Canada

The Canadian Mineral Industry 1955

Reviews by the Staff of the Mines Branch

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CONTENTS

*Corundum, emery, garnet, quartz, grindstones, pumice, and grinding pebbles.

67462-2—1½

Page

INDUSTRIAL MINERALS (Cont'd)

MINERAL FUELS

Preface

This volume contains reviews of the metals and minerals produced in Canada on a commercial scale during 1955, as well as a few others, which, while not produced in Canada, are nevertheless important to industry.

Statistics are final, and, except as noted, are from the Dominion Bureau of Statistics. Market quotations are mainly from standard marketing reports published in London, Montreal and New York.

All reviews were prepared by officers of the Mines Branch with the exception of that on uranium, which was written by an officer of the Geological Survey of Canada.

The thanks of the Branch are due to all those who contributed data, and especially to those mining operators and others connected with the industry whose co-operation throughout has been invaluable.

John Convey,
Director,
Mines Branch.

INTRODUCTION

DEVELOPMENTS IN THE CANADIAN MINERAL INDUSTRY IN 1955

Canada's mineral industry in 1955 achieved the largest annual advances in volume and value of output ever recorded. The index of physical volume of output (based on average for 1935-39 equal to 100) stood at 242.0 at the end of 1955 compared to 209.7 for 1954, and value of production rose from $1,488,382,091 to $1,795,310,796.

Major growth factors in the industry were the continued expansion in actual and potential production of crude petroleum, a great increase in the output of iron ore, large-scale developments in the uranium industry, and the extension of base-metal production facilities, particularly of nickel, copper, and zinc. Industrial minerals shared notably in the headway, more than one half of the main minerals of the group achieving records in volume output.

Metal production reached a record billion dollars for the value of $1,007,839,501, twenty-six per cent above the 1954 value. Mineral fuels increased 17 per cent in value to $414,318,015, and industrial minerals 11 per cent to $373,153,280. Crude petroleum ranked first at $305,640,036, copper second at $239,756,455, and nickel third at $215,866,007. The only principal metals and minerals with decreased tonnage were lead (7 per cent decrease), silver (10 per cent), and coal (less than one per cent).

The big three among the provinces in terms of value of mineral output were Ontario at $583,954,682, Quebec at $357,010,045, and Alberta at $325,974,326. Nova Scotia, Yukon, and Northwest Territories showed small decreases, compared to 1954.

Exports of metals and minerals and their products, valued at $1,431,000,000, accounted, in value, for about 33.4 per cent of the total Canadian exports in 1955, the gain over 1954 being $276,000,000.

The mineral industry, exclusive of smelting and refining, employed about 105,000 persons in 1955, with salaries and wages of approximately $384,000,000. It is significant that although approximately the same number of persons were employed in 1952, the physical volume index rose from 174.7 in that year to 242.0 in 1955, indicating a large increase in productivity.

Crude Petroleum and Natural Gas

Production of crude petroleum at the end of 1955 was at the rate of about 435,000 barrels a day with a potential production at about 650,000 barrels a day. Alberta, which supplied more than 87 per cent of the total, increased its output 29 per cent above that of 1954. Saskatchewan and Manitoba showed increases of 109 and 93 per cent, respectively.

Over $400,000,000 was spent on exploration and development of crude petroleum and natural gas in western Canada in 1955, with the emphasis on oil field development drilling. The main development of the year was expansion of the Pembina oil field in Alberta; at the end of 1954 it was producing 6,500 barrels daily and by the end of 1955 this had increased to 97,000 barrels daily. In natural gas, the main development concerned the increasingly important problem of market outlets for the growing reserves. The Federal Power Commission of the United States gave approval for importation of natural gas from Canada's Westcoast Transmission Company Limited whose source of gas is the Peace River section of British Columbia and Alberta. This company planned to construct a 650-mile pipe line from the gas fields to Sumas, British Columbia, on the international boundary. Problems connected with marketing western gas in central Canada, however, were unresolved at year's end. In order to help in getting the 2,327-mile gas line project of Trans-Canada Pipe Lines Limited under way, a proposal was put forward during the year that the Federal and Ontario governments jointly finance the 675-mile section through northern Ontario.

