249,710
United Kingdom.......	1,251	31,866	1,435	35,241
Total.................	17,527	281,734	17,961	284,951
Total imports..........	367,483	1,649,217	319,124	1,605,746

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

	1957		1956	
	Short Tons	$	Short Tons	$
Exports				
United States.........	457,713	3,234,474	333,763	2,279,882
Bermuda	139	5,543	136	6,027
Other countries......	36	1,102	36	921
Total................	457,888	3,241,119	333,935	2,286,830
Consumption (apparent).	1,681,154	-	1,575,993	-

Salt - Production, Trade and Consumption, 1947-57
(short tons)

	Production(1)	Imports	Exports	Apparent Consumption(2)
1947	728,545	219,878	11,212	937,211
1948	741,261	186,071	5,630	921,702
1949	749,015	236,688	3,474	982,229
1950	858,896	238,239	4,100	1,093,035
1951	964,525	258,822	4,561	1,218,786
1952	971,903	288,125	2,844	1,257,184
1953	954,928	307,333	2,354	1,259,907
1954	969,887	370,412	1,199	1,339,100
1955	1,244,761	365,255	146,472	1,463,544
1956	1,590,804	319,124	333,935	1,575,993
1957	1,771,559	367,483	457,888	1,681,154

(1) Producers' shipments.
(2) Shipments plus imports less exports.

Producers*

Ontario

Ontario accounted for 87 per cent of the Canadian production of 1957. Salt-recovery operations are confined to the southwestern section of the province, where the salt occurs in thick beds 800 to 1,500 feet below the surface.

* See map on page 398.

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 other 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, has contracted to supply salt brine to a chemical plant in Detroit. This brine will be pumped to Detroit through several 10-inch pipelines linking the Detroit plant with brine wells at Sandwich, Ontario. The pipelines are located in a trench in the river bottom.

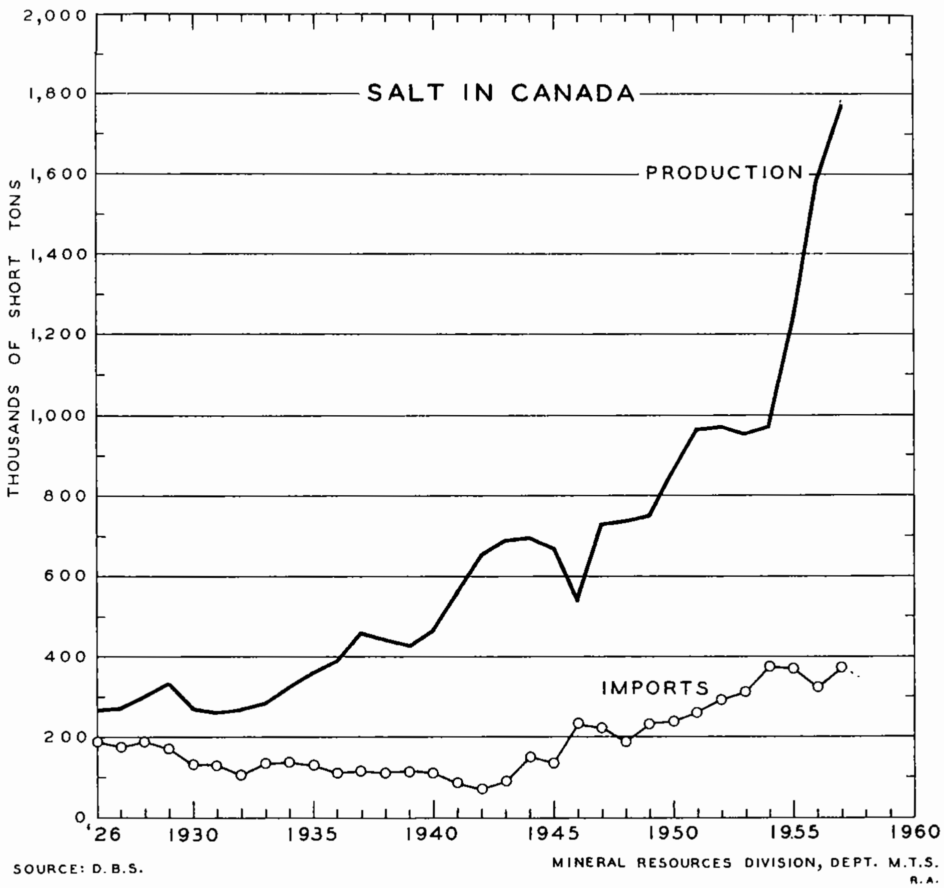
Nova Scotia

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, 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 use in tanning and in refrigerator cars, water-softeners, etc.



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 south-easterly through central Saskatchewan and thence into southwestern 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

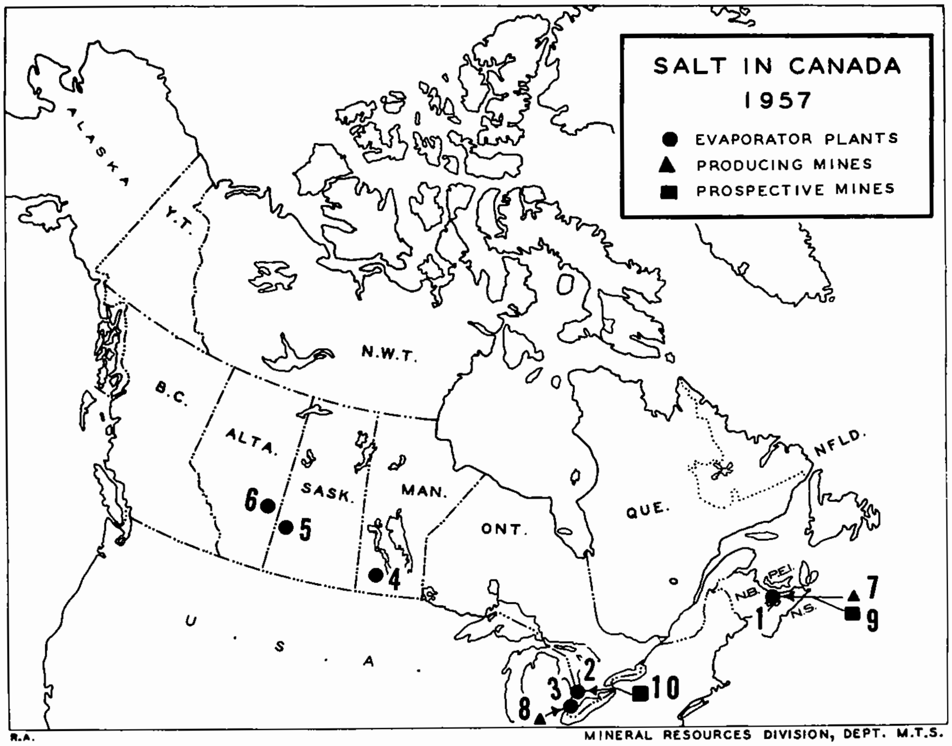
Brine is used extensively in the chemical industry for the manufacture of chlorine, hydrochloric acid, caustic soda and related chemicals. Fine salt produced by vacuum-pan evaporation of brine also is used in the chemical industry and for dairy, household and food purposes.

(text continued on page 399)

Consumption of Salt in Specified Canadian Industries, 1957

Industry	Quantity Used (short tons)
Chemical	
Brine (salt content) Dry salt	800,406
Slaughtering and meat-packing	1,076
Leather tanneries	7,064
Fish-processing	23,578
Stock and poultry foods, prepared	22,662
Dairy products	490
Fruit and vegetable preparations	13,449
Bread and bakery products	14,259
Miscellaneous food preparations	9,880
Confectionery	374
Breweries	973
Soaps and cleaning preparations	1,938
Dyeing and finishing of textiles	1,951
Pulp and paper mills	45,483
Artificial ice	261
Miscellaneous manufacturing	15,368
Other industries	721,939*

* Apparent consumption (1957) less amounts used by specified industries. Includes coarse rock salt for winter maintenance of roads and railways, refrigeration, chemical uses, etc., as well as fine salt.



Evaporator Plants

1. Sifto Salt Ltd. (Nappan)
2. Sifto Salt Ltd. (Goderich and Sarnia)
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)

The coarser grades of salt are used in the curing of fish, for ice and dust control on highways, for dairy purposes, for the regeneration of zeolites in water-softening, as refrigerants, etc. 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 very 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.

SAND, GRAVEL AND CRUSHED STONE

by
F. E. Hanes

Aggregate, as understood in this review, is obtained from naturally occurring sand and gravel deposits or from crushed and beneficiated bedrock. The products from these two sources are used in all concrete construction, in highway, railroad and waterway construction and in the manufacture of terrazzo, stucco dash and cast-stone materials.

The volume of aggregate produced in 1957 reached an all-time high of 193,011,846 short tons valued at $136,553,687, gaining by 10 per cent over the output of 1956. Nineteen per cent of the aggregate produced in 1957 was composed of crushed stone.

The aggregate industry has grown rapidly in the last 10 years (see graph, page 402). Production of sand and gravel in 1957 was 2.8 times greater than in 1947. Crushed-stone production increased 4.2 times in the same period. The amount of aggregate increased by 203 per cent in volume and 330 per cent in value over the 10-year period.

Imports and Exports

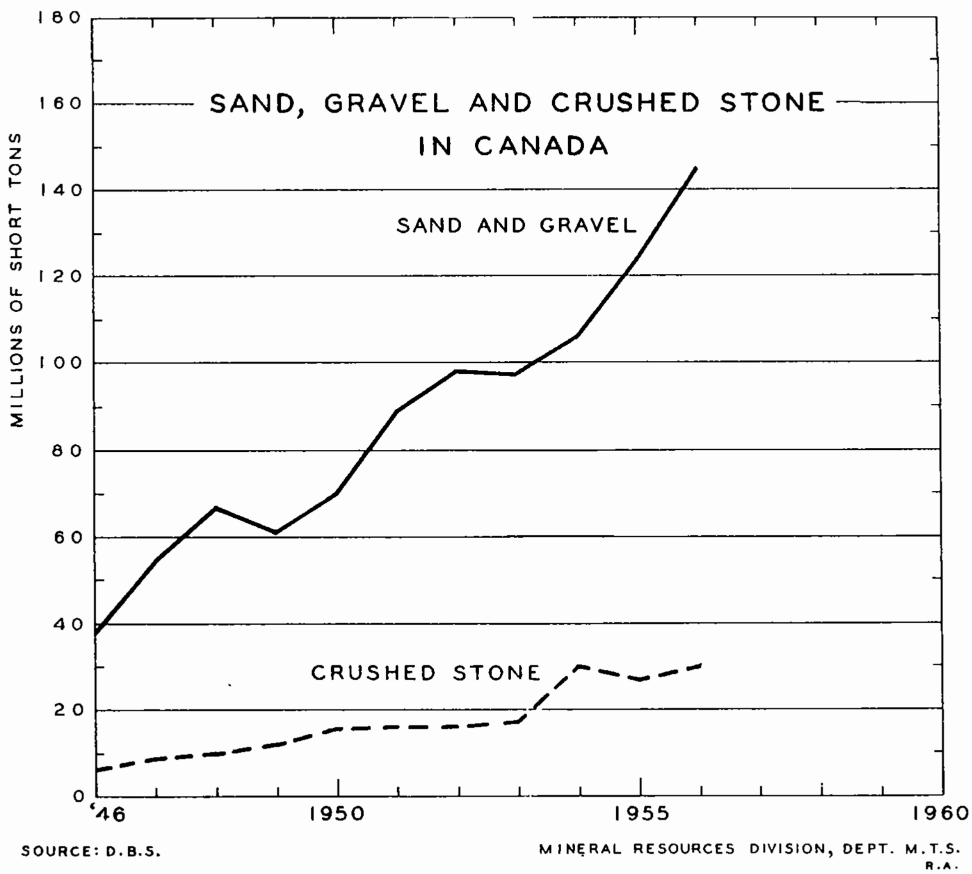
The following import and export totals are based on the 1956-57 figures reported by the Dominion Bureau of Statistics.

The amount of aggregate imported in 1957 was down 3 per cent in volume but rose 12 per cent in value compared with that of 1956. Imports amounted to 1,343,752 short tons valued at $1,729,426. Crushed stone made up 80 per cent of the aggregate imported from the United States.

PRODUCTION OF SAND, GRAVEL AND CRUSHED STONE

	SAND AND GRAVEL				CRUSHED STONE				TOTAL PRODUCTION SAND, GRAVEL AND CRUSHED STONE			
	1957		1956		1957		1956		1957		1956	
	Short Tons	$	Short Tons	$	Short Tons	$	Short Tons	$	Short Tons	$	Short Tons	$
By province												
Newfoundland	2,707,869	1,659,293	2,439,615	1,673,579	351	1,650	9,021	32,106	2,708,220	1,660,943	2,448,636	1,705,685
Nova Scotia	1,932,125	1,875,222	1,674,284	1,659,034	338,681	716,167	318,847	599,661	2,270,806	2,591,389	1,993,131	2,258,695
New Brunswick	7,341,578	3,676,312	6,140,029	3,152,911	1,224,662	1,194,047	2,074,407	1,709,724	8,566,240	4,870,359	8,214,436	4,862,635
Quebec	40,252,310	20,384,952	36,641,317	16,150,499	15,441,898	19,336,844	10,581,666	13,074,302	55,694,208	39,721,796	47,222,983	29,224,801
Ontario	63,599,656	35,913,363	58,922,642	33,476,144	15,622,241	18,428,375	13,879,351	17,101,690	79,221,897	54,341,738	72,801,993	50,577,834
Manitoba	6,545,619	3,365,132	6,875,732	2,286,177	415,441	414,458	230,892	342,496	6,961,060	3,779,590	7,106,624	2,628,673
Saskatchewan	6,480,617	3,080,662	6,184,900	3,105,804	-	-	-	-	6,480,617	3,060,662	6,184,900	3,105,804
Alberta	11,801,271	9,981,206	10,522,429	8,877,758	45,331	257,353	36,257	232,051	11,846,602	10,238,559	10,558,686	9,109,809
British Columbia	15,340,731	10,674,630	15,873,130	10,286,344	3,921,465	5,594,021	2,672,018	3,026,784	19,262,198	16,268,651	18,545,148	13,313,128
Total	156,001,776	90,610,772	145,274,078	80,668,250	37,010,070	45,942,915	29,802,459	36,118,814	193,011,846	136,553,687	175,076,537	116,787,064
By type												
Sand												
Building; concrete	14,173,048	9,673,088	11,902,438	9,219,153								
Sand and gravel												
Concrete; road-building	108,654,941	56,593,792	102,177,661	51,832,543								
Railroad ballast	7,687,770	3,057,655	7,124,461	2,493,086								
Crushed gravel	25,486,017	21,286,237	24,069,518	17,123,468								
Crushed stone												
Concrete aggregate					11,355,030	15,761,075	10,421,209	13,280,234				
Railroad ballast					1,672,185	2,136,969	1,309,156	1,262,783				
Road metal					17,489,156	18,525,532	15,627,912	18,442,792				
Rubble and riprap					3,958,004	5,831,052	1,338,988	1,383,843				
Terrazzo, stucco and artificial stone					41,350	445,878	55,548	435,400				
Other uses					2,494,345	3,242,409	1,049,646	1,313,762				
Total	156,001,776	90,610,772	145,274,078	80,668,250	37,010,070	45,942,915	29,802,459	36,118,814				

Sand



At $676,319, exports in 1957 were 42 per cent higher in value than they were in 1956. Their volume, 23 per cent of which consisted of crushed stone, totalled 416,867 short tons, 25,000 less than in the previous year.

Consumption of Aggregate

Large construction contracts accounted for much of the aggregate consumed in 1956, and this condition continued through 1957. A few of the larger contracts were completed or nearly so. Of these, the St. Lawrence Seaway project demanded large quantities of concrete aggregate in lock and dam construction. Only 12 per cent of the 5 1/2 million tons of concrete required for the project remains to be supplied in 1958.

Federal, provincial, and municipal highway departments use immense quantities of aggregate. In 1957, a total of $861 million was budgeted for road construction; plans for arterial expressways and interconnecting main and secondary roads extend as far into the future as 1985. In mid-1957 the city of Montreal inaugurated a construction program of roads, tunnels and bridges that will cross Montreal from east to west and from north to south.

Also to be built is a north-south provincial expressway connecting New York State roads at the Quebec border with the Laurentian playgrounds at St. Jerome. The project, estimated to cost $157 million over a 10-year period, will require large amounts of aggregate.

Construction of the Trans-Canada Highway is being pushed ahead but considerable work has yet to be completed. More than 60 per cent of the paving and 46 per cent of the grading remains to be brought up to the required standard.

New Methods for Increasing Aggregate Quality

Natural sand and gravel deposits of acceptable aggregate near large industrial centres are becoming depleted. Many deposits of inferior quality are now being processed for the removal of deleterious material. Two recently tested methods are simple in operation and low in production costs.

One of the methods used for improving the quality of sand deposits is an innovation in jigging. Large shallow jig beds are activated by two superimposed eccentric motions. Unsound aggregate works upward in the pulsating bed and is floated off at the overflow end of the jig. A large amount of sand can be processed by this method.

The other method improves the quality of coarse aggregate by making use of the elastic property of stone. Sound gravel stones dropped on a massive inclined metal plate will bounce farther than unsound stones. Separation of gravel according to the degree of unsoundness is achieved by placing collector bins in the paths of the bouncing pebbles. Gravel up to 3 inches in size has been successfully tested by this method.

SILICA

by
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 and 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.

Canada's production of silica was 2,139,246 short tons in 1957. Most of the quartz, quartzite and silica sand produced in Canada is used domestically in the manufacture of silicon and ferrosilicon alloys, as a fluxing material in metallurgical industries, in the manufacture of silica brick, as an ingredient in portland cement, for foundry purposes, etc. Part of the Canadian production of lump silica is exported to the United States, where it is used in the manufacture of silicon and ferrosilicon alloys. In 1957 Canada exported 11 per cent of the year's production of silica.

Canada's requirements of high-purity silica sand, for the manufacture of glass, silicon carbide and chemicals and for other purposes, are supplied mostly by the United States. Less than 15 per cent of Canada's annual consumption of this type of silica is at present produced domestically.

Producers

Nova Scotia

Dominion Steel and Coal Corporation, Limited, quarries quartzite 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 for fluxing purposes.

Dominion Silica Corporation Limited quarries quartzite at St. Donat, Montcalm county, for use in the manufacture of silica sand at Lachine. Sand for use in the manufacture of glass and artificial abrasives, silica flour and other high-quality silica products is produced here.

Radius Exploration Limited of Montreal operates a sandstone quarry near Ste. Clothilde, Chateauguay county, for the production of various grit

(text continued on page 408)

Silica – Production and Trade

	1957 Short Tons	1957 $	1956 Short Tons	1956 $
Production (1)				
Quartz and silica sand				
Ontario	1,591,091	1,428,400	1,571,819	1,413,192
Quebec	284,403	1,321,830	320,955	1,243,465
Saskatchewan	168,051	84,026	183,563	91,782
British Columbia	95,701	350,930	63,317	279,074
Manitoba	-	-	2,580	9,030
Total	2,139,246	3,185,186	2,142,234	3,036,543
By use				
Ferrosilicon	387,759	1,133,766	383,687	1,211,788
Foundry	6,280	68,646	37,776	145,540
Flux	1,638,599	1,133,732	1,633,385	1,055,399
Glass, silicon carbide, flour and other industrial uses	106,608	849,042	87,386	623,816
Total	2,139,246	3,185,186	2,142,234	3,036,543
	Thousands of Bricks		Thousands of Bricks	
Silica brick	4,308	655,903	5,799	736,817
Imports				
Silica sand for glass and carborundum manufacture and for use in steel foundries, filtration plants and sand-blasting				
United States	743,820	2,351,770	840,314	2,594,932
Belgium	1,047	55,863	60	2,370
Total	744,867	2,407,633	840,374	2,597,302
Silex or crystallized quartz, ground or unground (2)	13,718	186,882	26,892	326,620
Piezoelectric quartz (3)	6	176,572	8	218,255
Total	13,724	363,454	26,900	544,875

Production and Trade (cont'd)

	1957		1956	
	Short Tons	$	Short Tons	$
Imports (cont'd)				
Flint and ground flint stones				
United States	393	14,235	553	13,223
Denmark	80	1,894	-	-
France	55	1,503	63	1,853
Total	528	17,632	616	15,076
Ganister				
United States	667	10,094	562	6,572
Fire-brick containing not less than 90 per cent silica				
United States		2,929,205		1,916,197
West Germany............		21,303		441
Total		2,950,508		1,916,638
Exports				
Quartzite				
United States	232,299	790,728	181,196	564,173

(1) Producers' shipments, including both crude and crushed quartz, crushed sandstone and quartzite, and natural silica sands.
(2) Mostly from the United States.
(3) Seventy-six per cent of the piezoelectric quartz imported in 1957 was obtained from Brazil. Most of the remainder was from the United States.

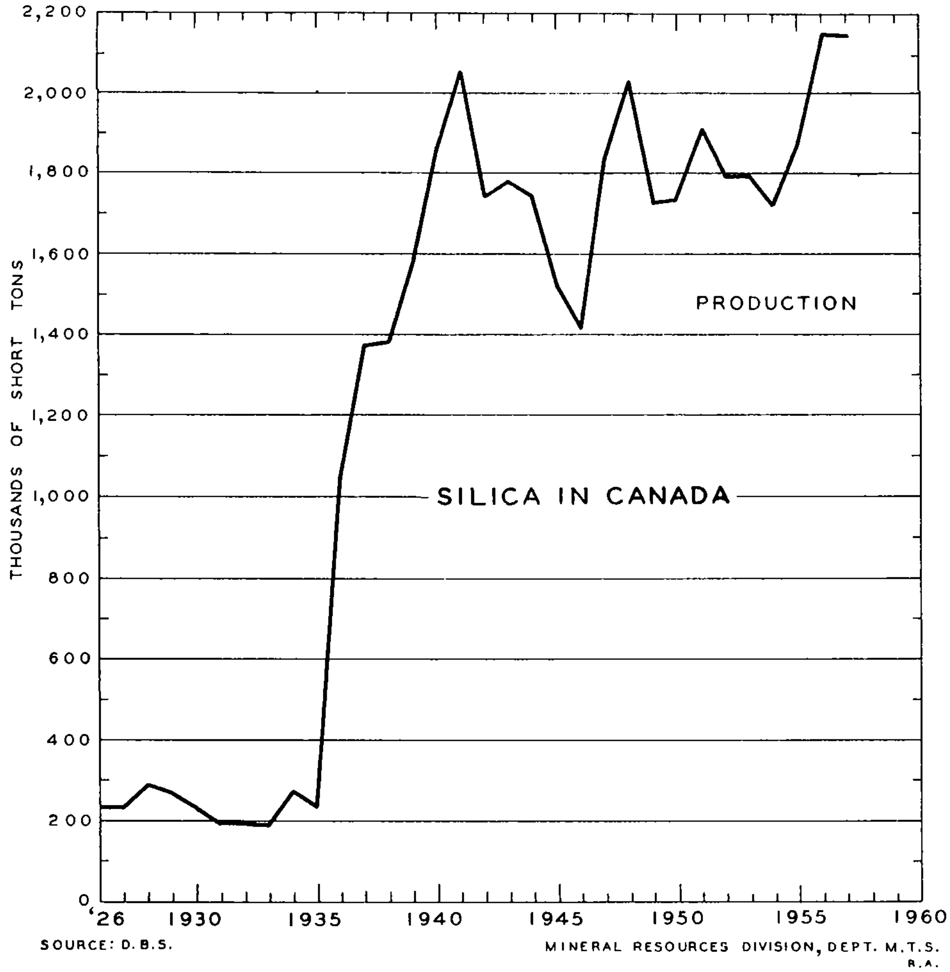
Silica - Consumption by Specified Industries, 1957

Industry	Consumption (short tons)
Glass-manufacturing	268,303
Articifical abrasives	125,534
Ferrosilicon	141,072
Foundry sand	170,113
Smelter flux	1,626,929
Other	148,169
Total	2,480,120

Silica – Production and Trade, 1947-57

	Production		Imports				Exports
	Quartz and Silica Sand	Silica Brick	Silica Sand	Silex or Crystal-lized Quartz	Ground Flint Stone	Ganister	Quartzite
	(short tons)	(thousands of bricks)	(short tons)				(short tons)
1947	1,836,428	3,094	533,456	15,004	335	400	223,240
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	178	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

Silica



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 sand is used in the manufacture of 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 products.

Ontario

Lorrain quartzite is quarried by Electro Metallurgical Company at Killarney, on Georgian Bay, and by Canadian Silica Corporation Limited, at Sheguiandah, Manitoulin Island. A large part of the production from these deposits is exported to the United States. The Canadian consumption of quartzite from this area is mainly for the manufacture of silicon and ferrosilicon.

A small percentage of the Sheguiandah output is for the production of silica flour at Canadian Silica's grinding plant 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 foundry purposes, glass manufacture and use in the hydraulic fracturing of oil-bearing formations.

Alberta

In 1957, Peace River Glass Company Ltd. of Edmonton produced a small quantity of foundry sand from its silica-sand deposit at Peace River. Sand from this deposit is to be used for the production of glass for the manufacture of glass-fibre products in the company-owned plant at Fort Saskatchewan, Alberta.

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 and amount of silica used is dependent upon the composition of the ore being fluxed; however, the silica content should be as high as possible. Small amounts of impurities such as iron and alumina are not objectionable. Silica used for flux is generally all -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 98 per cent, that of iron and alumina less than 1 per cent

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each and the total iron and alumina content less than 1 1/2 per cent. Lime and magnesia should each be less than 0.20 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 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 non-metallic ores.

Silica Sand

Glass Manufacture

Naturally occurring sand and that produced by crushing quartz, quartzite or sandstone are used in the manufacture of glass and fused silica-ware. The silica content should be more than 99 per cent and 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- and 100-mesh in size with a minimum of coarse or fines.

Silicon Carbide

Sand used for silicon-carbide manufacture should have a silica content of 99 per cent. The iron and alumina content should be less than 0.10 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 sandpapers. Various grades of closely sized sand are used in water-treatment plants as a filtering medium. 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.

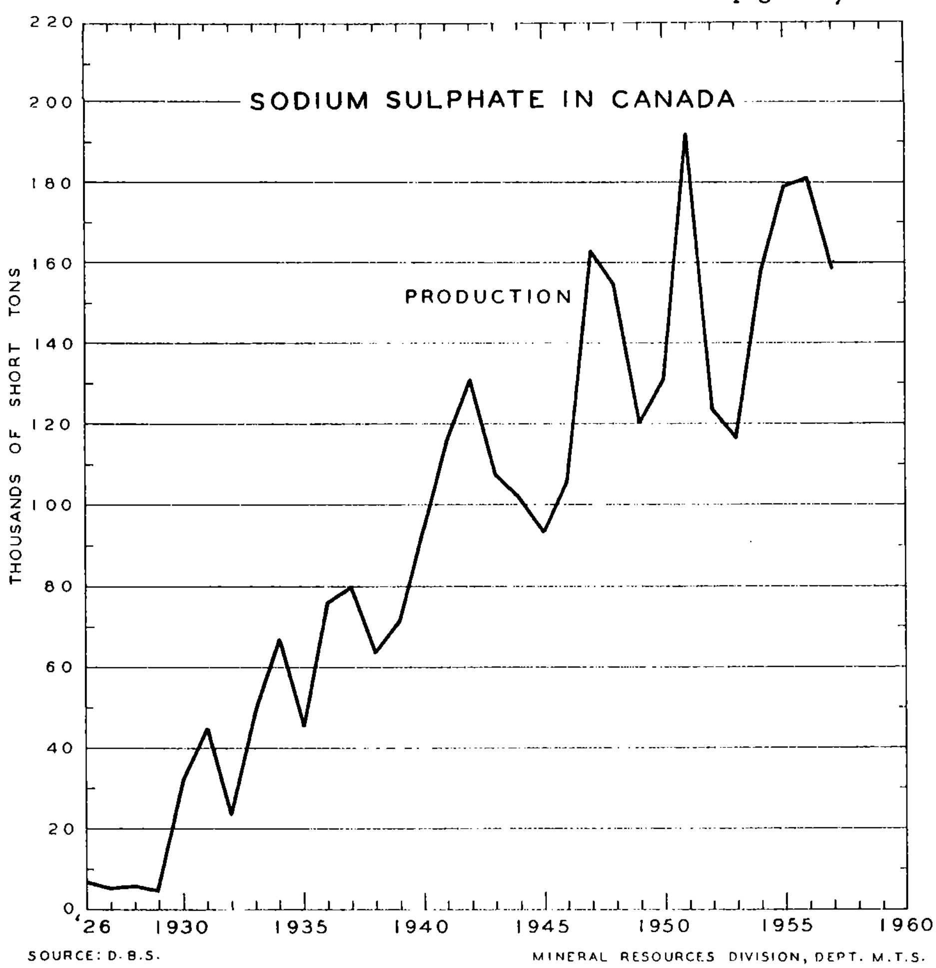
SODIUM SULPHATE

by
C. M. Bartley

Canadian production of natural sodium sulphate in 1957 decreased 12.8 per cent in tonnage and 9.5 per cent in value compared with the 1956 output. These figures reflect the slower pace of industry, particularly in the manufacture of pulp and paper, which accounts for the consumption of almost all the sodium sulphate produced in Canada.

Both demand for and value of sodium sulphate have fluctuated considerably. In terms of tonnage 1951 was the peak production year, with shipments of 192,371 short tons. In terms of value 1956 production was greatest, at $2,838,186.

(text continued on page 414)



Sodium Sulphate - Production, Trade and Consumption

	1957		1956	
	Short Tons	$	Short Tons	$
Production (shipments) ..	157,800	2,568,728	181,053	2,838,186
Imports				
Crude sodium sulphate or salt cake				
United States..........	18,907	336,960	20,576	369,897
United Kingdom	9,181	174,497	9,743	188,759
Total.................	28,088	511,457	30,319	558,656
Glauber's salts				
United States	993	36,530	1,819	68,501
West Germany	516	13,558	948	22,694
Other countries	3	439	1	135
Total.................	1,512	50,527	2,768	91,330
Exports				
Crude medium sulphate				
United States..........	37,023	593,390	60,579	985,801
Consumption				
Pulp and paper	160,042		156,698	
Glass, including glass wool.............	2,111		2,922	
Medicinals	67		54	
Soaps	1,252		1,335	
Total	163,472		161,009	

Sodium Sulphate

Sodium Sulphate - Production, Trade and Consumption, 1947-57
(short tons)

	Production(1)	Imports		Exports(2)	Consumption
		Salt Cake	Glauber's Salts		
1947	163,290	9,829	1,383	46,934	128,392
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	129,518
1954	158,417	30,235	5,134	66,049	138,090
1955	178,888	29,927	3,888	76,894	141,889
1956	181,053	30,319	2,768	60,579	161,009
1957	157,800	28,088	1,517	37,023	163,472

(1) Producers' shipments of crude sodium sulphate.

(2) The figures from 1947 to 1954 show the crude sodium sulphate exported to the United States and given in United States import statistics but not recorded separately in Canadian statistics. The figures from 1955 to 1957 show exports to the United States as given by official Canadian sources.

As in previous years, the entire Canadian production of 1957 came from Saskatchewan, where reserves have been estimated at more than 200 million tons. These reserves include 21 deposits, each containing at least 500,000 tons. Other deposits have been found in Alberta, British Columbia, and New Brunswick but to date have not been a source of production.

Producers

Four Saskatchewan companies produced sodium sulphate in 1957. They are: Saskatchewan Minerals, Sodium Sulphate Division, Chaplin; Ormiston Mining and Smelting Co. Ltd., Ormiston; Midwest Chemicals Limited, Palo; and Sybouts Sodium Sulphate Co. Ltd., Gladmar. The combined capacity of the processing plants, which totals more than 300,000 tons yearly, is adequate for all foreseeable demand. Other deposits, apart from those now being mined, have been tested or worked and, given a favourable market, could produce again.

Occurrences of Natural Sodium Sulphate in Western Canada

The Saskatchewan deposits and some of a similar nature in Alberta and British Columbia have formed in closed-drainage basins where mineral waters have evaporated. It is generally accepted that sodium sulphate is taken into solution by ground water, transferred to shallow lakes by normal drainage and there concentrated by evaporation. The yearly repetition of this process results in large accumulations of this salt.

Production Methods

The first attempts at production consisted in harvesting the permanent salt bed in cold weather after summer evaporation had removed most of the water from the lake. As this method is slow and not entirely satisfactory, it has been largely replaced by brine-pumping and improvements have resulted both in grade and in volume of product. During the hot summers, when the brine in the shallow lake is nearly saturated, it is transferred by ditches and pumps to open storage reservoirs and, as the weather cools, most of the salt precipitates. The remaining dilute brine is then pumped back to the lake and the sodium sulphate removed to a central stockpile. Thus, by taking advantage of the climatic cycle, large amounts of high-purity sodium sulphate are efficiently recovered.

Processing

The process for the recovery of a marketable product is essentially one of dehydration rather than refining. The water of crystallization is evaporated to reduce the raw crystalline Glauber's salt (mirabilite - $Na_2SO_4.10H_2O$), containing about 44 per cent sodium sulphate, to its anhydrous form (thenardite - Na_2SO_4), containing 95 to 100 per cent sodium sulphate. This is done at most of the Saskatchewan plants by taking raw material from the stockpile and putting it through evaporators and rotary kilns. The finished product is then crushed, screened and stored for shipment.

Uses

More than 99 per cent of Canadian sodium-sulphate production in 1957 was consumed by the kraft-paper industry in Canada and the United States. Sodium sulphate, which adds strength to the finished paper, is being consumed in increasing quantities in the rough-paper classes and also, through the use of improved bleaching processes, in newsprint. Kraft-pulp additions to newsprint provide higher wet strength and permit machines to operate at higher speeds.

Other users of sodium sulphate include manufacturers of glass, heavy chemicals, detergents and dyes. It is also used in tanning operations and in the preparation of feed supplements for cattle.

It was announced recently that one of the by-product sources of sodium sulphate in the United States, the manufacture of hydrochloric acid by the Mannheim process, is becoming obsolete and that some 55,000 tons a year of sodium sulphate produced from one plant by that process will not be available to consumers. This market, together with expanding pulp production, decreasing by-product production from rayon manufactures and the hope of larger sales to detergent manufactures, suggests that a larger and more stable market for Canadian sodium sulphate may develop.

Prices

Canadian sodium sulphate is sold by contract to individual consumers at prices which vary according to purity, tonnage and the term covered by the contract.

According to Oil, Paint and Drug Reporter of December 23, 1957, United States prices of sodium sulphate were as follows:

Salt cake, domestic bulk, 100% Na_2SO_4 basis, f.o.b. works, per ton	$28	
Sodium sulphate		
Anhydrous technical-grade, per ton	$52	
Detergent, rayon-grade, per ton	$34	
Crystallized, per lb		17 1/2¢ to 18¢

Photo: 10479 George Hunter

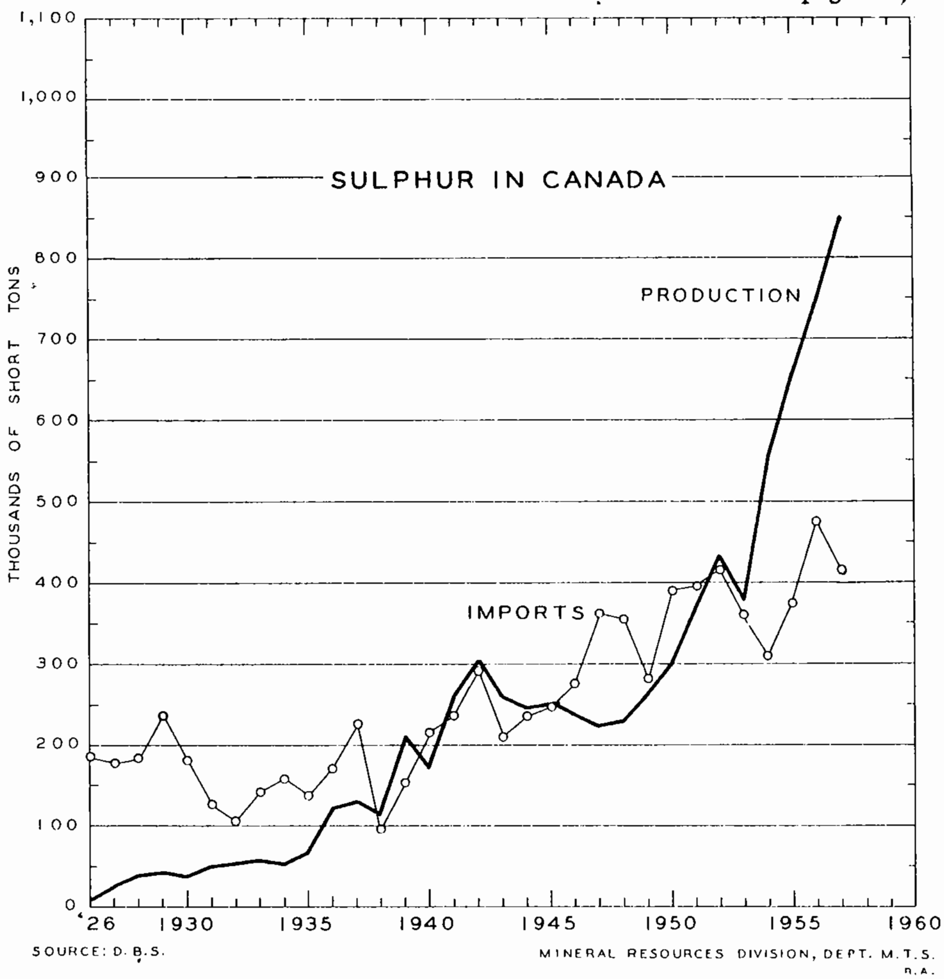
Night view of Noranda Mines, Limited, sulphur-acid plant at Cutler, Ontario.

SULPHUR

by
C. M. Bartley

No deposits of native sulphur have been found in Canada, but other sources of this commodity and its compounds occur widely. These include large bodies of sulphides and sulphates (e.g., pyrite-pyrrhotite and anhydrite-gypsum), tar sands and sulphur compounds in natural gases. Until recently Canada's production of sulphur was derived entirely from by-product pyrrhotite and pyrite and from smelter gases in the form of sulphur dioxide mainly for the manufacture of sulphuric acid. Since 1952 elemental sulphur has been recovered in the cleaning of natural gas. Production of elemental sulphur and of sulphur dioxide in gaseous and liquid forms has increased rapidly in the last few years; Canada is now among the top producers. It is expected that production of sulphur in its various forms will continue to increase in view of several projects now under development.

(text continued on page 422)



Sulphur - Production and Trade

	1957 Short Tons	1957 $	1956 Short Tons	1956 $
Production[1]				
Pyrite and pyrrhotite				
Gross weight..........	1,166,416	4,808,228	1,046,740	4,538,785
Sulphur content.........	515,096		473,605	
Sulphur in smelter gases[2]	235,123	2,322,067	236,088	2,323,590
Sulphur (elemental) made from natural gas[3]	100,706		33,464	
Total sulphur	850,925		743,157	
Imports				
Brimstone				
United States...........	416,930	9,752,368	472,976	11,831,667
Other countries	-	-	1,141	25,889
Total	416,930	9,752,368	474,117	11,857,556
Exports				
Pyrite				
United States...........		1,200,454		1,370,419
Netherlands............		849,524		422,970
United Kingdom.........		761,127		568,970
Taiwan		41,648		-
France		-		286,990
Total..................		2,852,753		2,649,349
Other sulphur				
Alaska.................	7,224	170,925	-	-
United States...........	4,956	117,244	146	3,444
India	184	4,873	4,130	123,022
Indonesia	-	-	55	1,650
Total..................	12,364	293,042	4,331	128,116

(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.