Proved reserves of crude petroleum in Canada at the end of 1955 amounted to 2,756,619,000 barrels. Reserves of natural gas were estimated at more than 20 trillion cubic feet and were rising at an annual rate of 2 trillion cubic feet.

The Metals

The main developments were in uranium and base metals, with exploration and development at a high level in the Blind River area of northern Ontario, the Chibougamau area in western Quebec, and the Bathurst-Newcastle area in New Brunswick.

For base metals, the year was outstanding. Nickel and zinc output reached all-time records, and copper output, after nine consecutive annual increases, was less than one per cent below the record of 1940. This high level of activity was due to increased world demand and higher prices, and, especially in the case of nickel, also to the results of long-range expansion programs. Production of lead was about 7 per cent less than in 1954. The price of copper moved from 28.9 cents a pound at the beginning of 1955 to 43.0 cents at the end of the year, nickel increased from 61.4 cents to 63.0 cents, zinc from 11.5 to 13.0, and lead from 14.25 to 15.50.

Nickel production came mainly from the mines of The International Nickel Company of Canada Limited and Falconbridge Nickel Mines Limited in the Sudbury area, Ontario, with new production from the Lynn Lake mine of Sherritt Gordon Mines Limited in north-central Manitoba. Two smaller producers in the Sudbury area sold nickel concentrates to Falconbridge. This company is preparing four new mines for production, one of which is expected to start operations in 1956.

Copper production was derived from ores of eight provinces, namely, Ontario, Quebec, Saskatchewan, British Columbia, Manitoba, Newfoundland, Nova Scotia, and New Brunswick, in order of production. Twenty-four companies accounted for the output, with those in Ontario and Quebec contributing 76 per cent of the total. In Quebec, Gaspe Copper Mines Limited, a large producer, commenced operations during the year, and several other producers increased mill capacity.

Exploration or development of copper properties was at a high level in several provinces. One of the most active areas was Chibougamau, Quebec, where three relatively new mines were in production and other properties were nearing production. This area shows promise of becoming one of the largest sources of copper production in Canada.

In the Bathurst-Newcastle area of New Brunswick, promising new lead-zinc properties were under development toward large-scale production, and establishment of a large metallurgical-chemical industry based on these resources was planned.

Iron ore output rose 121 per cent in 1955 over 1954, chiefly owing to the large-scale operations of Iron Ore Company of Canada in New Quebec-Labrador, although gains were also made by other operators in Quebec, Newfoundland, Ontario and British Columbia. The leading Canadian producers were: Iron Ore Company of Canada in New Quebec-Labrador; Dominion Wabana Ore Limited in Newfoundland; and Steep Rock Iron Mines Limited and Algoma Ore Properties Limited in Ontario. Bethlehem Steel Company brought its open-pit mine at Marmora, Ontario, into operation during the year, producing about 196,000 long tons of pelletized magnetite concentrates. Capacity is 500,000 tons a year.

Construction of the first unit of International Nickel Company's ammonia-leaching plant at Copper Cliff, Ontario, which will treat nickel-bearing pyrrhotite concentrate, was nearing completion at the end of 1955. Production of by-product iron ore from this operation will reach 1,000,000 tons a year following the completion of all units.

Development of an iron ore deposit under Falls Bay, Steep Rock Lake, Ontario, by Caland Ore Company was underway. Dredging operations are expected to be completed about 1960 and production of ore will likely start shortly after. Output is expected to be about 3,000,000 tons a year.

Production of uranium in 1955, valued at $26,000,000, came from six properties in the Beaverlodge area of northern Saskatchewan, a mine at Port Radium on Great Bear Lake in Northwest Territories, and one in the new Blind River camp in Ontario, north of Lake Huron. Two of these properties entered production in 1955 -- Gunnar Mines Limited in the Beaverlodge area and Pronto Uranium Mines Limited in the Blind River area.

Among other metals produced in 1955 were two new ones for Canada, namely, the pentoxides of niobium and tantalum. Production came from Boreal Rare Metals Limited at Cap-de-la-Madeleine, Quebec. Other tantalum properties in Northwest Territories, British Columbia, Ontario and Quebec were under intensive exploration during the year, with several at the pilot-plant stage of testing for recovery of marketable concentrates.