A serious sulphur shortage developed in 1950, when the world depended largely on sulphur produced by the Frasch process in the United States. Heavy industrial and military activity demanded almost all the available supply. As a result, efforts were made to increase production in the United States and elsewhere, and new sources of Frasch sulphur were developed in that country and in Mexico. In Canada the production from pyrite and pyrrhotite increased and elemental sulphur was recovered from natural gas for the first time.

By 1953 world supplies were about adequate and consumers were much less dependent on the United States. Canada, which in 1950 imported most of its sulphur, is now a net exporter with its production still rising rapidly. It is worth noting that two important developments have affected sulphur production in this country: the rise of the uranium industry and its use of sulphuric acid in eastern Canada; and the fact that substantial quantities of elemental sulphur are now recovered from natural gas in western Canada.

Pyrite and Pyrrhotite

Prior to the production of elemental sulphur by Frasch methods in the early 1900s, pyrite and pyrrhotite were the major sources in North America. However, the high purity, low cost and large volume of Frasch sulphur quickly made the pyrite-sulphur operations unprofitable. The only exceptions were those base-metal mines able to produce a high-purity pyrite or pyrrhotite concentrate as a by-product of their metal recovery. Pyrite is a compound of sulphur and iron in a very stable form. The cost of transportation and the processing necessary to obtain a marketable iron residue, and markets for the latter, are the key factors affecting its value as a source of sulphur. Where markets were favourably located for economic transportation and disposal of iron-oxide residue, pyrite concentrates were able to compete with elemental sulphur.

Consumption of Elemental Sulphur*
(short tons)

	1956	1955
Pulp and paper	313,851	300,899
Heavy chemicals	108,300	82,947
Rubber goods	2,905	2,783
Medicinal uses	126	27
Adhesives	41	29
Starch	27	340
Fruit and vegetable preparations	7	6
Sugar-refining	140	168
Petroleum-refining	225	255
Steel and iron	86	65
Miscellaneous chemicals	5,473	5,591
Asbestos products	10	8
Miscellaneous non-metallics	-	24
Glass	11	6
Total	431,202	393,148

* Available data.

Sulphur - Production, Trade and Consumption, 1947-57
(short tons)

	Production				Imports	Exports(3)	Consumption
	In Pyrites Shipped (1)	In Smelter Gases (2)	Elemental Sulphur from Natural Gas	Total	Brimstone	In Pyrites and Other Sulphur (4)	Elemental Sulphur (5)
1947	82,637	139,144	-	221,781	361,424	56,337	322,818
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	111,717	372,347
1951	215,363	156,427	-	371,790	395,928	178,083	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	359,105	134,241	352,466
1954	311,159	221,247	22,320	554,726	310,127	191,947	358,953
1955	403,986	224,457	29,093	657,536	373,373	$2,095,716	393,148
1956	473,605	236,088	33,464	743,157	474,117	$2,777,465	431,202
1957	515,096	235,123	100,706	850,926	416,930	$3,145,795	

(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) 1947-54 in short tons; 1955-57 in dollars.

(4) Pyrites - sulphur content; other sulphur - from natural gas and other sources.

(5) Consumption of elemental sulphur by industries. Coverage is incomplete.

In recent years improved processes in which pyrite is used as a raw material have been developed in Canada. In one developed by Noranda Mines Limited and applied at Port Robinson, Ontario, pyrite is used to produce elemental sulphur, sulphur-dioxide gas and high-grade iron sinter. Noranda's plant at Cutler, Ontario, uses pyrite and pyrrhotite to produce sulphur-dioxide gas for the manufacture of sulphuric acid and to produce iron sinter. This new process has thus created a larger market for pyrite.

Some of the increased production of pyrite and pyrrhotite was absorbed by the export markets (see table on page 420). The greater part, however, was used in Canada to produce sulphuric acid, the growing demand for which has come almost entirely from the uranium industry in Ontario and Saskatchewan.

In 1957, the pyrite-sulphur plant at Port Robinson used concentrates derived as a by-product of base-metal recovery in the Noranda area of northwestern Quebec. Adjustments and improvements are being made to the process to increase grade and efficiency.

The plant at Cutler, on the north shore of Lake Huron, 25 miles east of the town of Blind River, supplies sulphuric acid to the uranium mines of that area. The plant consists of a sulphur-iron (pyrite-sintering) unit, a pyrite-roasting unit and two sulphuric-acid units. Each acid unit has a rated capacity of 500 tons a day.

Both acid plants started production on imported elemental sulphur but, as sintering and roasting units come into operation, are converting to sulphur-dioxide gas produced from pyrite. The use of imported sulphur will eventually be discontinued.

The two Noranda plants, when operating at capacity, will account for most of the pyrite consumed in Canada. The Consolidated Mining and Smelting Company of Canada Limited produces sulphuric acid from pyrrhotite. The Nichols Chemical Company Limited, with plants at Barnet, British Columbia, Sulphide, Ontario, and Valleyfield, Quebec, produces it from pyrite, as did Lorado Uranium Mines Limited in northern Saskatchewan for a short time during 1957 and early 1958.

A new sulphuric-acid plant has been built at Copper Cliff, Ontario, by Canadian Industries Limited for the treatment of gas rich in sulphur dioxide. This gas is a by-product of the iron-ore recovery operation of The International Nickel Company of Canada Limited. Near by a pilot plant is being erected by Texas Gulf Sulphur Company for the study of the recovery of elemental sulphur from this gas.

Canada has huge reserves of pyrite and pyrrhotite, particularly in British Columbia, Manitoba, Ontario, Quebec and New Brunswick; and while much of this material has been considered to be of little value, metallurgical improvements, new processes, and increased markets for sulphur and iron are now making production attractive.

New Source of Elemental Sulphur

International Nickel, at its Port Colborne refinery, is applying a process for the recovery of nickel by the direct electrolysis of nickel matte. The method permits recovery of nickel, cobalt, precious metals and, for the first time, high-purity sulphur and selenium. In view of the tonnage of material processed by the refinery, this new process will supply substantial amounts of elemental sulphur in the future.

Sulphur from Smelter Gases

In 1957 the products recovered from smelter gases had a sulphur content of 235,123 short tons.*

Sulphur dioxide is recovered from smelter gas by The Consolidated Mining and Smelting Company of Canada Limited at Trail, British Columbia,

* It has been estimated that at least three times this amount of sulphur is wasted each year in Canada, for it is only in comparatively recent years that significant progress has been made in recovering sulphur compounds from these gases.

and is used to make sulphuric acid. At Copper Cliff, Ontario, Canadian Industries Limited uses sulphur dioxide, from International Nickel's smelter gas, for the same purpose. Highly concentrated sulphur-dioxide gas from the flash smelting of copper concentrates is liquefied and sold to Canadian pulp mills.

Elemental Sulphur from Natural Gas

Several sulphur compounds occur in natural gas. The most important is hydrogen sulphide, which is extremely toxic and corrosive and must be removed before the natural gas is transmitted to the market. Prior to 1952 it was treated as a nuisance and flared off, but, during the sulphur shortage, recovery plants were built. Several large gas fields in western Canada contain hydrogen sulphide in amounts up to 37 per cent. At Jumping Pound, Alberta, Shell Oil Company of Canada Limited can process 90 million cubic feet of natural gas and recover 80 tons of sulphur a day. The expanding market for natural gas makes it certain that large amounts of sulphur will be produced, particularly when the gas transmission line from Alberta to eastern Canada is completed.

The companies producing sulphur from natural gas, or planning to do so, are the following:

Company	Location	Capacity 1957 (short tons per year)	New Capacity Planned
Shell Oil Company of Canada	Jumping Pound, Alta.	28,800	
Royalite Oil Company Limited	Turner Valley, Alta.	10,800	
Imperial Oil Limited	Redwater, Alta.	7,000	
British American Oil Company Limited	Pincher Creek, Alta.	78,000	
Jefferson Lake Sulphur Company of Canada Ltd.	Taylor, B.C.	100,000	
		224,600	
West Coast Transmission Company Limited	Savanna Creek, Alta.		175,000

Output from the foregoing five sources in 1957, at 100,706 short tons, was less than capacity since some came into production late in the year. Production in 1956 totalled 33,464 short tons. A considerable increase over 1957 is expected in 1958.

A process similar to that of the foregoing operations will be used by Laurentide Chemicals and Sulphur Ltd. at its plant in Montreal East to recover 100 tons of sulphur a day from oil-refinery and chemical-plant wastes. This plant is expected to be in operation early in 1958.

Other Potential Sources of Sulphur in Canada

In addition to the sulphur recoverable from Canadian pyrite and pyrrhotite, smelter gases and natural gas, there are potential sources which may in the future supply large amounts. These include the Athabasca bituminous sands, which contain 5 1/2 per cent sulphur in very large deposits, and deposits of gypsum and anhydrite, particularly those in the Maritime Provinces.

Sulphuric Acid in Canada - Production, Trade and Apparent Consumption
(short tons of 100% acid)

	Production	Imports	Exports	Apparent Consumption
1947	668,802	116	29,909	639,009
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

Consumption of Sulphuric Acid*
(short tons of 100% acid)

	1957	1956
Fertilizers	668,900	563,400
Heavy chemicals	177,900	188,700
Non-ferrous 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
Soaps 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.

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Sulphur

Largely owing to the expansion of the uranium industry, the production and consumption of sulphuric acid increased during 1957. New facilities for its production in operation or in the final stages of construction during the year comprised the following:

	Raw Material	New Acid-producing Capacity (tons per day)	Remarks
Noranda Mines Limited, Cutler, Ont.	Pyrite	500	Expansion
Canadian Industries Limited, iron-ore plant, Copper Cliff, Ont.	Flue gas	300	New
Canadian Titanium Pigments Limited, Varennes, Que.	Sulphur	150	New
Canadian Industries Limited, Beloeil, Que.	Sulphur	150 (approx.)	New
Lorado Uranium Mines Limited, Uranium City, Sask.	Sulphur	60	New
Gunnar Mines Limited, Uranium City, Sask.	Sulphur	65	Expansion
Shawinigan Chemicals Limited, Shawinigan, Que.	Pyrite	70	New
The Nichols Chemical Company Limited, Valleyfield, Que.	Pyrite	?	Expansion
Total		1,300 +	

New acid-producing capacity available in 1958 totals more than 1,300 tons a day, more than 900 tons of which is to meet the demands of the uranium industry.

Uses

Sulphur has innumerable industrial uses and is one of the most important of the industrial minerals. In most industrial nations it is generally converted to sulphuric acid; but in Canada other forms are used, particularly by the pulp and paper industry, which accounts for about half the total consumption. The uranium,rubber, plastic, explosives and soap industries also use large amounts of sulphur, mainly in the form of sulphuric acid.

Prices

The price of elemental sulphur is controlled largely by United States production and consumption, although Mexican Frasch sulphur has been an influence in recent years. That of western Canadian elemental sulphur is not published, but available information suggests $23 to $24 a long ton. The price of Canadian pyrite is controlled to some extent by that of elemental sulphur but varies considerably. Pyrite is sold under contract and prices are not published.

The Oil, Paint and Drug Reporter of December 30, 1957, quotes the following sulphur prices per long ton:

Pyrites, Canada, 48-50% sulphur, works	$ 5 to $ 6
Sulphur, crude, United States, bright, bulk, United States and Canada f.o.b. vessels Gulf ports	$25
Sulphur, crude, Mexican, bulk, f.o.b. Coatzacoalcos	$24

TALC AND SOAPSTONE; PYROPHYLLITE

by
J. E. Reeves

The appreciable increase in the total production of talc, soapstone and pyrophyllite in 1957 over that of 1956 is largely attributable to a much higher output of pyrophyllite resulting from the continued development of the Newfoundland deposits. The production of talc and soapstone from Ontario and Quebec was 4 per cent higher and its value 8 per cent higher than in 1956.

Imports, consisting of the higher-priced grades of talc for the paint, ceramic and cosmetic trades, decreased 8 per cent in volume compared with those of 1956, but their value was slightly higher. The United States and Italy were the principal sources. The import volume for 1956 is the largest on record.

Exports of talc and soapstone, chiefly to the United States, declined 10 per cent from those of 1956, thus continuing the downward trend that has taken place since 1941. Official statistics on export of pyrophyllite are not available.

Canadian consumption of talc and soapstone has been increasing in recent years; from 1949 to 1956, inclusive, it exceeded production. This increase has been reflected in the upward trend of imports.

Occurrences

Talc and soapstone occur in numerous localities in Quebec, Ontario and British Columbia, deposits in the first two provinces having contributed most of Canada's production. Pyrophyllite occurs in British Columbia near Semlin, 2 miles east of Ashcroft, and at Kyuquot Sound in the northwestern part of Vancouver Island. In Newfoundland it occurs near Manuels, about 12 miles southwest of St. John's. The Newfoundland deposits are larger and are currently being developed.

In Quebec, important deposits of talc and soapstone occur just north of the Vermont border, about 60 miles southeast of Montreal, and in the Thetford Mines area. The deposits were formed by the alteration of serpentine rock, are high in iron, have a variable carbonate content and are somewhat off-colour. The products are used where colour specifications are not exacting, and low-carbonate material can be selected for use where low loss-on-ignition is important.

In Ontario the deposits are in the northwest, especially in the Kenora district, and in the southeast. The production comes from near Madoc, about 110 miles southwest of Ottawa. The talc in this locality, resulting from the alteration of white and grey dolomite, is low in iron and relatively high in carbonate and is used to a large extent where prime white colour is important.

Production, Trade and Consumption

	1957 Short Tons	1957 $	1956 Short Tons	1956 $
Production (shipments)				
Quebec (1)	17,803	220,330	15,576	185,298
Ontario (2)	11,236	160,015	12,371	167,851
Newfoundland (3)	5,686	47,328	1,379	12,077
Total	34,725	427,673	29,326	365,226
Imports				
United States	13,228	462,709	14,703	433,677
Italy	1,699	72,372	1,528	61,405
France	22	1,108	37	919
Total	14,949	536,189	16,268	496,001
Exports (4)				
United States	2,243	28,381	2,476	31,873
Ecuador	92	1,224	62	789
Nicaragua	18	243	-	-
Other countries	-	-	75	1,746
Total	2,353	29,848	2,613	34,408

	1956	1955
Consumption (domestic) (5)		
Paints	7,436	7,872
Roofing	9,091	9,414
Pulp and paper	900	687
Rubber	1,747	1,392
Toilet preparations	716	540
Electrical apparatus	791	311
Clay products	4,157	3,302
Soaps and cleaning preparations	117	64
Textiles and linoleum	-	975
Insecticides and miscellaneous chemicals	3,785	5,503
Polishes and dressings	7	8
Miscellaneous non-metallic mineral products	103	83
Tanneries	3	6
Asbestos products	-	9
Coal-tar distillation	2,385	783
Medicinal preparations	246	408
Total	31,484	31,357

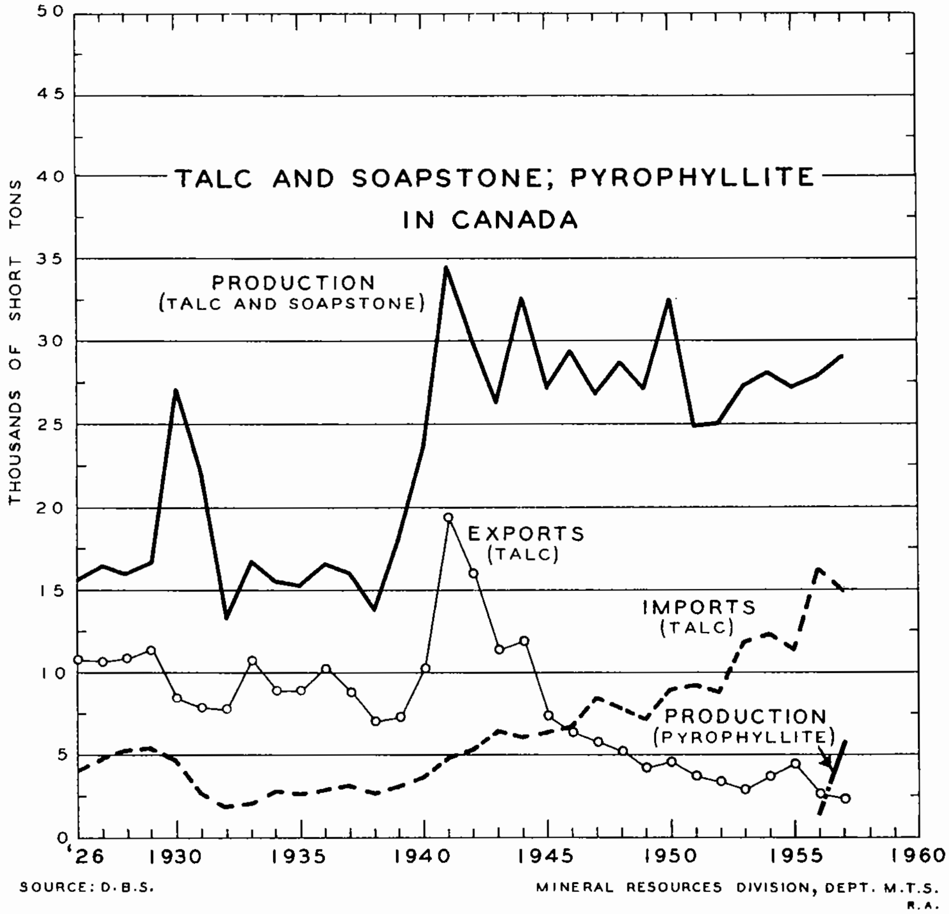
(1) Ground talc, soapstone blocks and crayons.
(2) Ground talc.
(3) Pyrophyllite.
(4) Excluding pyrophyllite.
(5) Available data.

Talc and Soapstone

Production, Trade and Consumption, 1947-57
(short tons)

	Production (1)	Imports	Exports	Consumption (2)
1947	26,709	8,472	5,807	27,115
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	29,326	16,268	2,613	31,484
1957	34,725	14,949	2,353	34,674

(1) Producer's shipments.
(2) Domestic.



There are several talc deposits in British Columbia and a small production was reported from 1916 to 1936. Most of it came from two small mines, one in the southern part of Vancouver Island and the other on the mainland about 100 miles northeast of Vancouver. They produced low-grade talc for the roofing industry. More recently, this industry has been using ground mica and fine-grained sand for dusting purposes. Massive talc, yielding a good white powder, occurs near the Alberta border west of Banff. Needs for high-grade white talc are being met by material from California.

Although the mineral talc is a hydrous silicate of magnesium, most commercial talcs contain appreciable amounts of other minerals such as serpentine, chlorite, tremolite, magnesite and dolomite. Soapstone is essentially a talcose rock of massive nature, from which blocks and crayons are derived, but ground soapstone is also an important source of low-carbonate material.

Pyrophyllite is very similar to talc but contains alumina instead of magnesia. It also is an alteration product, but it has been derived from siliceous rocks rather than from dolomites or serpentine rocks, and is often accompanied by sericite and quartz.

Producers

Quebec

Broughton Soapstone and Quarry Company Limited, Broughton Station, Beauce county, produces commercial grades of ground talc, and soapstone blocks and crayons.

Baker Talc Limited, 215 St. James Street West, Montreal, with grinding mill near Highwater, Brome county, produces talc derived from the Van Reet mine 10 miles to the north. Enlargement of the mill resulted in an increase in production in 1957 over that of 1956.

Ontario

Canada Talc Industries Limited, Madoc, operates the Conley and Henderson mines for the production of ground talc. The latter mine yields an especially high-grade white product.

Newfoundland

Newfoundland Minerals Limited, Box 2043, St.John's, commenced operations in June 1956, and plans additional development of the pyrophyllite deposits in 1958. Production is exported to the United States and the availability of a newly completed public dock will greatly aid shipping.

World Situation

The United States is the largest producer and consumer of talc, soapstone and pyrophyllite, and most of Canada's trade is with that country.

In addition, a small amount of very high quality white talc is imported from Italy and France for cosmetic and pharmaceutical use. A wide range of grades – especially of talc – is produced, and the need for some of these grades results in a certain amount of world trade.

Uses and Specifications

The roofing, paint, insecticide, ceramic and rubber industries account for much of the Canadian consumption. More recently the use of low-carbonate talc as a filler in asphalt pipeline enamels has attained importance.

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, as a filler and dusting agent in rubber products and as 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 and thus a low ignition loss is of first importance, because the enamel must be inert to 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 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.

Prices

Prices vary considerably according to quality, colour, loss-on-ignition, and fineness of grind.

Canadian prices of ground talc per short ton, in bags, f.o.b. Madoc, Ontario, as given by Canada Talc Industries Ltd. and quoted in The Northern Miner on October 17, 1957, were:

Filler grade, 50-lb bags	$ 11.50 to $ 15.00
Cosmetic grade, 50-lb bags	$ 26.00 " $ 50.00
Ceramic grade, 50-lb bags	$ 17.50 " $ 26.00
Roofing grade, 70-lb bags	$ 10.00 " $ 13.75

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 5, 1957, were:

New Jersey	
Mineral pulp, ground	$10.50 to $12.50, bags extra
New York	
Double air-floated, short-fibre, 325-mesh	$18.00 to $20.00
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 to $14.00
Crude	$ 5.50
Georgia	
Packed in paper bags	
98% through 200-mesh, grey	$10.50 to $11.00
White	$12.50 to $15.00

WHITING

by
H. M. Woodrooffe

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. Precipitated calcium carbonate, a by-product in the preparation of caustic soda and other chemicals, is also a source of whiting.

Canadian production is entirely of whiting substitute derived from the grinding of limestone and marble in Quebec and British Columbia.

The principal source of whiting substitute is a deposit of white marble near Bedford, in Missisquoi county, Quebec. Industrial Fillers Limited operates a quarry and ships to its grinding plant in Montreal. The ground material is used by various industries in eastern Canada. Production in British Columbia,which is on a smaller scale, is derived from a limestone of suitable colour.

Uses

True whiting originating in England is referred to commercially as a paris white, gilders' whiting, or ground cliffstone.

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.

Large quantities of whiting are used as a filler in rubber products, chemical composition being extremely important in this application. Some

(text continued on page 436)

Whiting - Production, Imports and Consumption

	1957 Short Tons	1957 $	1956 Short Tons	1956 $
Production				
Stone processed for whiting	13,599	163,694	17,448	174,120
Imports				
Whiting, gilders' whiting and paris white				
United States	4,642	208,398	5,543	208,040
United Kingdom	3,078	49,565	3,176	51,407
France	2,124	12,362	2,626	15,708
West Germany	-	-	11	759
Total	9,844	270,325	11,356	275,914
Chalk, prepared				
United States		4,781		5,829
Miscellaneous chalk, cliffstone, china or cornwall stone (ground or unground) and mica schist				
United States		3,633		6,368
West Germany		885		2,643
United Kingdom		59		-
Total		4,577		9,011

	1956	1955
Consumption		
Ground chalk, whiting and whiting substitute		
Explosives	341	321
Medicinals and pharmaceuticals	240	40
Paints	14,108	13,066
Soaps	41	51
Toilet preparations	14	17
Electrical uses	547	352
Clay products	26	6
Linoleum	7,223	7,009
Rubber goods	9,502	8,755
Tanneries	242	218
Gypsum products	260	347
Adhesive	124	162
Polishes and dressings	-	2
Asbestos products	57	672
Pulp and paper	466	563
Miscellaneous chemicals	1,015	1,476
Starch and glucose	4	-
Miscellaneous non-metallics	31	114
Total	34,241	33,171

Whiting

Whiting - Production, Imports and Consumption, 1947-57
(short tons)

	Production (1)	Imports(2)	Consumption(3)
1947	16,760	18,463	24,263
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	13,599	9,844	31,353(4)

(1) Stone processed for whiting.
(2) Whiting, gilders' whiting and paris white.
(3) Ground chalk, whiting and whiting substitute.
(4) Partially estimated.

whitings are chemically treated to improve dispersibility in the rubber mix. Whiting is used as a filler in linoleum, oil cloth, 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.

Prices

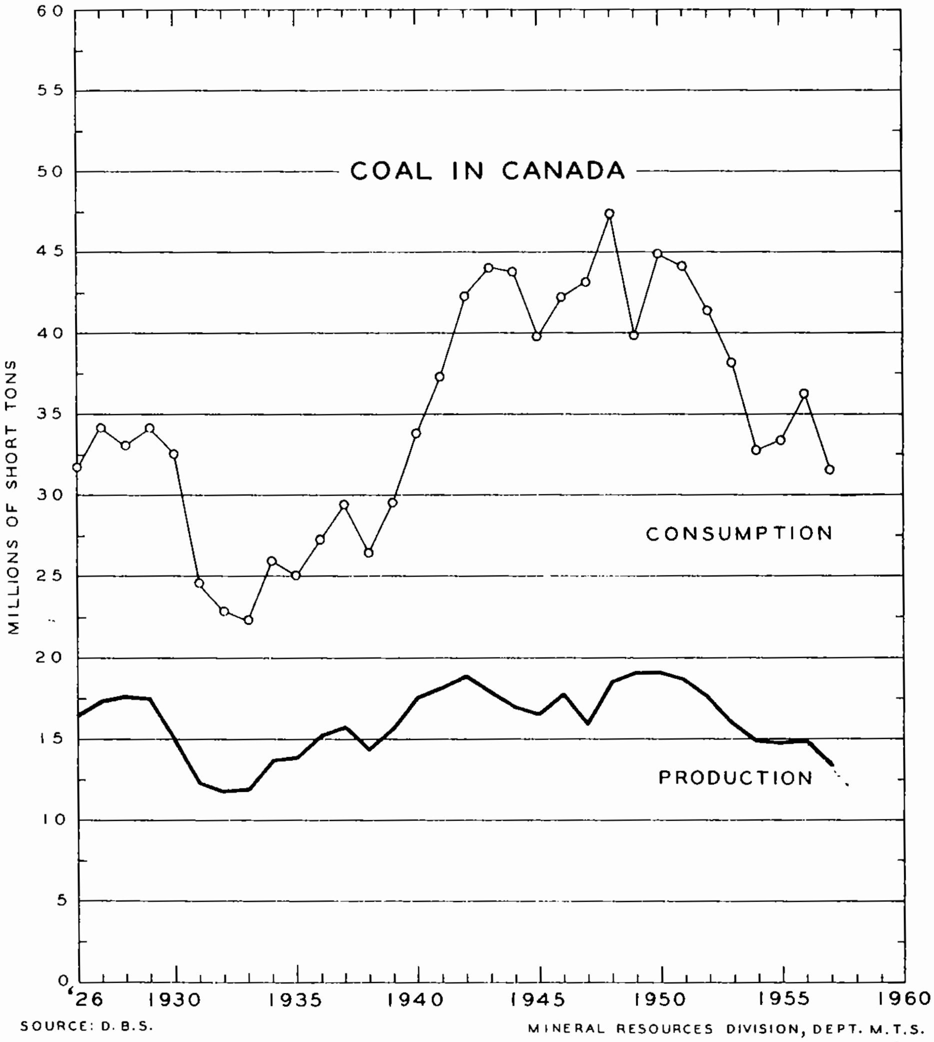
During 1957 the price of whiting substitute per ton, bagged, ranged between $15 and $20 f.o.b. plants.

COAL AND COKE

COAL

by
E. Swartzman

The increasing competition from oil and gas, aided by a generally milder winter, resulted in further reverses for the Canadian coal industry in 1957. Production, at 13,189,155 tons, was 11.6 per cent lower than in 1956, and 31.1 per cent below the 19,139,112-ton record of 1950. With the exception of the depression years 1931 to 1933, 1957 was the lowest production year since 1912.



Coal and Coke

Production of Coal by Provinces and Territories,[1] 1956 and 1957
(short tons)

		Bituminous	Subbituminous	Lignitic	Total
Nova Scotia	1957	5,685,770	-	-	5,685,770
	1956	5,775,025	-	-	5,775,025
New Brunswick	1957	976,597	-	-	976,597
	1956	988,266	-	-	988,266
Saskatchewan	1957	-	-	2,248,812	2,248,812
	1956	-	-	2,341,641	2,341,641
Alberta	1957	1,266,945[2]	1,889,601	-	3,156,546
	1956	2,064,405[2]	2,264,382	-	4,328,787
British Columbia and Yukon	1957	1,121,430[3]	-	-	1,121,430
	1956	1,481,891[4]	-	-	1,481,891
Total	1957	9,050,742	1,889,601	2,248,812	13,189,155
	1956	10,309,587	2,264,382	2,341,641	14,915,610
Value $	1957	76,631,638	9,191,001	4,398,031	90,220,670
	1956	80,284,374	10,745,222	4,320,167	95,349,763

(1) Coals classed according to "ASTM Classification of Coal by Rank - ASTM Designation D388-38", ASTM Standards on Coal and Coke.

(2) Includes a small amount of semi-anthracite from the Cascade area.

(3) 7,731 tons from Yukon.

(4) 9,372 tons from Yukon.

Nova Scotia contributed about 43 per cent of the total, Alberta 24, Saskatchewan 17, British Columbia and Yukon over 8 and New Brunswick just over 7. Every province showed a decrease in production. Whereas Nova Scotia, New Brunswick, Saskatchewan, British Columbia and Yukon showed, collectively, a decrease amounting to almost 6 per cent of their 1956 production, Alberta's output decreased by 27 per cent, bituminous coal accounting for 68 per cent of the Alberta decrease. The Maritime Provinces showed the smallest change with a decrease of only 1.5 per cent. For the country as a whole, the production of bituminous coal decreased by about 12 per cent, of subbituminous coal by about 16.5 per cent and of lignite by about 4 per cent.

In 1957 strip mines produced almost 35 per cent of the coal turned out; in 1956 they produced 37 per cent. Most of the decrease was in production from British Columbia, where strip-coal output, which amounted to more than 25 per cent of the provincial total in 1956, dropped to about 15 per cent in 1957.

Production of Coal by Type of Mining, 1957

		Short Tons	%
Nova Scotia	Strip mines	-	-
	Underground	5,685,770	100.0
New Brunswick	Strip mines	787,437	80.6
	Underground	189,160	19.4
Saskatchewan	Strip mines	2,248,789	100.0
	Underground	23	-
Alberta	Strip mines	1,385,972	43.9
	Underground	1,770,574	56.1
British Columbia and Yukon	Strip mines	164,599	14.7
	Underground	956,831	85.3
Canada	Strip mines	4,586,797	34.8
	Underground	8,602,358	65.2

Output per Man-day

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 a slight increase in output per man-day, strip mining showing an increase of 7.5 per cent and underground mining 3.6 per cent. Underground mining continues to show a steady increase in productivity per man-day, reflecting the influence of increasing and improved mechanization, especially in Nova Scotia, where the output per man-day increased from 1.970 tons in 1947 to about 2.944 in 1957.

Average Output of Coal per Man-day for Canada, 1956 and 1957
(short tons)

	1957	1956
Strip mines	14.307	13.340
Underground	2.885	2.780
All mines	3.994	3.932

Coal-producing Areas* **

Nova Scotia and New Brunswick

Nova Scotia produces high- and medium-volatile bituminous coking coals in the Sydney, Cumberland and Pictou areas and some non-coking 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 1957, 2,420,446 tons, approximately 36 per cent of the output, were shipped to central Canada for commercial and railway use; shipments of this kind in 1956 amounted to 2,564,660 tons. Of this, 98 per cent originated in Nova Scotia.

* 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.

** See map on page 442.

Saskatchewan

Only lignite is produced, chiefly from the Bienfait and Roche Percee fields in the Souris area. Approximately 51 per cent of the output of 1957 was shipped to Manitoba and about 14 per cent to Ontario 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, it is expected that Saskatchewan's lignite production will continue to increase.

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 railway and industrial steam coals, but commercial and domestic markets are also supplied. Owing to the shrinking market, however, mining has terminated in the Mountain Park area and has been seriously curtailed in the Crowsnest area. In the Lethbridge, Coalspur and several other areas of the foothills, lower-rank bituminous non-coking 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 semi-anthracite, some of which was shipped as far as Quebec, where it competes with imported anthracitic coals.

Only about 2.2 per cent of Alberta's output of coal in 1957 was shipped to central Canada, mainly for commercial use. About 7.8 per cent, consisting largely of subbituminous coal, was shipped to Manitoba, 21.5 per cent to Saskatchewan and 21.4 per cent to British Columbia, for industrial steam-raising and household use.

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 manufacutre of metallurgical coke. A

(text continued on page 444)

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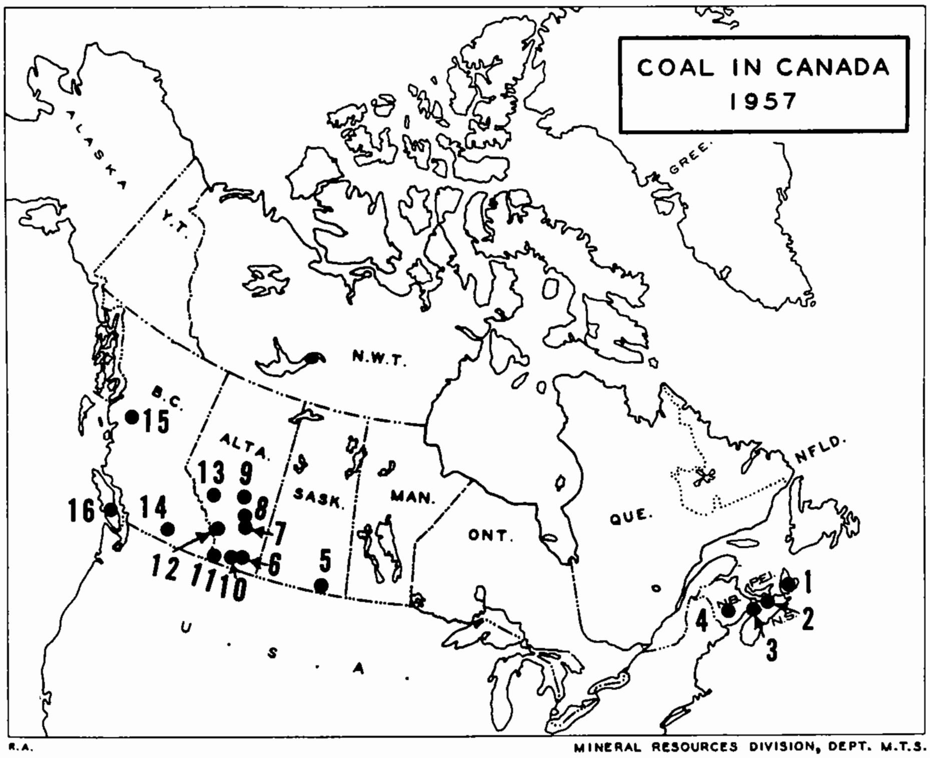


Coal Areas and Principal Producers

Nova Scotia

1. Sydney and Inverness* Areas (high-volatile bituminous)

    Dominion Coal Co. Ltd.
    Beaver Coal Co. Ltd.
    Bras d'Or Coal Co. Ltd.
    Four Star Collieries Ltd.
    Indian Cove Coal Co. Ltd.
    Old Sydney Collieries Ltd.
    *S.J. Doucet & Sons Ltd.
    *Evans' Coal Mines Ltd.
    *Margaree Steamship Co. Ltd.

2. pictou Area (medium- and high-volatile bituminous)

    Acadia Coal Co. Ltd.
    Drummond Coal Ltd.
    Greenwood Coal Co. Ltd.

3. Springhill and Joggins* Areas (high-volatile bituminous)

    Cumberland Railway and Coal Co.
    *Joggins Coal Co. Ltd.

New Brunswick

4. Minto Area (high-volatile bituminous)

    Avon Coal Co. Ltd.
    Crawford Contractors Ltd.
    King Mining Co. Ltd.
    Mills Ltd., D.W. & R.A.
    Miramichi Lumber Co. Ltd.
    Newcastle Coal Co. Ltd.
    Wasson Ltd., A.W.

Saskatchewan

5. Souris Valley Areas (lignite)

   Manitoba & Saskatchewan Coal Co. Ltd.
   North West Coal Co. Ltd.
   Western Dominion Coal Mines Ltd.

Alberta

6. Brooks and Taber Areas* (subbituminous)

   Kleenbirn Collieries Ltd.
   *Alberta Coal Sales Ltd.

7. Drumheller, Sheerness* and Carbon** Areas (subbituminous)

   Amalgamated Coals Ltd.
   Brilliant Coal Co. Ltd.
   Century Coals Ltd.
   Federated Co-ops Ltd.
   Midland Coal Mining Co.
   Murray Collieries Ltd.
   Red Deer Valley Coal Co. Ltd.
   *Lehigh Coal Co. Ltd.
   *Western Dominion Coal Mines Ltd.
   **McArthur, A.A.

8. Castor, Ardley* and Camrose** Areas (subbituminous)

   Battle River Coal Co. Ltd.
   Forrestburg Collieries Ltd.
   *Allyn Mann Construction Co.
   *Lynass, John H.
   **Camrose Collieries Ltd.

9. Edmonton, Tofield* and Pembina** Areas (subbituminous)

   Egg Lake Coal Co. Ltd.
   Starky Co. Ltd., J.B.
   Sundance Mines Ltd.
   White Mud Creek Coal Co. Ltd.
   *Black Nugget Coal Co. Ltd., The
   **Alberta Coal Co. Ltd.

10. Lethbridge Area (high-volatile bituminous)

    Lethbridge Collieries Ltd.

11. Crowsnest Area (medium-volatile bituminous)

    Coleman Collieries Ltd.
    West Canadian Collieries Ltd.
    Crow's Nest Pass Coal Co. Ltd., The

12. Cascade Area (low-volatile bituminous and semi-anthracite)

    Canmore Mines Ltd., The

13. Coalspur Area (high-volatile bituminous)

    Canadian Collieries Resources Ltd.

British Columbia

14. Nicola - Princeton Area (subbituminous)

    Mullin's Strip Mine Ltd.

15. Northern Area (medium- and high-volatile bituminous)

    Bulkley Valley Collieries Ltd.

16. Vancouver Island Area (high-volatile bituminous)

    Canadian Collieries Resources Ltd.

briquetting plant that started operating in 1953 produced just over 84,000 tons of railway briquettes in 1957. 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. More than 19 per cent of the total production was shipped to Manitoba and about 7.8 per cent to Ontario.

Beneficiation

The 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 first mechanical coal-cleaning plant for washing 2 x 0 inch slack, established in 1955 in the Minto area of New Brunswick, a second coal-cleaning plant to clean 6 x 1/4 inch coal was completed in that area in 1957. These two plants make possible the cleaning of more than 34 per cent of the output of New Brunswick, Both plants are equipped with modern mechanical and thermal drying machines.

In Nova Scotia, 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, but the plant has not yet been established. When it is completed, it will be possible to clean more than 80 per cent of the coal mined in the province. One of the smaller operating companies continued to conduct experiments, aided by the Mines Branch, to determine the system of mechanical cleaning most suited to its conditions, especially in relation to the grade of coal produced by continuous mechanical mining. In this regard it should be noted that increasing use is being made of the'Dosco Miner', a continuous mechanical miner of the ripper type, in the Sydney area and that one of the smaller mines is using a boring-type miner.

A major problem continues to be the beneficiation of fines with a view to preparing a product with a uniform and satisfactory ash content that will find greater acceptance in the household and industrial markets. To this end additional equipment has been installed at certain western collieries for the cleaning and drying of fines.