Coal

Coal was produced in Canada in 1955 in Nova Scotia, Alberta, Saskatchewan, British Columbia, Yukon, and New Brunswick, in that order of output. Production at 14,818,880 tons was only slightly below that of 1954, thus arresting the steady decline since the record output of 1950 at 19,139,112 tons. The largest decrease occurred in Alberta where utilization of fuel oil and natural gas has been making inroads on the markets for coal.

Industrial Minerals

Owing to the great growth of the construction and chemical industries in Canada, output of industrial minerals has steadily increased in recent years, and in 1955 sixteen of the twenty-five major industrial minerals produced in Canada achieved all-time records in volume output. Overall value of production, at $373,153,280, was $37,646,960 higher than in 1954, the main gains being in asbestos, cement and gypsum.

The principal developments during the year concerned asbestos, sulphur, salt, and cement, all of which made production records.

Most of the increase in asbestos output camé from four new mills in the Eastern Townships of Quebec; these mills began production in 1954. During 1955, the large-scale expansion and modernization program continued. One of the major projects underway was the draining of Black Lake by Lake Asbestos of Quebec Limited in preparation for mining an orebody under the lake. A mill was being constructed at the site with a capacity of 5,000 tons daily. At the Matheson mine of Canadian Johns-Manville Company Limited, in northern Ontario, shaft sinking was commenced to develop an underground orebody to supplement production from its open pit. Output from Cassiar Asbestos Corporation's deposit in northern British Columbia nearly doubled in 1955 as a result of mill expansion and construction of an aerial tramway.

The higher output of sulphur in 1955 can be attributed mainly to the first full year's operation of Noranda's plant at Port Robinson, Ontario, where pyrites from base-metal flotation operations were processed into sulphur, sulphur dioxide, and iron sinter. Noranda Mines Limited, Noranda, Quebec, is the largest producer of pyrites but there are five other producers in Quebec, one in British Columbia, and one in Newfoundland. In 1955, Noranda commenced construction of another plant, in the Blind River area of northern Ontario, similar to the one at Port Robinson, which will convert by-product pyrites into sulphuric acid for use in the leaching processes at uranium mines in the area.

Elemental sulphur is produced from sour natural gas in Canada at two plants in Alberta; two others were under construction in 1955. The sulphur, in the form of hydrogen sulphide, must be removed from natural gas to prepare the gas for consumption. Output of elemental sulphur from this source will increase greatly in the near future as natural gas begins to flow in large amounts to new markets.

A major development in the salt industry in 1955 was the commencement of operations at Canada's second rock-salt mine, at Ojibway, near Windsor, Ontario. The first, at Malagash, Nova Scotia, has been in operation for many years. Resulting from the new production of rock salt, total exports of salt rose from only 1,199 tons in 1954 to 146,472 tons in 1955. It is expected that imports of coarse salt will decrease substantially as the new domestic source is utilized by consumers.

The cement industry continued to make notable headway, with production in 1955 at 25,168,464 barrels, a gain of 2,730,987 barrels over 1954. Completion of present and planned construction programs will bring total annual capacity to 34,000,000 barrels, twice the Canadian output in 1950.

Canada recorded its first important production of lithia in 1955, source of the output being Quebec Lithium Corporation's property near Val d'Or in western Quebec.