To aid the industry in various beneficiation problems, the Mines Branch co-operated during the year with industrial organizations in conducting laboratory- and plant-scale tests on coal-cleaning and the use of fine coal in compounded agglomerates as a reducing agent in the smelting of minerals. The Branch also studied the effects of continuous mechanical mining on the size distribution and cleaning characteristics of Nova Scotia coals. It conducted investigations on a continuing basis on the coking properties of various Canadian coals in relation to special preparation for export and use in prospective steel-industry developments.

Consumption

Briquettes

Briquettes available for consumption decreased sharply from 879,208 tons in 1956 to 467,825 tons in 1957. About 61 per cent of the amount marketed in Canada (about 73 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 53.7 per cent - from 620,000 tons in 1956 to 287,000 tons in 1957. The Saskatchewan output remained almost constant at 40,935 tons. These briquettes, used almost entirely for household and commercial purposes, are made from carbonized lignite. About 23 per cent of the 269,147 tons manufactured in Alberta was prepared from semi-anthracite coal in the Cascade area and the remainder from medium-volatile bituminous coals in the Crowsnest area. In British Columbia, railway briquettes amounting to 84,437 tons, an output more than 55 per cent below that of 1956, were prepared from medium-volatile bituminous coal in the East Kootenay (Crowsnest) area.

Imports of briquettes from the United States in 1957 were 53,418 tons less than in 1956, amounting to 73,306 tons. These briquettes, used almost entirely for household and commercial purposes, are made from low-volatile bituminous coals and from anthracite.

Household and commercial consumption increased from 159,208 tons in 1956 to 180,768 tons in 1957 despite increased competition from oil and gas.

Consumption of Canadian and Imported Coal, 1952-57

	Canadian Coal(1)		Imported Coal(2)		
	Short Tons	% of Consumption	Short Tons	% of Consumption	Total
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	19,037,493	60.4	31,516,119

(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 ex-warehoused for ships' stores. Imports of briquettes are not included.

Coal and Coke

Imports of Coal for Consumption,(1) 1956 and 1957
(short tons)

Country of Origin		Anthracite	Bituminous	Total
United States	1957	1,790,827	17,193,023(2)	18,983,850
	1956	2,392,378	19,779,831(3)	22,172,209
United Kingdom	1957	134,671	-	134,671
	1956	153,249	155	153,404
Total	1957	1,925,498	17,193,023	19,118,521
	1956	2,545,627	19,779,986	22,325,613
Value $	1957	24,605,035	91,641,107	116,246,142
	1956	30,060,480	98,107,953	128,168,433

(1) From Trade of Canada; includes briquettes but does not include coal imported and subsequently sold for use on board ships.
(2) Includes 2,116 tons of lignite and 73,306 tons of briquettes.
(3) Includes 1,940 tons of lignite and 126,724 tons of briquettes.

Exports of Coal, 1956 and 1957
(short tons)

Destination	1957	1956
United States	351,024*	339,893*
Japan	29,976	-
St. Pierre and Miquelon	15,311	10,086
United Kingdom	-	240,137
West Germany	-	4,050
Total	396,311	594,166
Value $	3,357,959	4,710,030

* Includes a small quantity to Alaska.

Consumption of Fuels for Domestic and Building Heating, 1947-57

	Fuel Oil and Distillate(1)	Natural Gas(2)	Manufactured Gas(2)	Coal and Coke(3)
	(bbl)	(M cu ft)	(M cu ft)	(short tons)
1947	16,273,423	28,198,903	20,525,540	13,117,157
1948	17,036,106	30,824,172	21,570,466	13,429,436
1949	18,733,890	32,164,544	23,864,281	12,473,258
1950	24,669,930	40,004,435	20,363,572	12,653,394
1951	29,787,032	43,048,025	24,072,327	11,436,717
1952	34,863,926	43,328,304	22,527,092	10,515,475
1953	38,585,104	46,390,654	21,418,959	8,941,428
1954	46,808,256	56,864,148	22,090,283	8,599,993
1955	52,861,644	68,591,360	15,742,947	8,283,432
1956	61,276,831	77,937,257	16,392,636	8,048,673
1957	63,170,085	92,217,497	13,478,976	6,952,821

(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.

Relation of Fuel Consumed by Railway Locomotives to Gross Ton Miles of Traffic,(a) 1946-57

	Traffic in Millions of Gross Ton Miles(b)	Coal and Oil Consumed in Terms of Thousands of Tons of Coal(c)	Fuel Consumed in Terms of Tons Coal per Million Gross Ton Miles Traffic	Oil Consumed as Percentage of Total Fuel
1946	128,311.9	12,192	95.0	4.6
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

(a) Railway Transport, Dominion Bureau of Statistics.

(b) Freight-train cars plus passenger-train cars, exclusive of locomotives and tenders.

(c) 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.

87875-1—30

Fuel Consumed by Railway Locomotives, 1943–57

	Coal(1) (thousands of tons)	Fuel and Diesel Oil(1) (millions imperial gallons)	Estimated Heat Equivalent of Oil in Terms of Coal(2) (thousands of tons)	Estimated Heat Equivalent of Oil as a Percentage of Total Coal and Oil
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
1945	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*	291.9	1,990.2	16.9
1953	8,323*	308.2	2,101.3	20.2
1954	6,502*	326.6	2,226.8	25.5
1955	5,587*	384.6	2,622.2	31.9
1956	5,587*	444.6	3,031.3	35.2
1957	3,322*	419.4	2,859.5	46.3

(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.
* Inclusive of railway briquettes.

Value of Canadian Coals

The average value of Canadian coal f.o.b. mines continued to rise. In 1957 it was $6.84 a ton; in 1956 it was $6.40. Imported coal also increased in value from $5.74 in 1956 to $6.08 in 1957. This increase in the value of Canadian and imported coal to some extent counteracts the previous decrease in costs resulting from more intensive and improved mechanical mining and preparation.

Comparative Value of Canadian Coals, 1956[1] and 1957

		1956		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	13,200	8.819	33.41	9.300	35.23
New Brunswick					
Bituminous	11,980	8.085	33.74	8.386	35.00
Saskatchewan					
Lignite	7,920	1.845	11.65	1.956	12.35
Alberta					
Bituminous	12,100	6.069	25.08	6.466	26.72
Subbituminous	9,130	4.745	25.99	4.864	26.64
British Columbia					
Bituminous	13,700	5.924	21.62	6.537	23.86
Yukon					
Bituminous	11,440	11.855	51.81	11.848	51.78
Canada					
Bituminous	12,930	7.787	30.11	8.467	32.74
Subbituminous	9,130	4.745	25.96	4.864	26.64
Lignite	7,920	1.845	11.65	1.956	12.35
Average	11,500	6.393	27.80	6.841	29.74

(1) The Coal Mining Industry - 1956. Dominion Bureau of Statistics.
(2) These values are calculated on the basis of the 1956 production for the various mines.

87875-1—30½

Movement of Coal under Subvention

Coal Moved under Subvention, 1956 and 1957
(short tons)

Origin of Coal	1956	1957
Nova Scotia	2,543,302	2,372,678
New Brunswick	21,358	47,768
Saskatchewan	247,814	320,500
Alberta and British Columbia	783,518	480,734
Total	3,595,992	3,221,680

Source: Statistics from Dominion Coal Board.

COKE

by
E.J. Burrough
Fuels Division

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 non-ferrous 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 use as domestic fuel.

Coke - Production and Trade

	1957		1956	
	Short Tons	$	Short Tons	$
Production				
From bituminous coal				
Ontario	2,948,497	43,919,104	3,094,784	46,454,399
Nova Scotia, New Brunswick, Quebec and Newfoundland	979,925	16,911,795	931,113	15,155,722
Manitoba, Saskatchewan, Alberta and British Columbia	190,778	2,611,557	305,319	3,767,573
Total	4,119,200	63,442,456	4,331,216	65,377,694
Of pitch coke	5,395	128,303	8,089	203,078
Of petroleum coke	273,296	3,668,318	270,905	3,099,677
Total	4,397,891	67,239,077	4,610,210	68,680,449
Bituminous coal used to make coke				
Imported	4,667,809		4,813,850	
Canadian	1,052,516		1,114,648	
Total	5,720,325		5,928,498	
Imports (all types)				
United States	1,077,325	17,010,356	943,312	13,200,283
United Kingdom	64	2,166	27	956
Total	1,077,389	17,012,522	943,339	13,201,239
Exports (all types)				
United States	126,021	1,668,902	134,479	1,529,132
United Kingdom	14,682	661,468	14,633	571,205
Other countries	17,595	757,794	10,555	378,541
Total	158,298	3,088,164	159,667	2,478,878

Coal and Coke

The advent of western natural gas into the industrial centres of Ontario and Quebec, now in progress, 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 non-ferrous 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; Montreal Coke & Manufacturing Company, at Ville La Salle, Quebec, with rated annual capacity of 656,000 tons of coal (the company normally produces domestic coke and also supplies Montreal with gas); Algoma Steel Corporation, Limited, with a metallurgical-coke plant at Sault Ste. Marie, Ontario, which has a rated annual capacity of 2 million tons of coal; Hamilton By-Product Coke Ovens Limited, at Hamilton, Ontario, with a rated annual capacity of 415,000 tons of coal; Dominion Steel Foundries Limited, with an annual capacity of 540,000 tons of coal; and The Steel Company of Canada Limited, at Hamilton, with a rated capacity of 1,470,000 tons of coal a year.

Photo: 50170, George Hunter

The British American Oil Company Limited, sulphur plant, Pincher Creek, Alberta.

NATURAL GAS

by
R.A. Simpson

Developments in the natural-gas industry in 1957 were related principally to the construction of pipelines which will carry western Canada natural gas to centres in every province except the Maritimes and Newfoundland. The nation's first major gas-transmission line, which runs from northeastern British Columbia to Vancouver and the Canada-United States border, was completed. The second major line, the one that runs from Alberta to eastern Canada, was about half completed. When fully utilized these lines will almost triple the present production of natural gas in British Columbia and Alberta and benefit many sectors of the Canadian economy. Proved reserves totalling about 24 trillion* cubic feet of gas exist in western Canada.

The natural-gas industry in Canada has a long history, but as shown in the chart on page 457, which covers marketed production from 1926 to 1957, annual increases were small until recent years. Production in 1957, exclusive of field waste, reached 220,006,682 M cubic feet, 30 per cent more than in 1956. It was valued at $20,962,501. Alberta provided 83.2 per cent of the production, Ontario 6.5 per cent, Saskatchewan 6.4 per cent and British Columbia 3.8 per cent. The remainder was from New Brunswick and the Northwest Territories. Beginning in 1959, when both major transmission lines will be linked for the full year to distribution systems in major consuming centres, there will be a marked rise in production.

Developments and Production by Provinces**

British Columbia

Although exploration for natural gas in northeastern British Columbia was carried out in the early 1920s and the early 1940s, it was not until 1948 that a large-scale program got under way. In 1952 the highly successful Pacific Fort St. John No. 4 well found large quantities of gas in the Lower Cretaceous (Cadomin), in three Triassic zones and in the Permo-Pennsylvanian, and established the Peace River district as an important natural-gas region. Stratigraphic and structural conditions in thick sedimentary sequences throughout the 30-million-acre basin lying east of the Rocky Mountains give much promise of major gas reserves, which have been estimated at approximately 2 trillion cubic feet. Zones in sedimentary beds of all ages down to and including those of the Devonian have been indicated as potential gas sources. The Fort St. John gas field has the largest reserves in British Columbia. Other fields developed to date are within 75 miles of Fort St. John. Exploration is reaching farther

* 1 trillion = 1,000,000,000,000.

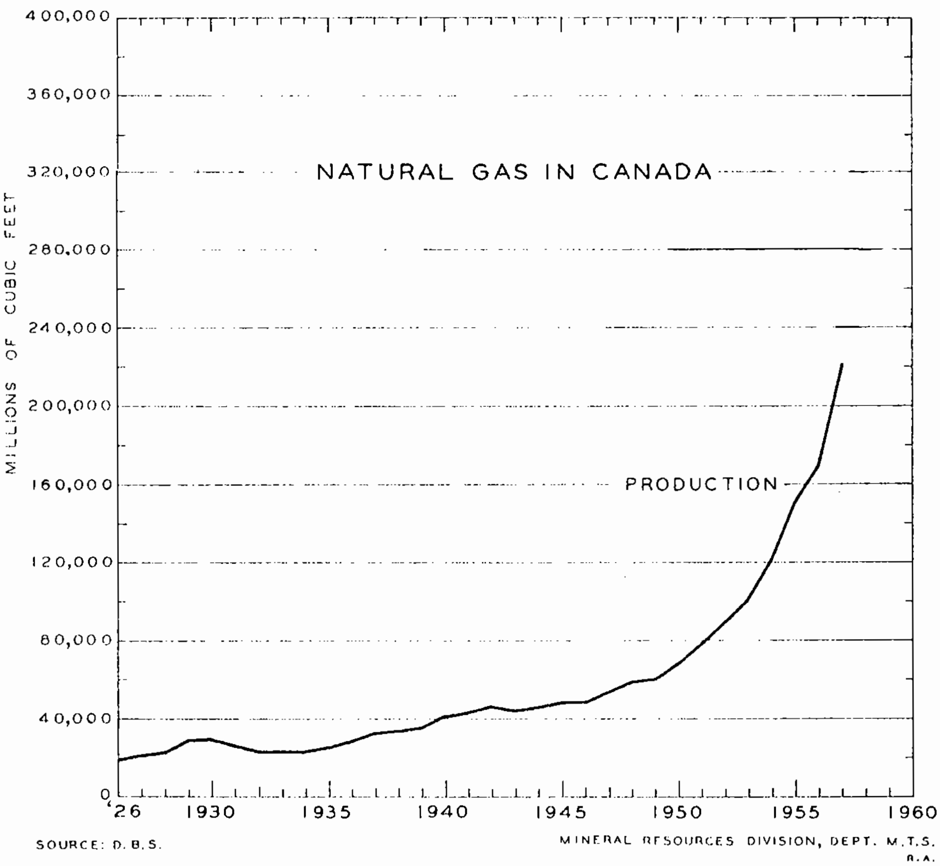
** See map on page 459.

Natural Gas

Natural Gas - Production

	1957		1956	
	M. Cu. Ft.	$	M. Cu. Ft.	$
Alberta(1)				
Turner Valley.....	27,395,127		29,789,073	
Jumping Pound....	21,880,534		17,128,767	
Leduc-Woodbend ..	12,908,849		13,691,054	
Pincher Creek	12,864,228		(2)	
Bonnie Glen.......	6,639,250		7,695,331	
Morinville........	2,901,513		(2)	
Others...........	98,551,319		77,829,668	
Total............	183,140,820	13,735,562	146,133,893	10,960,042
Ontario...........	14,400,913	5,328,338	12,811,618	4,740,298
Saskatchewan				
Coleville-Smiley ..	10,326,062		8,495,896	
Steelman	8,370,961		(2)	
Cantuar..........	3,122,210		(2)	
Success	1,735,788		1,579,823	
Nottingham	1,222,922		(2)	
Brock	1,027,304		1,187,170	
Others	7,754,579		8,412,762	
Total	33,559,826		19,675,651	
Waste...........	19,565,479		9,867,954	
Net production	13,994,347	1,368,647	9,807,697	980,770
British Columbia				
Fort St. John	4,399,856		(2)	
Southeast Fort St. John	1,910,729		(2)	
West Buick Creek .	630,756		(2)	
Kiskatinaw	623,544		(2)	
Montney..........	542,968		(2)	
West Kiskatinaw...	167,089		(2)	
Total.............	8,274,942	366,867	187,846	20,193
New Brunswick				
Stony Creek.......	176,417	156,641	190,322	141,315
Northwest Territories				
Norman Wells	19,243	6,446	21,210	6,938
Canada (total).......	220,006,682	20,962,501	169,152,586	16,849,556

(1) Production figures represent total production less field waste.
(2) The figure comparable with that of 1957 is not available.



afield, but because of ground conditions it is confined mainly to the general area of the Alaska Highway. At the end of 1957, exploration companies held 29,467,028 acres of land in British Columbia, 90 per cent being in the Peace River district. Other areas attracting attention were the Queen Charlotte Islands and Fernie, each with about 4 per cent of the acreage held for exploration.

Twenty-four successful exploratory wells were drilled during 1957. Of these 11 were new-field wildcats, one was a new-pool wildcat, one a shallower-pool test and one a deeper-pool test, and 10 were outpost wells. Although one successful discovery well was almost 185 miles from Fort St. John, most were drilled within 75 miles northwest of this town. As a result of the year's exploratory drilling in British Columbia, the West Blueberry and Highway fields were extended and the Dawson Creek field was discovered. Production from this field is from the Cadotte of Lower Cretaceous age. In addition, a second well was completed in the mid-Devonian south of Fort Nelson and supported previous evidence that formations of this age in the area are favourable.

Development drilling was concentrated in the West Buick Creek field, and seven wells were completed. Five were in the Nikanassin formation of Jurassic age and one each was in the Triassic 'A' and 'D' horizons. Three development wells were completed in the Fort St. John field and two in the newly discovered Dawson Creek field.

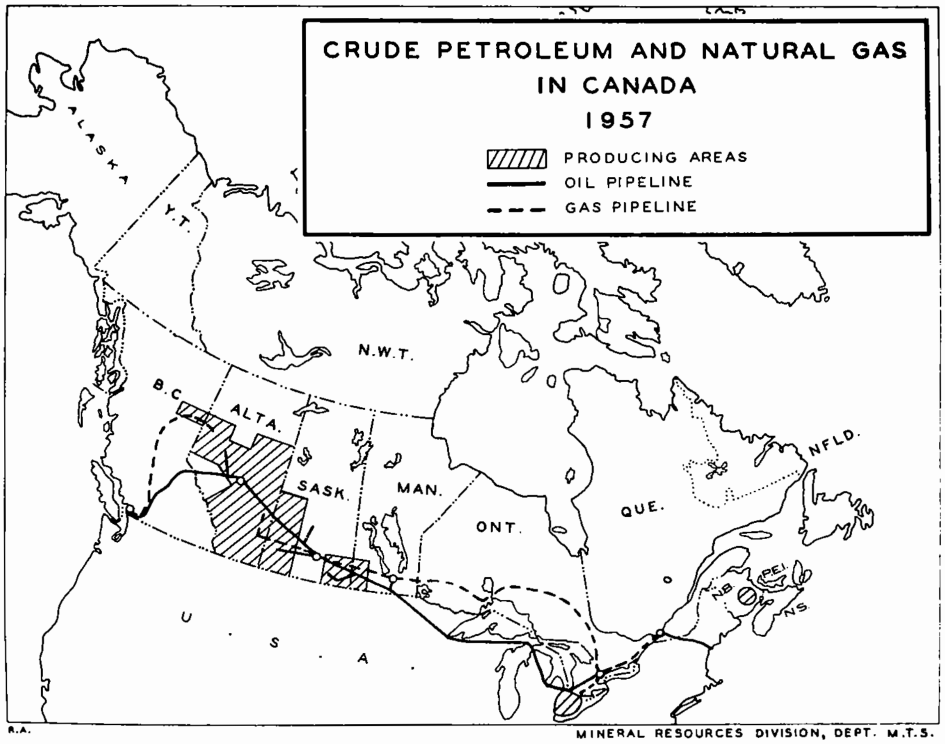
Geophysical survey work totalled 148 crew-months, all of it seismic, while surface geological mapping added 35 crew-months of field activity to the total. Twenty-six drilling rigs, or 12.4 per cent of all rigs in operation in western Canada, were in operation at the end of the year.

Natural-gas production in British Columbia was officially recorded for the first time in 1956, although there has been minor production to supply local needs since 1954. A total of 8,274,942 M cubic feet was produced in 1957, but 7,686,575 M cubic feet were recovered during the last two months of the year, when the pipeline of Westcoast Transmission Company Limited began taking deliveries of British Columbia natural gas. Output in 1958 can be expected to rise sharply.

Alberta

The history of natural-gas discovery in Alberta dates from 1883, when gas was encountered in water-well drilling during construction of the Canadian Pacific Railway. Drilling commenced in the Medicine Hat area in 1890 and by 1921 the availability of large supplies of natural gas was attracting industry to that town. In the same year a 174-mile gas line was built from the nearby Bow Island gas field to Calgary. This was one of the earliest long-distance gas transmission lines in North America. The discovery of the Turner Valley field in 1914 was the next major event, and in 1924 the famous Royalite No. 4 naphtha producer was introduced into that field. In the Edmonton area natural gas was first discovered in 1914 near the town of Viking, 75 miles southeast of the city, and in 1923 gas supply to Edmonton was established. From these early discoveries and small pipeline systems a province-wide distribution has grown up. Alberta's natural-gas resources, now more than adequate to meet provincial demands for the foreseeable future, will shortly supply a transmission and distribution system reaching as far east as Montreal.

Alberta's recovered production in 1957 continued at record levels, amounting to 183,140,820 M cubic feet from all fields, or 25 per cent more than in 1956. Almost one third of the increase was attributable to exports via the Westcoast and Trans-Canada pipelines, which began taking significant quantities of gas late in the year. The remainder was due to continued build-up in provincial marketing, which resulted largely from an even greater rate of gas-reserve growth.



Disposable reserves of natural gas in Alberta were placed at 21,100 billion* cubic feet in 1957; they were at 20,500 billion cubic feet at the end of 1956.

Initial gas-well completions were below those of 1956 and more emphasis was placed on exploratory drilling. This was in accordance with developments during the year, which were highlighted by requests to the Oil and Gas Conservation Board for permission to export large quantities of Alberta natural gas via proposed new pipelines. Exploratory drilling increased by 20 per cent over the 1956 total while development drilling declined by more than 34 per cent. These figures include wells drilled for oil as well as for gas. The following table shows the number of successful gas wells drilled since 1954 by type and by year.

	1957	1956	1955	1954
Successful exploratory gas wells	52	59	68	55
Successful outpost gas wells	18	15	9	15
Successful development gas wells	55	64	61	70
Total	125	138	138	140

* 1 billion = 1,000,000,000.

Natural Gas

At the end of 1957 Alberta had 584 gas wells capable of production and 766 capped gas wells. In 1956, gas wells available for immediate production totalled 523 and there were 713 capped gas wells. Many of the 8,015 oil wells also yield gas, and in 1957 they produced 55 per cent of Alberta's natural-gas production. The proportion supplied incidental to oil production has been steadily declining while that supplied from gas fields has been steadily rising. This trend will continue as markets for gas are developed, and the emphasis will shift from primary gas areas to oil fields.

The successful exploratory wells drilled during the year in further preparation for large markets in the immediate future were widely distributed throughout the province although there were several areas where successful explorations were concentrated. At least 11 successful exploratory wells were completed adjacent to the pipeline of the Alberta Gas Trunk Line Company Limited, which runs north to the Provost field, and three were completed adjacent to the southern route of the line. Three successful exploratory wells were completed near the British Columbia border, where Westcoast Transmission Company draws its Alberta gas. Nine completed gas exploratory wells were drilled in the Kaybob area and six in the Virginia Hills-Swan Hills region. Considerable activity was concentrated near Whitecourt, where three gas exploratory wells were successful.

The discoveries made in formations of Lower Cretaceous age were the most numerous and accounted for almost 57 per cent of the successes. Mississippian and Devonian discoveries accounted for most of the remainder.

Two wells drilled in the southwestern part of the province adjacent to the mountain front west of the Pincher Creek field in the Waterton Lakes area found significant gas in formations of Mississippian. Discoveries in the Whitecourt area indicated the presence of a large gas field. Of the exploratory successes, 10 wells indicated immediate reserves of 10 billion cubic feet or more.

The year's exploratory program thus illustrates the widespread geographical and geological distribution of natural-gas occurrences. The areas of deep sediments in the western and northwestern parts of Alberta attracted the largest proportion of exploratory effort in 1957 and the results obtained give great promise of very large ultimate reserves. In the plains region of the eastern half of the province more shallow drilling has also developed large reserves. In the past, exploration in the foothills and the adjacent deep Alberta basin has resulted in the discovery of the Pincher Creek, Savanna Creek, Jumping Pound, Sarcee, Harmatton-Elkton, Homeglen-Rimbey, Windfall, Chinook Ridge and other fields; on the east side, the Princess, Bindloss, Cessford, Provost, Drumheller and Nevis fields have been the more important finds. Some of the latter group of fields have served as initial sources for the

Trans-Canada pipeline, and the foothills fields are to be linked to the system as markets grow.

Development drilling, although not as active as in the previous year, extended many of these gas fields. Forty-five successful development wells were completed, considerable emphasis being given to fields on the east side of the province.

At the end of the year Alberta had almost 69 per cent of all the active drilling rigs in western Canada. Survey work during the year amounted to 903 crew-months of seismic exploration and 41 crew-months of gravity work, while geological surface parties worked 72 crew-months. At the end of the year 65 per cent of all seismic crews in western Canada were in Alberta.

Saskatchewan

The first natural-gas discovery of significance in Saskatchewan was made in the Lloydminster field in 1934, when production was obtained from a Lower Cretaceous sand. The fields which contain the bulk of Saskatchewan's natural gas were not discovered until the 1950s. The Coleville-Smiley field has the largest reserves; this field and the Hatton, the Hoosier and the Cantuar fields contained 88 per cent of Saskatchewan's 516 million M cubic feet of natural gas reserves at the end of 1957. Gas-bearing formations are predominantly Cretaceous in age.

All gas fields are on the west side of the province although the recent prolific oil-field discoveries of the southeast area constitute important gas sources. During the year preparations were begun to construct a gas-processing plant at Steelman, in this area. It will process casinghead gas from the Steelman, Lampman, Kingsford, Frobisher, Alida, Nottingham, Hastings, Carnduff, Alameda and Glen Ewen oil fields.

Half of the 70 per cent increase in production in Saskatchewan in 1957 resulted from increases in output from the Steelman field and one quarter from increased production in the Cantuar and Hoosier fields on the western side of the province.

Five discoveries of natural gas were made in Saskatchewan during 1957 - four in the Coleville-Smiley area and one in the Cantuar area.

Development drilling resulted in 11 successful completions, nine of these being close to the Coleville-Smiley field and two near the Cantuar field. At the end of the year Saskatchewan had 172 gas wells capable of production, but only 70 were producing. The rapid progress being made in construction of a province-wide gas distribution system will result in a greater utilization of provincial reserves. Exploration results to date, however, indicate that Saskatchewan will, over the long term, be dependent to a considerable degree on gas from Alberta.

Natural Gas

Thirty-five drilling rigs were in operation at the end of the year; at the end of 1956 there were 61 in operation, this number being about 18 per cent of those operating in western Canada. Survey activity was concentrated, as elsewhere, in seismic work, which accounted for 245 crew-months of the total of 268. Emphasis is primarily on oil exploration in southeastern Saskatchewan.

Manitoba

Oil was being produced from 12 fields and several individual-well areas, but there is no recovery of gas. About 90 per cent of the oil production comes from the North Virden-Scallion, Virden-Roselea and Daly fields in the vicinity of the town of Virden near the Saskatchewan border. Manitoba's oil fields have no associated gas caps and the gas saturation is relatively low. The small amount of gas released at the well-head is flared.

Manitoba will continue to rely on natural gas from Alberta to supply its town distribution systems.

Northwest Territories and Yukon

The only natural-gas production in the territories is that derived from the Norman Wells oil field, in the Northwest Territories, discovered in 1920. This field is on the Mackenzie River, 90 miles south of the Arctic Circle. Natural-gas production never exceeded 1, 500 M cubic feet annually until 1948, when it increased. It has since ranged between 18, 000 and 30, 000 M cubic feet.

A development well was drilled in 1957 to test a gas discovery of 1955 about 75 miles west of the southern tip of Great Slave Lake. Three other wells in the same area were dry. All drilling activity in the territories was completed during the first two months of the year. Seismic survey work, all carried out during the first five months, totalled 15 crew-months. Surface geology work totalled 47 crew-months.

At the end of the year there were two capped gas wells in the Northwest Territories; 62 wells were capable of producing oil and gas but only 19 were on production.

Ontario

The production increases of recent years reflect the continuing success of exploratory and development programs being carried out in the relatively restricted area of southwestern Ontario. Moreover, the local producing industry shows signs of continuing its gradual upward trend for some time to come. Production in 1957 was, however, only about 43 per cent of provincial demand, which will rise rapidly as the present large-scale laying of distribution lines is completed throughout the more populated areas.

During 1957 the number of gas-well completions and the total footage drilled set an all-time record for Ontario. Eight successful exploratory gas wells were drilled. Exploratory work was concentrated in Kent, Lambton, Elgin, Middlesex, Essex, Manitoulin and Huron counties, which are given here in descending order of the number of exploratory wells drilled. The average depth of all exploratory wells was 1,438 feet.

Development-drilling programs resulted in 154 successful gas wells. Norfolk county had 87, Haldimand 20, Welland 16 and Kent 14. The remaining 17 were in eight other counties.

Quebec

Although there has been no recorded natural-gas production in Quebec, exploratory activities date from 1865, when drilling was initiated in the Gaspé peninsula. Early drilling was also carried out in the St. Lawrence River valley, and since the early 1880s small gas flows from a number of shallow wells have been used by the Lowlands farmers.

In recent years a systematic exploratory program has been carried out in the 10,000 square miles of the St. Lawrence Lowlands between Montreal and Quebec. In 1957 drilling operations were conducted by eight companies. One well was completed at a depth of 2,198 feet in the Batiscan 'field' and a second is listed as successful because of indications of gas from several horizons.

Proximity to large markets and ease of access in exploration are incentives to continuing the exploration programs which were recently accelerated.

New Brunswick

The history of the oil and gas industries in New Brunswick dates back to 1859, when interest was first aroused in an area east of the Petitcodiac River. Over the years sporadic drilling proved unsuccessful and it was not until 1910 that the Stony Creek field was discovered on the west side of the Petitcodiac River. By 1912 natural gas was being delivered to Moncton by pipeline. For many years gas production was about 650,000 M cubic feet annually, but in recent years it has gradually dropped to about 145,000 M cubic feet. This is the only locality of oil or gas production in Canada east of Ontario and about 85 per cent of the value of its output has been derived from natural-gas sales.

During 1957 one small gas well was drilled in the Stony Creek field. At the end of the year there were 66 producing wells in the field, 47 being classified as gas and 19 as oil wells.

Pipeline Transportation

Trans-Canada Pipe Lines Limited

Completion of arrangements in 1956 for the transportation of natural gas from Alberta to eastern Canada represented the final phase of resource development and marketing negotiations which were under way as early as 1950. In that year the two predecessors of Trans-Canada Pipe Lines Limited placed applications before The Petroleum and Natural Gas Conservation Board of Alberta for permission to remove natural gas from the province. Late in 1953 the Government of the Province of Alberta declared a surplus of gas for use outside the province. In January 1954 the two principal contenders combined to form Trans-Canada Pipe Lines Limited and attempts to obtain adequate supply and marketing contracts and financial backing were actively commenced by the new company. However, it was not until June 1956 that financing arrangements were sufficiently advanced to permit a start on construction of the $370 million pipeline to Ontario and Quebec.

The steps leading to final approval of the project included an agreement reached in November 1955 in which the federal and Ontario governments undertook to construct, at a cost of $120 million, a 675-mile section in northern Ontario from the Manitoba border to Kapuskasing. For this purpose a Crown company, Northern Ontario Pipe Line Crown Corporation, was organized. Inasmuch as this assistance did not enable Trans-Canada to complete its financing, provision was made in June 1956 for a short-term federal loan to permit commencement of construction on the western section. By April of that year all government permit requirements had been complied with and all gas-purchase contracts and the principal Canadian sales contracts were in order. Construction was started in July and by year-end 218 miles of the 586-mile, 34-inch western section from Alberta to Winnipeg had been finished.

On the western portion of the line construction was continued in 1957 and by September the 34-inch section was completed. The 30-inch section eastward from Winnipeg was completed almost to the Lakehead before the weather forced construction to halt. Winnipeg was receiving natural gas in September, and before the end of the year distribution systems in Brandon, Rivers, Hamiota, Neepawa, Portage la Prairie and Kenora were being supplied with Alberta natural gas.

In southern Ontario construction was commenced on the 20-inch portion of the pipeline from Toronto to Montreal and this was completed before the year-end. Lateral lines to Ottawa and Lindsay were finished. By the end of 1957 imported natural gas was being brought to Montreal and being supplied to other communities east of Toronto along Lake Ontario and the St. Lawrence River. When the Trans-Canada line is completed in 1958, Alberta natural gas will replace the present imported supply.

Initial capacity of the line will be 300,000 M cubic feet a day. Additional compressors will be installed during the first four years of operation to raise the daily capacity to 570,000 M cubic feet, and provision is being made for an ultimate daily capacity of 780,000 M cubic feet.

Trans-Canada will initially pay 10 cents per M cubic feet for gas in the field. On the basis of a 75-per-cent load factor, average general service prices to distributors per M cubic feet would be 28.3 cents in Manitoba, 49.3 cents in southern Ontario and 52.1 cents in eastern Ontario and Montreal.

Westcoast Transmission Company Limited

Construction of this company's 650-mile, 30-inch gas pipeline from the Peace River area to a point near Vancouver was commenced in April 1956, when initial financing was completed, and by the end of that year more than 70 per cent of the line had been completed. Further financing for early expansion of the $152 million project was arranged later in the year. The company was incorporated in 1949, but it was not until November 1955 that supply and market contracts were in order and Canadian and United States government approval was obtained for this international project.

The line, which was completed on October 1, 1957, connects the producing areas of the Peace River district of British Columbia and adjacent areas in Alberta to markets in British Columbia. Near Huntingdon, British Columbia, it joins the pipeline system that serves markets in the United States.

The completed system totals 803 miles of pipe. There are 27 miles of gathering line in Alberta and 89 miles in British Columbia, both of varying diameters; a 26-inch trunk line connecting the gathering system in Alberta with the main line at Taylor, British Columbia; and the main 650-mile transmission line from Taylor to Huntingdon. Natural gas from British Columbia also enters the main line at Taylor after being treated in a processing plant at that location to remove impurities.

When the line commenced operations, deliveries were made to Inland Natural Gas Company Limited for distribution in localities in the interior of British Columbia, to British Columbia Electric Company Limited for distribution in Vancouver and the lower Fraser River valley, and to Pacific Northwest Pipeline Corporation for deliveries in the states of the Pacific Northwest. These companies continued construction of large-scale distribution facilities in their respective areas.

Westcoast's basic price to producers in the Peace River area for the first five years is 10 cents per M cubic feet and, after the initial build-up period, the sales price to British Columbia Electric and Inland Natural Gas on a 100-per-cent load-factor basis will be 30 1/2 cents per M cubic feet. Sales to Pacific Northwest Pipeline, when the volume reaches 400,000 M cubic feet daily,

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will be at the rate of 22 cents per M cubic feet under the terms of an initial contract and 25 cents, on a 90-per-cent load-factor basis, under a second contract which provides for additional deliveries by 1959. Deliveries during the first three months of operation were at the rate of 3,500,000 M cubic feet a month.

Gas Pipelines in British Columbia

British Columbia Electric Company Limited began taking supplies of natural gas in November 1956 from the United States. The company immediately began conversion of the system from manufactured to natural gas and by mid-January 1957 the conversion had been completed. At the end of 1956 the company had 925 miles of distribution lines made up chiefly of converted manufactured-gas lines and 37 miles of transmission line joining the system to the main supply terminal near Huntingdon. British Columbia Electric has franchises in 15 communities in the Fraser River valley and the West Vancouver area and during 1957 completed installation of transmission distribution lines to serve these locations. At the end of 1957 the company had 1,547 miles of pipeline, 1,491 of which were distribution lines.

In October 1957 Inland Natural Gas Company Limited completed its system to serve communities in the Cariboo, Okanagan and West Kootenay areas of British Columbia. The system consists of 377 miles of transmission lines and 370 miles of distribution lines.

Gas Pipelines in Alberta

The Alberta Gas Trunk Line Company Limited commenced construction of its gathering system within the province and by July had connected the Bindloss field to the Trans-Canada pipeline. In August the line was completed to the Provost field. At the end of the year 117 miles of 18- and 34-inch pipe was in place.

Northwestern Utilities Limited added 12 communities to its system and increased its distribution lines from 858 to 947 miles and its transmission lines from 742 to 784 miles. Canadian Western Natural Gas Company Limited added 41 miles of distribution lines and one more community to its system.

Gas Pipelines in Saskatchewan

The Saskatchewan Power Corporation, which serves all communities in Saskatchewan that have gas systems except Lone Rock and Lloydminster, continued its program to link all communities to a province-wide system. During the year Regina, Chaplin, Herbert, Morse, Kerrobert, Wilkie and St. Louis were connected and took supplies of natural gas. This, plus additions to established systems in other communities, involved the installation of 27 miles of gathering lines, 40 miles of transmission lines and 240 miles of distribution lines.

Gas Pipelines in Manitoba

In September 1957, the distribution system of Winnipeg & Central Gas Company began taking natural gas from Trans-Canada Pipe Lines Limited. At the end of the year Winnipeg & Central had 284 miles of pipeline converted to natural gas.

Gas Pipelines in Ontario

During the year pipeline construction was at a high rate. Most of the accelerated programs were undertaken when Trans-Canada negotiated for interim supplies of imported natural gas with an established gas company in Ontario and began laying sections of line to communities between Toronto and Montreal. Communities receiving natural gas as a direct result of Trans-Canada's line included Aurora, Newmarket, Lindsay, Brockville, Ottawa, Eastview, Rockcliffe, Port Hope, Cobourg, Trenton, Belleville, Napanee, Gananoque, Prescott and Cornwall. A total of 1,398 miles of pipeline was laid in the province during the year.

Natural-gas Pipeline Mileage

Natural-gas pipeline mileage by provinces, at the end of each year from 1952, is shown in the following table:

	Gathering(1)					
	1952	1953	1954	1955	1956	1957
New Brunswick	21	21	21	21	10	10
Ontario	2,303	2,326	1,959	2,046	651	660
Saskatchewan	36	115	188	474	99	126
Alberta	1,262	1,466	1,672	1,727	733	862
British Columbia.......	-	-	6	60	-	116
Total	3,622	3,928	3,846	4,328	1,493	1,774
	Transmission(2)					
	1952	1953	1954	1955	1956	1957
New Brunswick	-	-	-	-	11	11
Ontario	-	-	-	-	1,744	2,096
Manitoba	-	-	-	-	-	7
Saskatchewan	-	-	-	-	635	675
Alberta	-	-	-	-	1,651	1,698
British Columbia.......	-	-	-	-	37	1,120
Total					4,078	5,607

(table continued on next page)

Natural Gas

	Distribution					
	1952	1953	1954	1955	1956	1957
New Brunswick.....	65	65	65	65	65	65
Quebec	-	-	-	-	926	961
Ontario............	2,068	2,118	3,420	3,638	3,658	4,695
Manitoba	-	-	-	-	146	278
Saskatchewan	24	31	80	162	339	579
Alberta	1,349	1,503	1,506	1,672	1,879	2,015
British Columbia ...	-	-	5	6	925	1,861
Total..............	3,506	3,717	5,076	5,543	7,938	10,454
Total (Canada - all lines)	7,128	7,645	8,922	9,871	13,509(2)	17,835(2)

(1) Includes transmission lines for 1952-55.

(2) Does not include Trans-Canada Pipe Lines additions of 210 miles in 1956 and 1,363 miles in 1957.

Natural-gas Processing

Three new natural-gasoline plants commenced production in 1957 and at the end of the year 13 plants were in operation. All but one are in Alberta. The gas-treating plants have a total capacity of 522,000 M cubic feet a day.