Mineral Production of Canada, 1954 and 1955

		1954		1955	
		Quantity	$	Quantity	$
Metallics					
Antimony	lb	1,302,333	349,249	2,021,726	563,345
Bismuth	lb	258,675	572,183	265,896	572,362
Cadmium	lb	1,086,780	1,847,526	1,919,081	3,262,439
Cerium	lb	-	-		
Columbium	lb	90	2,294	42	988
Cobalt	lb	2,252,965	5,912,997	3,318,637	1,032
Copper	s t	302,732	175,712,693	325,994	8,563,700
Gold	oz	4,366,440	148,764,611	4,541,962	239,756,455
Indium	oz	477	1,278	104,774	156,788,528
Iron ore	l t	6,572,855	49,666,507	14,538,551	232,598
Iron ingots	s t	90,562	2,910,663	115,955	110,435,850
Lead	s t	218,495	58,250,831	202,763	4,831,845
Magnesium & calcium		-	4,101,642	-	58,314,500
Manganese ore		-	-	-	6,585,409
Mercury	lb	-	-	75	-
Molybdenite (MoS_2)	s t	376	457,912	695	250
Nickel	s t	161,279	180,173,392	174,928	823,954
Platinum group metals	oz	189,350	7,956,087	214,252	215,866,007
Platinum	oz	154,356	12,950,469	170,494	8,321,633
Pitchblende, etc...		-	26,467,574	-	14,747,732
Selenium	lb	323,529	1,617,645	427,109	26,031,604
Silver	oz	31,117,949	25,907,870	27,984,204	3,203,319
Tantalum (Ta_2O_5)	lb	77	2,696	390	24,676,472
Tellurium	lb	8,171	14,300	9,014	9,760
Thallium	lb	-	-	275	15,774
Tin	l t	149	263,359	220	378
Titanium ore	s t	1,541	9,462	1,464	408,030
Tungsten (WO_3)....	s t	1,085	5,795,781	971	10,634
Zinc	s t	376,491	90,207,285	433,357	5,508,437
Total Metallics			799,916,306		118,306,466
					1,007,839,501
Non-metallics					
Arsenious oxide ...	lb	1,180,350	48,333	1,571,787	69,159
Actinolite	s t	-	-	-	-
Asbestos	s t	924,116	86,409,212	1,063,802	96,191,317
Barite	s t	221,472	2,003,796	253,736	2,277,166
Bituminous sands ..	s t	-	-	-	-
Diatomite	ton	4	192	16	352
Feldspar	s t	16,096	301,049	18,152	355,879
Fluorspar	s t	118,969	2,987,026	128,114	2,708,437

	1954		1955	
	Quantity	$	Quantity	$
Graphite .... s t	2,463	254,534	-	-
Grinding pebbles .... s t	-	-	-	-
Grindstone....... s t	-	-	10	1,500
Gypsum .... s t	3,950,422	7,094,671	4,667,901	8,037,153
Iron oxides ...... s t	5,798	183,507	7,702	162,512
Lithia (Li_2O)..... s t	9	6,300	57	61,752
Magnesitic dolomite & brucite ..	-	4,394,280	-	2,151,820
Mica .... s t	853	85,139	820	77,541
Mineral water ... gal	284,078	148,057	306,683	160,510
Nepheline syenite .... s t	123,669	1,770,528	146,068	2,099,512
Peat moss .... s t	99,272	3,018,622	117,579	3,485,287
Perlite .... s t	-	-	-	-
Phosphate .... s t	-	-	-	-
Quartz .... s t	1,716,151	1,574,893	1,869,913	2,039,575
Salt............. s t	969,887	8,340,163	1,244,761	10,122,299
Silica brick ...... M	3,578	465,157	4,763	602,625
Sodium carbonate. s t	-	-	-	-
Sodium sulphate .. s t	158,417	2,385,573	178,888	2,799,715
Soapstone & talc.. s t	28,143	335,353	27,160	338,967
Sulphur (pyrite & smelter) ..... s t	532,406	4,875,969	628,443	5,984,953
Titanium dioxide . s t	88,408	3,841,270	117,042	5,192,810
Volcanic dust .... s t	-	-	-	-
Total non-metallics.......		130,523,624		144,920,841
Structural Materials				
Clay products	-	32,360,098	-	35,259,770
Cement .... bbl	22,437,477	59,035,644	25,168,464	65,650,025
Lime .... s t	1,214,839	14,742,149	1,331,118	15,810,904
Sand & gravel .... s t	110,961,034	58,987,671	127,524,474	67,775,053
Stone .... s t	32,767,925	39,857,134	30,512,920	43,736,687
Total		204,982,696		228,232,439
Total industrial minerals		335,506,320		373,153,280
Fuels				
Coal .... s t	14,913,579	96,600,266	14,818,880	93,579,471
Natural gas . M cu. ft	120,735,214	12,482,109	150,772,312	15,098,508
Crude petroleum ...... bbl	96,080,345	243,877,030	129,440,247	305,640,036
Peat .... ton	6	60	-	-
Total fuels		352,959,465		414,318,015
Grand total		1,488,382,091		1,795,310,796

ALUMINUM

By H.A. Graves

Each year since 1952, the Canadian aluminum industry has established a new production record. During 1955, output of The Aluminum Company of Canada Ltd. (Alcan), at present Canada's only producer, amounted to 613,000 short tons, an increase of approximately 9 per cent over 1954 and 12 per cent over 1953.