Production from natural-gasoline plants in Alberta since 1950 is shown in the following table:

	Natural Gasoline (bbl)	Propane (bbl)	Butane (bbl)	Sulphur (short tons)
1957	968,162	1,111,355	747,709	100,706
1956	913,572	925,716	591,638	33,464
1955	868,416	796,482	492,051	29,093
1954	682,378	529,117	245,189	22,320
1953	602,368	433,083	198,401	18,298
1952	579,873	337,678	140,228	8,931
1951	515,027	248,554	84,527	-
1950	431,362	141,070	33,906	-

Markets for Natural Gas

Natural-gas sales in 1957 to domestic, commercial and industrial customers are summarized in the following table. Ontario accounted for 38 per cent of the increase over the sales of the previous year and Alberta, Saskatchewan and British Columbia for the remainder.

Sales of Natural Gas, 1957

	Volume (M cu. ft.)	Value ($)	Number of Customers Dec. 31, 1957
Atlantic Provinces			
Domestic	143,367	243,811	3,399
Industrial	157	257	1
Commercial	2,203	3,188	28
Total	145,727	247,256	3,428
Ontario			
Domestic	21,468,496	29,509,168	331,008
Industrial	9,856,394	8,309,925	2,853
Commercial	4,368,077	5,856,690	21,437
Total	35,692,967	43,675,783	355,298
Manitoba and Saskatchewan			
Domestic	4,475,032	3,245,589	41,049
Industrial	5,765,405	1,570,537	400
Commercial	2,047,320	1,072,354	4,066
Total	12,287,757	5,888,480	45,515
Alberta			
Domestic	32,228,228	12,373,059	158,488
Industrial	59,235,826	8,030,581	505
Commercial	22,883,175	6,300,799	16,199
Total	114,347,229	26,704,439	175,192
British Columbia			
Domestic	2,923,170	4,465,924	56,269
Industrial	527,150	442,003	36
Commercial	1,678,789	2,916,506	9,468
Total	5,129,109	7,824,433	65,773
Canada (total)			
1957	167,602,789	84,340,391	645,206
1956	143,725,649	64,652,458	514,162
1955	117,800,311	55,181,479	484,306
1952	66,005,785	27,101,680	263,268

The preceding tabulation represents gas utility sales whereas the production figures on page 2 are gross withdrawals from fields less field waste. The difference in the totals of the two tables is accounted for by the storage in Alberta fields of 17,059,234 M cubic feet and by field use and natural-gas-processing-plant use and loss, also in Alberta. Domestic supply was further augmented to the extent to which imports exceeded exports.

Exports and Imports

Exports of natural gas in 1957 amounted to 15,731,072 M cubic feet valued at $2,322,434, the two exporting companies being Canadian-Montana Pipe Line Company, which sells gas in Montana, and Westcoast Transmission Company Limited, which sells to a company that distributes gas in the states of the Pacific Northwest.

Natural-gas imports totalled 30,550,944 M cubic feet valued at $7,239,684, all of which came from the United States. The quantity imported was twice that imported during 1956. Ontario imported 26,996,178 M cubic feet valued at $6,159,986, the gas coming in at Niagara and Windsor. Niagara imports accounted for 60 per cent of the provincial total. British Columbia imported 3,491,214 M cubic feet valued at $1,064,516. Minor imports were received at the Alberta town of Coutts on the United States boundary.

The Canadian import duty on gas brought in by pipeline for use in heating and cooking is 3 cents per M cubic feet. There is no export duty.

PEAT

by
A. A. Swinnerton

Peat moss is the dead, slightly humified, fibrous moss found in peat bogs. When dried and shredded it has a high absorptive capacity and for this reason is widely used in horticulture as a packing material and a means of introducing humus into the soil, and in stables and poultry runs as litter.

Peat moss is widely distributed in Canada, commercial production coming from plants in British Columbia, Manitoba, Ontario, Quebec, New Brunswick and Nova Scotia. Seventy-eight per cent of the 137,747 tons produced in 1957 came from the Fraser River delta in British Columbia and the Rivière du Loup area of Quebec.

Canada's peat-moss industry is still expanding, production being 7.5 per cent greater in 1957 than in 1956. With a growing market in the United States, which absorbs most of the Canadian output, some of the larger operators are developing new deposits.

While the harvesting of peat moss has been largely mechanized, considerable manual labour is still required for digging: mechanical excavators are unsatisfactory for dealing with peat-containing roots. At an operation in British Columbia peat is excavated by hydraulic jets, pumped to the plant and dried by steam heat in a modified paper-making machine. Experimental work is also being carried out on the dehydration of peat by pressure and artificial heat.

The only notable mechanization in eastern Canada is the 'milling' process operated at one bog in Quebec, one in Ontario and one in Nova Scotia. In this process the peat is lightly harrowed to a depth of 1 or 2 inches, allowed to dry and gathered by large-scale 'vacuum cleaners' mounted on caterpillar treads. It is then transported to the mill for baling and shipment.

Small quantities of peat fuel have been produced in recent years from a bog at Gads Hill Station near Stratford, Ontario, but no production was reported for 1957. On the Burin peninsula of Newfoundland small quantities of peat fuel have been harvested for local use.

Producers

British Columbia

The peat operations of the Fraser River delta near New Westminster are the largest in Canada. Four bogs are being worked - Pitt Meadows, Byrne Road, Lulu Island and Delta (or Burns). From this small area 12 companies in 1957 produced 58,779 tons, almost half of Canada's production. The

Peat Moss – Production and Exports

	1957		1956	
	Short Tons	$	Short Tons	$
Production (shipments)				
By provinces				
British Columbia	58,779	2,343,832	63,812	2,393,571
Quebec	48,704	1,140,476	40,268	951,644
New Brunswick	18,731	779,675	13,421	520,224
Manitoba	5,700	213,855	6,145	236,254
Ontario	4,720	220,232	3,267	97,091
Nova Scotia	1,113	36,434	1,141	41,930
Total	137,747	4,734,504	128,054	4,240,714
By uses				
Horticulture	125,584	4,365,802	112,001	3,775,567
Poultry and stable litter	12,113	364,785	15,993	458,368
Other uses	50	3,917	60	6,779
Total	137,747	4,734,504	128,054	4,240,714
Exports				
United States	117,660	6,656,857	113,300	6,066,393
Venezuela	167	8,650	–	–
Other countries	50	3,216	46	2,452
Total	117,877	6,668,723	113,346	6,068,845

	1957		1956	
	No. of Firms or Producers	No. of Bogs	No. of Firms or Producers	No. of Bogs
Nova Scotia	1	1	1	1
New Brunswick	3	4	3	4
Quebec	14	16	15	17
Ontario	2	2	2	2
Manitoba	1	1	1	1
British Columbia	12	12	12	12
Total	33	36	34	37

Peat Moss - Production and Exports, 1947-57
(short tons)

	Production *	Exports
1947	80,019	72,918
1948	89,800	77,924
1949	80,249	68,390
1950	75,195	65,962
1951	76,809	71,874
1952	74,899	68,276
1953	81,654	73,509
1954	99,272	87,333
1955	117,579	102,997
1956	128,054	113,346
1957	137,747	117,877

* Producers' shipments.

largest producers are Industrial Peat Limited and Atkins and Durbrow Limited.

Manitoba

Western Peat Company Limited, the province's only producer, works the Julius (or Shelley) bog, about 50 miles east of Winnipeg.

Ontario

Two companies operate in Ontario at present. Atkins and Durbrow (Erie) Limited, near Port Colborne, produced most of the output in 1957, applying the milling process already described. Humar Corporation Ltd. processes and sells humus from a bog near Dundas.

Quebec

The peat moss deposits worked in Quebec are mainly in the lower St. Lawrence region. Fourteen companies contributed to the output in 1957, but most of the production came from Premier Peat Moss Producers, whose operations are at Rivière du Loup, Isle Verte and Cacouna; Tourbières Rivière-Ouelle, in the Rivière du Loup area; and Quebec Peat Moss Company, St. Guillaume.

New Brunswick

New Brunswick's most important peat-moss deposits are in Northumberland county (on both sides of Miramichi Bay), in Gloucester county and on Miscou and Shippigan Islands. Three companies produced peat moss in 1957: Fafard Peat Moss Company, at Pokemouche; Atlantic Peat Moss Co. Ltd., at Shippigan and on Shippigan Island; and Bot Trotters Ltd., at Centreville.

Nova Scotia

Annapolis Peat Moss Company, Limited, the only producer of peat moss in Nova Scotia, worked the Caribou bog near Berwick in 1957, employing the milling process already described.

Other Occurrences

Newfoundland

Peat moss is not produced in Newfoundland. The deposits are close to the coast and their development would probably be handicapped by poor drying weather. In 1954, the province's Department of Mines and Resources started a survey of its peat resources and issued a detailed report on bogs in the Avalon and Burin peninsulas in 1955.

Prices

The price of peat moss in 1957 varied from approximately $24 to $40 a ton according to location.

CRUDE PETROLEUM

by
R. A. Simpson

The Canadian petroleum industry produced more crude oil in 1957 than in any previous year, but the percentage increase was small compared with the increases of the immediately preceding years.

Crude-oil output in 1957 reached 181,848,004 bbl valued at $453,593,620. This was the result of a production increase of 6 per cent, but the gain in 1956 had amounted to 33 per cent. For the fifth consecutive year, however, the value of petroleum production exceeded that of any other mineral.

The average daily production during 1957 amounted to 498,200 bbl. Reserves of liquid hydrocarbons were increased during the year to 3,269 million bbl, 128 million bbl more than in 1956. At the year-end there were 12,159 oil wells in western Canada; at the end of 1956 there were 10,587.

Alberta, Canada's greatest oil-producing province, turned out 137,492,316 bbl in 1957, thus accounting for 75.6 per cent of Canadian production. The province's share was 91.3 per cent in 1954, 87.3 per cent in 1955 and 83.7 per cent in 1956. In 1957, for the first time since the discovery of Leduc - the beginning of Canada's growth as a significant crude-oil producer - the annual production was less than in the previous year.

Production in Saskatchewan increased by almost 75 per cent during the year to a record of 36,861,089 bbl, continuing the marked expansion begun in 1954. The province's share of the national production increased to 20.3 per cent from 5.6 per cent in 1954, 8.7 per cent in 1955 and 12.2 per cent in 1956.

Manitoba's production rose slightly to 6,089,743 bbl. The percentage of Canada's total amounted to 3.3, which was about the same as in previous years.

The remaining crude-oil-producing areas - in Ontario, Northwest Territories, British Columbia and New Brunswick - added only 1,404,856 bbl to the total, or less than 1 per cent.

The most important oil-field developments occurred again in the huge Pembina field of Alberta and in southeastern Saskatchewan. Footage drilled dropped 12.1 per cent from the record high of 1956, reflecting the drop in crude-oil requirements that occurred during the latter part of the year. Exploratory drilling increased about 18 per cent while geophysical activity declined about 10 per cent.

Crude Petroleum

Crude-oil Production

	1957		1956	
	Bbl	$	Bbl	$
Alberta				
Pembina	37,185,478		33,721,287	
Redwater	21,184,682		28,182,265	
Leduc-Woodbend	18,295,291		21,097,718	
Bonnie Glen	8,176,121		10,290,407	
Fenn-Big Valley	7,798,439		8,028,779	
Wizard Lake	4,377,067		4,823,992	
Joarcam	4,259,153		4,540,276	
Joffre	3,211,847		3,333,764	
Sturgeon Lake South	2,636,989		1,962,933	
Golden Spike	2,520,680		3,941,614	
Acheson	2,346,727		2,579,503	
Stettler	2,027,463		2,111,694	
Westerose	1,781,034		2,317,544	
Turner Valley	1,595,082		1,776,393	
Harmattan-Elkton	1,579,240		799,200	
West Drumheller	1,460,725		1,397,044	
Erskine	1,238,025		997,773	
Wainwright	997,105		678,671	
Sundre	926,814		796,336	
Lloydminster	895,028		1,091,536	
Big Lake	807,162		56,448	
Keystone	777,910		35,842	
Excelsior	758,650		1,004,637	
Bentley	702,730		260,900	
Malmo	694,710		754,407	
Duhamel	603,198		648,020	
Bellshill Lake	585,868		183,750	
Fairydell-Bon Accord	511,662		572,089	
Homeglen-Rimbey	511,017		487,040	
Sturgeon Lake	477,683		403,598	
Pincher Creek	452,413		12,875	
Westward Ho	444,398		282,676	
Glen Park	342,563		421,973	
New Norway	331,444		389,616	
Gilby	297,315		155,818	
Willesden Green	282,927		31,598	
Clive	249,967		283,392	
Drumheller	244,813		293,301	
Innisfail	186,788		9,740	
Jumping Pound	178,053		156,925	
Chauvin	147,840		171,584	
Glenevis	142,108		57,238	
Taber	139,408		120,527	
Cessford	127,732		197,826	
Battle South	125,617		135,104	
Alhambra	119,716		154,698	

Crude-oil Production (cont'd)

	1957		1956	
	Bbl	$	Bbl	$
Hamilton Lake	111,974		123,621	
Battle	95,980		108,406	
Other fields	2,547,680		1,927,263	
Total	137,492,316	355,555,140	143,909,641	353,629,158
Saskatchewan				
Steelman	9,565,662		1,849,390	
Weyburn	3,423,773		386,795	
Coleville-Smiley	3,123,557		3,633,832	
Midale	2,478,273		1,430,098	
Nottingham	2,309,424		1,365,847	
Dollard	2,078,998		1,302,192	
Fosterton	1,907,023		1,866,736	
Success	1,656,214		1,728,871	
Carnduff	1,588,562		120,754	
Cantuar	1,346,888		1,357,160	
Battrum	931,783		842,681	
Lloydminster	797,640		882,993	
Alida	749,322		648,967	
Bone Creek	674,461		246,431	
Instow	640,010		217,633	
Hastings	516,750		255,882	
Lone Rock	501,691		634,562	
Alameda	465,039		19,926	
Gull Lake	455,317		532,286	
Queensdale	288,772		3,301	
Wapella	256,057		264,141	
Glen Ewen	179,354		12,391	
North Premier	167,382		90,159	
Other fields	759,137		1,384,343	
Total	36,861,089	79,325,064	21,077,371	36,253,078
Manitoba				
North Virden	2,347,994		2,183,000	
Virden-Roselea	2,097,405		1,782,675	
Daly	1,045,641		1,215,136	
Routledge	242,725		-	
Woodnorth	106,129		202,879	
Other fields	249,849		402,850	
Total	6,089,743	15,467,947	5,786,540	13,633,088
Ontario	623,666	2,160,000	593,370	1,958,121
British Columbia	340,945	763,717	148,454	302,375
Northwest Territories	420,844	294,591	449,409	762,773

(table continued on next page)

38,173,663 acres in the Northwest Territories, 29,370,417 acres in British Columbia and 8,008,084 acres in Manitoba.

Drilling Activity

Drilling activity was down by more than 11 per cent in 1957. Development drilling declined by nearly 20 per cent during the latter half of the year. Exploratory drilling, on the other hand, increased by 13 per cent. Exploratory wells, which were 31 per cent successful in 1956, were only 27 per cent so in 1957. The average well depth was 4,700 feet.

Wells Drilled to Completion - Western Canada

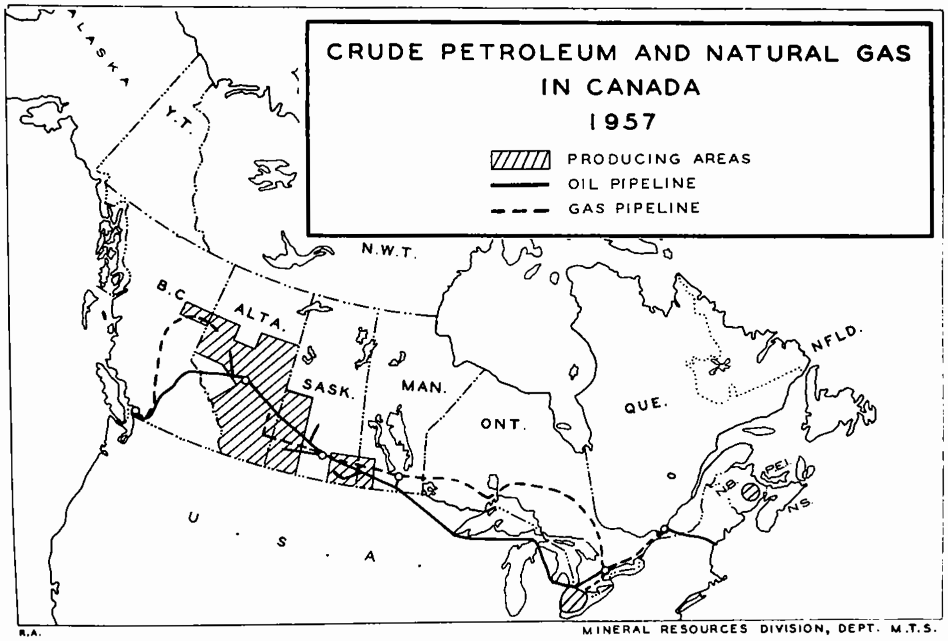
	Oil Wells		Gas Wells		Dry Holes		Total	
	1957	1956	1957	1956	1957	1956	1957	1956
British Columbia	11	7	41	34	40	16	92	57
Alberta	874	1,368	125	138	449	392	1,448	1,898
Saskatchewan	899	808	20	16	383	311	1,302	1,135
Manitoba	127	202	-	-	97	60	224	262
Northwest Territories	0	4	1	-	3	3	4	7
Total	1,911	2,389	187	188	972	782	3,070	3,359

Liquid Hydrocarbon Reserves

The Canadian Petroleum Association reserve study showed that liquid hydrocarbon reserves increased by 139,810,000 bbl during 1957. Reserves at the end of the year amounted to 3,269,114,000 bbl made up of 2,874,454,000 bbl of crude oil and 394,660,000 bbl of natural-gas liquids. Alberta's reserves totalled 2,731,587,000 bbl made up of 2,360,933,000 bbl of crude oil and 370,654,000 bbl of natural-gas liquids. Saskatchewan had 420,457,000 bbl of crude oil and 497,000 bbl of natural-gas liquids. Manitoba accounted for 34,258,000 bbl, all of crude oil, and British Columbia's reserves were made up of 334,000 bbl of crude oil and 23,509,000 bbl of natural-gas liquids.

Numbers of Oil Wells and Fields

Alberta and British Columbia showed a slight increase in the number of oil fields while Saskatchewan registered a drop. The decline in the last-named province is attributable to the fact that, in the Steelman area, the province combined a number of fields into one. The table on page 481, compares by provinces, the last two years' statistics on wells and fields.



Oil Wells and Oil Fields – Western Canada *

	Oil Fields		Producing Wells		Wells Capable of Production	
	1957	1956	1957	1956	1957	1956
British Columbia	4	1	15	9	22	9
Alberta	89	86	7,136	6,743	8,015	7,390
Saskatchewan	39	46	2,652	2,047	3,226	2,414
Manitoba	12	12	735	646	846	736
Northwest Territories	1	1	19	31	38	38
Total	145	146	10,557	9,476	12,107	10,587

* At end of year.

In eastern Canada, where wells have much less producing potential than wells in western Canada, only a few wells were added during the year. At year-end Ontario had 1,548 wells and New Brunswick 19.

Developments by Areas

British Columbia

Ninety-five wells were drilled in British Columbia during 1957. Of these, 11 were successful oil wells, 41 successful gas wells and 40 dry holes.

The remaining three were suspended. There were four oil fields in the province at year-end.

The Boundary Lake field, the first oil field in the province, had three successful development wells completed. Exploratory drilling at two locations 5 miles and 8 miles southwest of the field disclosed oil in the Triassic Schooler Creek. This is the formation from which oil is produced in the Boundary Lake field.

Two successful oil wells were drilled in the West Buick Creek field. One successful oil well was drilled in the Fort St. John field and one in the Blueberry Creek field. Two additional wells in the Blueberry Creek area, near mile 100 on the Alaska Highway, found oil in the Mississippian. Tests of wells in this area indicate that the field is the most prolific in British Columbia.

Crude-oil production increased to more than double its 1956 volume. More than 95 per cent of production came from the Boundary Lake and Fort St. John fields. All the crude oil produced is sold locally.

Alberta

In Alberta 450 fewer wells were drilled in 1957 than in 1956. A total of 1,448 were completed, of which 874 found oil, 125 found gas, 436 were abandoned, and 13 were used as service wells or returned as potential service wells. In 1957, footage drilled equalled 7,472,525 feet; in 1956 it amounted to 10,093,579 feet.

Development drilling declined by 37 per cent in 1957. Drilling in the huge Pembina field, which in 1956 accounted for almost half the wells drilled in the province, added only 286 to the field to bring the number of wells in it to 1,974. This, the major factor in the province's decline, was to be expected because the field is approaching full development. In 1956, 880 wells were added. The Keystone field was being developed rapidly and 74 successful wells were added to bring its total to 81. Other active areas included the Bellshill Lake, Wainwright, Willesden Green, Harmattan-Elkton and Sturgeon Lake fields, where 30, 25, 25, 23 and 21 wells were added respectively to increase the respective totals to 51, 169, 31, 63 and 110.

Exploratory drilling increased 10 per cent during the year and raised the total of oil discoveries to 113 from the 92 discovered in 1956. Although a few of the wells were drilled in the northern extremity of the province, most of the drilling was distributed south of 57° north latitude. Drilling was somewhat more concentrated in the Pembina field and the area between Edmonton and Calgary. Nearly 22 per cent of the successful exploratory oil wells were extensions of the Pembina field. Another 35 per cent of successful exploratory drilling was between Edmonton and Calgary and 20 per cent in locations northwest of Edmonton. About 12 per cent of the successful wells were in the east central area and 8 per cent in the south.

Of the 113 successful exploratory oil wells, 21 were designated as new-field discoveries. The most significant were those in the area centred about 120 miles northwest of Edmonton and included the discoveries at the Kaybob, Virginia Hills and Edith Lake locations. Production in this area is from the Upper Devonian Beaverhill Lake group, and pay thickness is substantial with indicated potentials ranging up to 1,550 bbl a day. In the central part of the province an important Leduc reef discovery was made at Innisfail some 60 miles north of Calgary. In 1956, oil was discovered in the Blairmore formation at Innisfail, but the more important Upper Devonian find was made in 1957. In the Joffre field, an exploratory well found oil in the Nisku member of the Devonian about 2 miles from a 1956 discovery well in the same formation. Subsequent development drilling indicated a large reservoir. In the area about 85 miles east of the town of Peace River where the initial 'Granite Wash' oil pool was made in 1956, a successful exploratory well has found what appears to be a second pool in the sediments overlying the Precambrian basement rocks. The most important trends were those in the area northwest of Edmonton and the search for Devonian reef structures characterized by the Innisfail discovery.

Saskatchewan

A total of 1,258 wells were drilled in Saskatchewan during 1957, 118 more than were drilled in 1956. For the first time Saskatchewan had more oil-well completions than Alberta, bringing in 899 oil-producing wells. The province's success rate was sustained by continued activity in its southeastern part. The footage drilled increased to 5,361,723 feet from the 4,724,954 feet of the previous year. Almost three fourths of the total footage drilled was development footage.

There were 33 oil discoveries in the province. Most of them served to extend field boundaries or to fill in non-producing parts of established areas. By the end of 1957, however, three trends appeared to be developing in the Mississippian of southeastern Saskatchewan. One of these lies to the south of the Weyburn-Midale-Steelman fields and extends from Tribune southward. Successful wells near Pinto and Hitchcock were drilled in this area. Another, indicated by successful discoveries at East Bellegarde, Redvers and Wauchope, is a triangular-shaped area running east and west and lying immediately north of the Alida and Nottingham fields. A third lies immediately north of the last-mentioned area and includes the Parkman field oil and well near Conningham Manor.

The discoveries in the Ordovician and Silurian system in southeastern Saskatchewan may be significant, particularly since production is obtained from these systems across the border in the United States.

Manitoba

During 1957, 224 wells were drilled, of which 153 were development wells and 71 were exploratory wells. There were 127 successful oil wells, of which three were new discoveries. The most important discovery was

Dillman-Plymouth-Kirkella No. 1-10 well, about 12 miles northwest of the Daly field near the Saskatchewan border. Production was from the Mississippian Lodgepole member. The other two discoveries were stepouts, one 1 1/2 miles west of the nearest production in the Routledge field and the other 1 mile south of the nearest production in the Virden-Roselea field.

The most active development was in the North Virden, Virden-Roselea and Routledge fields. North Virden had 54, Virden-Roselea 37 and Routledge 19 successful wells. At year-end there were 846 wells capable of production, 110 more than at the end of 1956. Almost 85 per cent of all wells are in the Virden-Roselea, North Virden and Daly fields. The remainder are in nine smaller fields of which Routledge is the most important. By the end of the year operations in the Lulu Lake field had become uneconomical and all wells were abandoned.

The testing of the Devonian and older formations in the area east and north of the Mississippian truncation, which was begun in 1956, was continued but without success.

Northwest Territories and Yukon Territory

The small production of the Northwest Territories comes from the Norman Wells field on the Mackenzie River, 90 miles south of the Arctic circle. Crude oil from this field serves a small refinery located at Norman Wells.

Only four wells were drilled in the Northwest Territories. One of these found gas and three were dry holes. All were in the area southwest of Great Slave Lake.

The drilling of one well in the Yukon Territory was suspended.

Ontario

Drilling in Ontario continued at the same rate as in previous years; 421 wells were drilled, 294 being development wells and 127 exploratory. Of the same total, 46 found oil, 162 found gas and 213 were dry holes. Only two oil discoveries were made, but they were not of major significance. Of the successful oil wells, 25 were in Aldborough township, Elgin county, 13 were drilled in Lambton county, 6 in Kent county and the remaining 2 in Middlesex county.

New Brunswick

The Stony Creek field, 9 miles south of Moncton, remains the only oil-producing field east of Ontario. Production, which dates from 1910, declined steadily from the 1941 high of 31,359 bbl to the 1955 output of 12,548 bbl. In 1957 19,401 bbl were produced; in 1956 production amounted to 22,300 bbl.

One development well was completed in 1957, but it was a small gas find. A second development well was suspended. Oil from the 19 wells in the field supplies a small refinery located there.

Transportation

With the construction of the Interprovincial pipeline in 1950, the transportation of crude oil became a major part of Canada's oil industry. From that year pipeline mileage increased until, at the end of 1957, there were 6,800 miles in operation. During the year pipelines were increased by 993 miles, or 17 per cent. Net deliveries of crude oil rose to 290,857,612 bbl from the 274,940,340 bbl of the previous year. The largest transporters in order of decreasing gross deliveries are: Interprovincial Pipe Line Company; Montreal Pipe Line Company Limited; Trans Mountain Oil Pipe Line Company; Imperial Pipe Line Company Limited and Pembina Pipe Line Limited.

The mileage of extensions of pipelines into the United States, which carry Canadian oil exclusively, remains at 1,514, exclusive of loops.

Oil-pipeline Mileage in Canada

Year End	Miles
1950	1,423
1951	1,577
1952	2,500
1953	3,794
1954	4,656
1955	5,079
1956	5,807
1957	6,800

Tariffs

Pipeline tariffs per bbl of oil are as follows: from Edmonton, Alberta, to Vancouver, British Columbia, 40 cents; from Edmonton to Sarnia, Ontario, 64 cents; from Edmonton to Clarkson and Port Credit, Ontario, 72 cents; from Cromer, Manitoba, to Sarnia, 48 cents, and to Clarkson and Port Credit, 56 cents. Additional charges are made to bring oil to the pump stations on the trunk lines. For example, rates, including gathering charges, to take oil to Edmonton from Pembina, Leduc, Redwater and Big Valley, are 12, 7, 2 and 18.5 cents respectively.

Interprovincial Pipe Line Company

The Interprovincial pipeline is the longest oil pipeline in the world. It originates in the Redwater field and connects with the pump station at Edmonton, where the bulk of crude oil to be shipped east is delivered. In addition to deliveries from Redwater, the pipeline takes deliveries from 10 other pipelines in the three Prairie Provinces. It makes deliveries of 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: Saskatchewan – Saskatoon, Moose Jaw and

Regina; Manitoba - Brandon and Winnipeg; Ontario - Sarnia, Clarkson and Port Credit; the United States - St. Paul-Minneapolis and Wrenshall (Minnesota), Superior (Wisconsin) and West Branch, Bay City and Midland (Michigan).

During 1957 a 156-mile extension, 20 inches in diameter, from Sarnia to Clarkson and Port Credit, was completed. In addition, 326 miles of 24-inch pipe consisting of two loops were completed between Regina, Saskatchewan, and Gretna, Manitoba. Between Gretna, Manitoba, and Superior, Wisconsin, 78.4 miles of 26-inch line made up of three loops were completed. The company now has two complete lines from Regina to Superior.

Deliveries for the year totalled 101,239,559 bbl, increasing only 4 per cent over 1956 deliveries, which amounted to 97,116,072 bbl. Refineries in western Canada took 34.1 million bbl while those in the United States and Ontario accepted 20.9 and 41.9 million bbl respectively. An additional 4.2 million bbl were delivered to tankers at Superior.

Trans Mountain Oil Pipe Line Company

The Trans Mountain pipeline consists of 719 miles of 24-inch trunk line joining Edmonton and Vancouver. A 5 1/2-mile spur line runs from Sumas, Washington, to the international boundary and connects with a 20-inch line running southward to serve refineries at Ferndale and Anacortes, in Washington.

During 1957 the capacity of the line was increased from 200,000 to 250,000 bbl a day by the construction of two loops of 30-inch pipe and one permanent and three temporary pumping stations. The looped sections were between Edson and Hinton in Alberta and Darfield and Kamloops in British Columbia.

Deliveries for the year rose almost 20 per cent - to 56,535,164 bbl from the 47,251,641 bbl of 1956. Of this total, 40 per cent was delivered to refineries in British Columbia, 48 per cent was taken by refineries in Washington, and 12 per cent constituted offshore shipments. Of the 7,140,991 bbl delivered to tankers, 92,338 bbl were for Japan and the remainder went to the United States.

Pembina Pipe Line Limited

A total of 116 miles of gathering lines and 32 miles of loop were laid during 1957. The gathering lines were constructed chiefly in the Willesden Green and Keystone fields, which lie respectively 20 miles south and 10 miles east of the Pembina field. The 16-inch loop was laid between Edmonton and Calmar.

Throughput totalled 38,045,754 bbl, having increased about 19 per cent over that of the previous year. By November 1957, the system was serving 2,113 wells which were producing into 344 batteries.

Other Crude-oil Pipelines

Rangeland Pipe Line Company's system at the end of 1957 consisted of 84 miles of gathering and 57 miles of trunk line connecting the Gilby, Bentley and West Joffre fields in Alberta with the pipeline of Texaco Exploration Company at Rimbey in the same province. Texaco looped 5 1/2 miles of its main line in 1957 and increased gathering lines to 29 miles.

In Saskatchewan, Trans Prairie Pipelines Limited increased the length of its trunk line to 50 miles in the process of joining the Weyburn field to the line of Westspur Pipe Line Company. Westspur and Producers Pipelines Limited combined to form a gathering and trunk-line system serving the Midale, Steelman, Alida, Nottingham, Hastings, Glen Ewen, Carnduff and South Manor fields of southeastern Saskatchewan. The line connects with the Interprovincial system and Cromer, Manitoba.

Petroleum-processing

There was no change in the number of operating refineries in Canada in 1957. Two refineries were under construction, one in Ontario, between Toronto and Hamilton, and one in Port Moody, British Columbia. Crude-oil production capacity at the end of December 1957, was 761,895 bbl a day, having increased by 61,845 bbl a day over its 1956 limit.

Imperial Oil Limited operated nine refineries whose daily crude-oil capacity was 39.3 per cent of the Canadian total. The rest of the national capacity was as follows: British American Oil Company Limited, five refineries, 16.8 per cent; Shell Oil Company of Canada Limited, two refineries, 10.5 per cent; McColl-Frontenac Oil Company, two refineries, 9.3 per cent; 20 remaining companies, a total of 24.1 per cent.

Crude-oil Refining Capacity by Regions

	1939		1945		1950	
	Bbl/day	%	Bbl/day	%	Bbl/day	%
Maritimes	32,750	16.4	34,250	14.8	22,300	6.2
Quebec	64,500	32.2	59,000	25.5	143,000	39.9
Ontario	44,500	22.2	75,450	32.6	75,200	21.0
Prairies and Northwest Territories	35,570	17.8	41,515	18.0	89,525	24.9
British Columbia	22,700	11.4	21,000	9.1	28,850	8.0
Canada	200,020	100.0	231,215	100.0	358,875	100.0
	1955		**1956**		**1957**	
	Bbl/day	%	Bbl/day	%	Bbl/day	%
Maritimes	18,300	3.0	42,300	6.1	44,300	5.8
Quebec	210,000	34.0	247,000	35.3	255,800	33.6
Ontario	148,800	24.0	159,700	22.8	198,510	26.1
Prairies and Northwest Territories	174,850	28.3	180,800	25.8	189,035	24.8
British Columbia	66,500	10.7	70,250	10.0	74,250	9.7
Canada	618,450	100.0	700,050	100.0	761,895	100.0

Canadian Crude Oil as a Percentage of Refinery Receipts, by Regions

	1936	1939	1940	1945	1950	1955	1956	1957
Maritimes	0	0	0	0	0	0	0	0
Quebec	0	0	0	0	0	0	0.4	0
Ontario	1.6	0.4	1.2	0.5	1	78.8	84.5	86.1
Prairies and Northwest Territories	23.5	37.0	92.3	58.2	99	100	100	100
British Columbia	0	0	0	0	0	100	100	100
Canada	3.5	17.0	16.4	11.7	24.4	54.7	54.1	53.2

Marketing

Crude oil delivered from domestic oil fields to refineries within Canada totalled 125,857,741 bbl in 1957, only 265,667 bbl more than in 1956. Domestic demand for crude oil in the last half of 1957 was 6 million bbl more than in the same period of the previous year. For the first half of 1957 the demand was 4.5 million bbl less than in the first half of 1956. Exports of crude oil for the year were above those of 1956 by 12,766,142 bbl. During 1957, 55,674,228 bbl were exported, but this total would have been considerably greater had not foreign demand for Canadian crude dropped markedly in the last quarter. Exports by quarters during the first three quarters were 88, 38 and 39 per cent respectively above those of the respective quarters of 1956. Exports during the final quarter were 23 per cent below those of the same quarter of 1956. Total supply of crude oil, on a daily average basis, amounted to 804,804 bbl, of which 498,214 bbl daily came from Canadian fields and 306,590 were imported. Crude oil exports averaged 152,532 bbl a day.

Degree of Petroleum Self-sufficiency

The refining industry in Canada took delivery of 341 million bbl of crude oil – domestic and foreign – and manufactured the equivalent of 89.6 per cent of the country's petroleum-product requirements. Although crude-oil production was the equivalent of 76 per cent of refinery runs, allowance for imports, exports and stock changes resulted in a petroleum self-sufficiency, on trade balance, of 63.9 per cent – 1 per cent less than last year. Of the total crude-oil run to stills, 53.2 per cent was made up of crude oil from Canadian fields.

Trade

The 55,674,228 bbl of crude oil exported by Canada in 1957 were worth $140,974,837; the 42,908,086 bbl exported in 1956 were valued at $103,923,155. A one-third increase to 3,635,832 bbl raised the value of product exports to $15,829,942. An increase to 111,905,473 bbl from 106,641,358 bbl raised the value of crude-oil imports to $305,557,147 from $270,882,104. A decline of about 2.5 million bbl to 34,644,099 bbl placed the value of product imports at $155,970,000.

Venezuela supplied 78.7 per cent of crude-oil imports, Middle East countries 12.5 per cent, the United States 7.4 per cent and Trinidad 1.4 per cent. All exports, except 92,000 bbl in small shipments to Japan, went to the United States. The State of Washington took 49.4 per cent of Canada's exported crude oil, California 12.9 per cent and Minnesota, Wisconsin and Michigan, together, 37.7 per cent.

In mid-1957, the United States imposed voluntary import restrictions on crude oil entering areas I to IV inclusive in the United States. Included are Minnesota, Wisconsin and Michigan. In December, Area V, which includes California and Washington, was also brought into the program. Demand had been low for Canadian crude from all its traditional United States markets and the import restrictions had no immediate effect.

There is no tariff on crude oil entering Canada. There is a United States import tax of 5 1/4 cents a bbl on Canadian crude oil testing under 25° A.P.I. gravity and 10 1/2 cents a bbl on oil testing at or above that gravity.

Regional Consumption of Petroleum Products

The following table gives net sales of products by regions during 1957.

	Motor Gasoline	Kerosene and Stove Oil	Diesel Fuel Oil	Light Fuel Oils 2 and 3	Heavy Fuel Oils 4, 5 and 6
	(bbl)	(bbl)	(bbl)	(bbl)	(bbl)
Newfoundland	798,160	486,538	810,956	584,642	2,029,984
Maritimes	5,589,751	1,962,282	2,054,173	3,131,678	4,550,675
Quebec	17,899,825	4,973,939	3,835,118	12,365,620	15,936,190
Ontario	33,379,342	4,224,535	4,398,484	23,152,065	10,774,162
Manitoba	4,750,232	184,993	1,073,812	2,563,726	1,733,806
Saskatchewan	7,659,196	292,786	1,878,946	2,521,541	3,071,523
Alberta and Northwest Territories	9,415,811	258,383	3,232,172	1,125,171	3,216,255
British Columbia	8,232,311	2,224,332	3,438,527	3,421,443	7,284,133
Total	87,724,628	14,607,788	20,722,188	48,865,886	48,596,728

Source: Dominion Bureau of Statistics figures.

In Newfoundland, the Maritime Provinces, Quebec and British Columbia, there are high sales of heavy fuel oils, which are used to a large extent for bunkering ships. Ontario used relatively large quantities of light fuel oil for domestic heating and motor gasoline to serve the large motoring public concentrated in that province.

Crude Petroleum

All Oils – Supply and Demand
(bbl)

	1957	1956
Supply		
Production		
Crude oil	181,848,004	171,981,413
Natural gasoline etc.	2,980,504	2,595,210
Total production	184,828,508	174,576,623
Production, bbl /day	506,379	476,985
Imports		
Crude oil	111,905,473	106,641,358
Products	34,644,099	37,456,653
Total imports	146,549,572	144,098,011
Change in stocks		
Crude oil	+ 699,643	- 871,857
Products	-2,661,024	-7,549,496
Total change in stocks	-1,961,381	-8,421,353
Total supply	329,416,699	310,253,281
Demand		
Exports		
Crude oil	55,674,228	42,908,086
Products	3,635,832	2,560,313
Total exports	59,310,060	45,468,399
Domestic sales		
Motor gasoline	87,724,628	83,020,237
Middle distillate	87,645,800	84,577,275
Heavy fuel oil	48,596,728	46,476,581
All other products	28,701,008	31,317,929
Total domestic sales	252,668,164	245,392,022
Uses and losses		
Refinery	17,811,405	16,845,131
Field and pipeline	1,409,122	551,515
Total plant uses and losses	19,220,527	17,396,646
Fuel oil, ex-warehoused, ships' stores	-	-
Total demand	331,198,751	308,257,067
Oils not accounted for	1,782,052	1,996,214
Domestic demand, all oils, total	271,888,691	262,788,668
Domestic demand, all oils, bbl/day	744,901	718,002

Prices

The average field prices of crude oil in Alberta, Saskatchewan and Manitoba were $2.52, $1.86 and $2.44 respectively. The Canadian average in 1957 rose to $2.38 from the 1956 average of $2.37.