This output was achieved in spite of a power interruption at Kitimat, British Columbia, early in the year and a power shortage during the last quarter in the Saguenay district, Quebec, resulting from severe drought during the summer of 1955. The effects of this drought will curtail production in Quebec aluminum smelters until mid-April 1956, resulting in a probable loss for 1956 of 65,000 tons. Despite the cut-back, aluminum output in 1956 is expected to reach another all-time high, owing to new facilities nearing completion.

Even with increased production of aluminum, demand continues to be much greater than supply. Alcan has stepped up its plans for greater output at the Isle Maligne smelter in Quebec and at Kitimat in British Columbia. In addition, a new company, Canadian British Aluminum Company Limited, was formed in 1955 and has announced plans for the building of a $130,000,000 primary aluminum-producing plant at Baie Comeau, Quebec, with an ultimate annual capacity of 160,000 tons to be reached by 1965. The present rated capacities and estimated future capacities for these two companies under the current expansion program, are given below:

	1955	1956	1957	1958
The Aluminum Company of Canada Ltd.				
Arvida, Quebec	362,000	362,000	362,000	362,000
Isle Maligne, Que.	93,000	115,000	115,000	115,000
Shawinigan Falls, Que.	68,000	68,000	68,000	68,000
Beauharnois, Que.	37,000	37,000	37,000	37,000
Kitimat, B.C	90,000	150,000	210,000	270,000
Canadian British Aluminum Co. Ltd.				
Baie Comeau, Que.	-	-	40,000	40,000
Totals	650,000	732,000	832,000	892,000

	1959	1960	1965
The Aluminum Company of Canada Ltd.			
Arvida, Quebec	362,000	362,000	362,000
Isle Maligne, Que.	115,000	115,000	115,000
Shawinigan Falls, Que.	68,000	68,000	68,000
Beauharnois, Que.	37,000	37,000	37,000
Kitimat, B.C.	330,000	330,000	330,000
Canadian British Aluminum Co. Ltd.			
Baie Comeau, Que.	80,000	120,000	160,000
Totals	992,000	1,032,000	1,072,000

Aluminum - Production, Trade, and Consumption

	1955		1954	
	Short Tons	$	Short Tons	$
Production-Ingot	612,543		560,886	
Imports				
Bauxite and alumina, for refining				
British Guiana	1,831,011	8,180,032	2,140,641	10,684,762
French Africa	461,956	2,514,433	417,003	2,458,979
Surinam	450,664	2,422,029	282,730	2,735,430
Jamaica	127,231	7,067,169	55,933	3,053,543
Japan	21,141	1,285,226	565	27,853
United States	91	4,251	51,156	1,054,455
France	-	-	2,911	12,812
Trinidad	-	-	4,480	36,432
Total	2,892,094	21,473,140	2,955,419	20,064,266
Cryolite				
Denmark	2,204	468,270	4,409	803,620
West Germany	1,103	260,000	-	-
United States	96	24,317	45	11,220
Total	3,403	752,587	4,454	814,840
Aluminum products				
Semi-mfg.		3,042,866		2,261,117
Fully-mfg.		16,926,626		13,423,094
Total		19,969,492		15,684,211

	1955		1954	
	Short Tons	$	Short Tons	$
Exports				
Primary forms				
United Kingdom	259,112	99,040,796	211,140	75,256,214
United States	193,648	76,129,245	198,480	70,772,233
Others	57,871	24,023,735	58,874	23,433,776
Total	510,631	199,193,776	468,494	169,462,223
Semi-Fabricated				
United States	6,028	3,992,310	6,021	3,077,244
Others	6,878	3,622,723	11,426	5,963,924
Total	12,906	7,615,033	17,447	9,041,168
Manufactured				
United States		1,281,127		1,349,747
Colombia		138,149		213,138
Others		336,173		559,286
Total		1,755,449		2,122,171
Scrap				
United States	10,014	3,006,013	6,904	1,602,957
West Germany	2,527	958,532	5,546	1,740,246
Others	581	197,942	1,473	545,724
Total	13,122	4,162,487	13,923	3,888,927
Consumption of aluminum ingot	91,522		78,155	

In conjunction with the expansion program, are plans for increasing the mining of bauxite ore. The present alumina-producing capacity of Alumina Jamaica Limited, is to be more than doubled. The proposed increase will raise the capacity of the Jamaican works from 230,000 tons to 543,000 tons by mid-1957.

Increasing demand for aluminum products has stimulated a substantial expansion in fabricating plant capacity. It is reported that a new company, Pacific Coast Aluminum Limited, is setting up a $500,000 aluminum-extrusion plant in the vicinity of Vancouver, British Columbia. Production is scheduled to begin in May 1956. Reynolds International Incorporated has acquired a sheet and foil plant at Cap-de-la-Madeleine in Quebec, and is planning expansion.

Consumption of aluminum in the United States is increasing much more rapidly than smelting capacity. Although there was a record production of more than 1,500,000 tons, the supply of metal was scarce during the year as a result of the continued rise in demand for aluminum products. The situation was partly relieved by the Government's action in diverting to industry substantial amounts of aluminum from its stockpile. If the amounts to be deferred during the first half of 1956 are included, the Government will than have made available for civilian use a total of 450,000 tons of aluminum since the first quarter of 1954. The rated capacity of the four American aluminum-producing companies as of January 1, 1956, was 1,609,200 tons. New plants and expansion of existing ones are expected to add more than 500,000 tons to the annual primary aluminum capacity.

In the United States, there was renewed interest during 1955 in the study of methods for extracting alumina from high-alumina clay deposits found in Pennsylvania and in the Pacific Northwest.

Consumption and Exports

Canadian consumption of ingot aluminum is less than 100,000 short tons annually. The per capita consumption in Canada rose from 1.5 pounds in 1947 to 10.1 pounds in 1954. The rate was 19.1 pounds for the United States, 11.9 pounds for Switzerland, and 11.8 pounds for the United Kingdom in 1954.

Most of the surplus is exported under Government purchase contracts to the United Kingdom and the United States. The United Kingdom received 49.1 per cent of all exports in 1955 and the United States took 39.3 per cent. In the previous year, the ratios were respectively 45.0 per cent and 42.3 per cent. Canada continued in 1955 as the major foreign source of supply for the United States.

Uses

The uses of aluminum are based on low density, high electrical and thermal conductivity, malleability, reflectivity, high strength, casting characteristics, or various combinations of these properties. During 1955, the use of aluminum ranked first in building materials, second in transportation applications, and third in household appliances.

Aluminum is being used as a successful substitute for many other materials, for example:

Product	Aluminum Competes With
Electrical conductors	copper
Foil	paper, plastics, rock wool, lead and tin.
Castings	magnesium, zinc, steel, iron, plastics, copper, bronze and wood.

Product	Aluminum Competes With
Utensils	cast iron, stainless steel, common steel, copper, glass and earthenware.
Architectural	steel, stainless steel, wood, plastics, brick, masonry, copper, bronze, asphalt, asbestos, plaster.

The inroads of aluminum into the whole field of electrical engineering is remarkable. The use of aluminum for cable making will increase so long as the price of copper remains at its present high level.

The automobile industry is accelerating its consumption of aluminum, with one of the latest models using 197 pounds per car, including gold-anodized aluminum grills. In contrast, the average use of aluminum ten years ago was 10 pounds per car.

The low cost of aluminum has all but eliminated tin and lead foils from the packaging market.

Prices

The Canadian price of aluminum ingot was 19.75 cents per pound at the beginning of the year. At the end of July, the price of ingot in Canada was raised to 21 cents a pound where it remained till the end of the year.

The price of aluminum ingot in the United States was raised from 22.2 to 23.2 cents per pound on January 7, 1955, and again in July to 24.4 cents.

ANTIMONY

By R.E. Neelands

The Consolidated Mining and Smelting Company of Canada Limited (Cominco) produced metallic antimony from 1939 to 1944 at its lead-zinc smelter and refineries at Trail, British Columbia. Since 1944, the output has been in the form of a lead alloy containing from 1 to 35 per cent antimony; normally it contains 25 per cent antimony and 75 per cent lead. The production of 783 tons of contained antimony in 1955 compares with 515 tons in 1954 and the all-time high of 834 tons in 1945.

The principal source of the antimony produced at Trail is the silver-lead-zinc ore of Cominco's Sullivan mine at Kimberley, British Columbia. Lead concentrate from the Sullivan, together with concentrates containing small amounts of antimony from a number of other mines, are treated at the Trail smelter, the lead bullion produced containing about one per cent antimony, most of which is recovered as antimonial lead in the course of making

(Cont'd on page 14)

Antimony - Production, Trade and Consumption

	1955 Short Tons	1955 $	1954 Short Tons	1954 $
Production				
Antimony content of antimonial lead	783		515	
Antimony in dore slag	228		136	
Total	1,011	563,345	651	349,249
Imports				
Antimony metal				
United Kingdom	340	212,543	585	296,071
Belgium	123	58,781	245	108,975
China	53	19,630	-	-
Czechoslovakia	32	12,350	29	10,263
Netherlands	132	52,959	59	27,778
West Germany	*	77	21	8,689
Other countries	-	-	83	39,006
Total	680	356,340	1,022	490,782
Antimony oxides				
United Kingdom	65	28,950	81	37,595
United States	45	25,074	22	12,123
West Germany	32	13,907	11	5,394
Belgium	1	516	1	511
Total	143	68,447	115	55,623
Antimony salts				
United States	18	18,627	11	12,175
West Germany	1	1,024	-	-
United Kingdom	**	61	1	1,063
Total	19	19,712	12	13,238
Exports				
Antimony content of antimonial lead	787		349	
Consumption in production of:				
Antimonial lead	495		467	
Type metal	56		59	
Babbitt	121		129	
Solder	25		11	
Cable alloys	2		169	
Antimony oxide	1		1	
Batteries	3		5	
Other uses	91		69	
Total	794		910	
Consumption of antimonial lead alloy (antimony content)				
25% antimonial lead	128		418	
Other grades	592		482	
Total	720		900	

* 220 pounds ** 112 pounds

electrolytically refined lead. In the smelting process, slags and flue dust containing a high percentage of antimony are accumulated and, as the Trail plant is not equipped to treat them, are sold to foreign smelters.

Based on figures for 1954, the principal producing countries on a mine basis are China (8,800 tons of contained antimony), Bolivia (5,751), Mexico (4,610) and Algeria (2,595). The United States, the principal consumer, used about 10,130 tons of primary metal in 1955 compared with 12,180 tons in 1954. World demand and supply were in balance but the price per pound in the United States increased from 31.97 cents to 36.47 cents.

Occurrences and Development

A number of 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 county, Quebec; Gray Rock property, Truax Creek, Bridge River district, Stuart Lake mine, Fort St. James area, and Caroline property, West Kootenay district, British Columbia; Highet Creek deposit, Mayo district, and Wheaton River deposits, near Whitehorse, Yukon.

The 1954 Annual Report of the Minister of Mines for British Columbia contains a report on the Gray Rock property, based on an examination made in 1954 by a member of his staff.

No active development on any Canadian antimony deposit has been reported for several years.

Uses and Consumption

The metal 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; it is alloyed with tin in the manufacture of Babbitt metal and with lead and tin for solders, collapsible tubes, and type metal.

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

Prices

The United States price of antimony, 99.50 per cent, boxed, at New York, was 31.970 cents per pound from January until the middle of August, when it increased to 36.470 cents, remaining at this level for the balance of the year.

The average value of contained antimony produced in Canada in 1955 was estimated by the Dominion Bureau of Statistics to have been 27.23 cents a pound.

The price quoted in the latter part of the year for antimonial lead (25 per cent antimony), f.o.b. Toronto, was 14.8 cents a pound.

BISMUTH

By R.E. Neelands

About 60 per cent of Canada's production in 1955 was refined bismuth produced by The Consolidated Mining and Smelting Company of Canada Limited (Cominco) at Trail, British Columbia. The remainder was semi-refined metal (about 98 per cent Bi) produced by Molybdenite Corporation of Canada Limited at La Corne, 23 miles northwest of Val d'Or, Quebec.

Bismuth - Production, Trade and Consumption

	1955		1954	
	Pounds	$	Pounds	$
Production*				
British Columbia	160,767	361,726	225,351	507,040
Quebec	105,129	210,636	33,324	65,143
Total	265,896	572,362	258,675	572,183
Exports of metal	56,142		134,513	
Imports				
Bismuth, residues and concentrates				
Peru	5,908	11,888	-	-
Bismuth salts				
United Kingdom		17,244		17,899
United States		4,555		13,237
Total		21,799		31,136
Consumption of bismuth metal by industries				
Medicinals & pharamaceuticals	22,000		20,000	
White metal foundries	36,000		36,000	
Miscellaneous	14,000		18,000	
Total accounted for	72,000		74,000	

* Refined metal from Canadian ores plus bismuth content of bullion exported.

Domestic Sources

British Columbia

Bismuth produced at Trail originates for the most part in the lead-zinc-silver ores produced at Cominco's Sullivan mine at Kimberley but some comes from other company mines and from custom ores and manufacturers' residues. The sources of the company's bismuth output are not separately reported.

Lead bullion produced at the Trail lead smelter contains about 0.05 per cent bismuth. The residue resulting from the electrolytic refining of the bullion is treated for the recovery of contained precious metals, bismuth, and antimony. The refined bismuth has a purity exceeding 99.99 per cent.

Quebec

At the La Corne mine, mill capacity was increased from 400 to 540 tons a day. This mine is operated primarily for the molybdenum content of the ore. The flotation process produces a concentrate containing 7 per cent bismuth, which is separated by leaching to form bismuth oxychloride. This is smelted in electric arc furnaces to produce crude metal with a bismuth content of 98 per cent or over. In 1955, 99,670 pounds of ingots were produced.

North Sullivan Contact Mines Limited, a company associated with Molybdenite Corporation, gave serious consideration to reopening of the Indian molybdenum mine about 20 miles west of La Corne in Preissac township. The ore is reported to be of a similar character and grade to that at the La Corne mine.

World Production

The annual world production of bismuth is about 4 million pounds, the leading producing countries being Mexico, Peru, and South Korea.

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 alloys it is used in making type-metal.

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

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

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

In the United States, consumption by principal uses in 1952 and 1953 was as follows: (Ref: U.S. Minerals Year Book - 1953)

	1953		1952	
	Pounds	Per cent of total	Pounds	Per cent of total
Pharmaceuticals	414,200	27	406,800	23
Solders	221,000	14	145,900	8
Fuse alloys	191,200	12	261,700	15
Other alloys	613,800	39	865,800	49
Rectifier coatings	47,500	3	25,500	1
Other uses	80,300	5	69,300	4
	1,568,000	100	1,775,000	100

Prices

E & M J Metal and Mineral Markets quoted the price of bismuth in ton lots or larger as $2.25 a pound in New York throughout the year. The crude bismuth metal produced by the Molybdenite Corporation of Canada Limited had an estimated value of $1.80 a pound.

CADMIUM

By R.E. Neelands

Refined cadmium is produced in Canada by The Consolidated Mining and Smelting Company of Canada Limited (Cominco) at Trail, British Columbia, and Hudson Bay Mining and Smelting Company Limited at Flin Flon, Manitoba. A small amount of cadmium is produced from zinc concentrates which are exported to foreign smelters, but this is not all reported. In 1955, the estimated over-all production was 1,919,081 pounds compared with 1,086,780 pounds in 1954.

The metal is a minor constituent of many zinc ores and is recovered as a by-product at various zinc plants throughout the world either by fractional distillation or by leaching and electrolysis. In the electrolytic zinc refining process used at Trail and Flin Flon the cadmium is accumulated in precipitates resulting from the purification of zinc electrolyte solution and it is recovered from the precipitates by leaching and electrolysis. About 70 per cent of the cadmium in zinc concentrates is recoverable and metal of a purity of not less than 99.95 per cent is produced in the form of balls, sticks and slabs.

Domestic Sources

British Columbia

The principal source of cadmium is the silver-lead-zinc ore of Cominco's Sullivan mine at Kimberley. The ore is milled near Kimberley to produce zinc and lead concentrates, which are shipped to Trail. Other sources included the company's Bluebell mine on Kootenay Lake, its H.B. mine near Salmo, and its Tulsequah mines on the northwest coast, also the Jersey zinc-lead mine of Canadian Exploration Limited near Salmo and Silver Standard Mines Limited near Hazelton. A number of small or medium-sized producers exported zinc concentrates containing cadmium to zinc plants in Idaho and Montana. Zinc concentrates produced at the Sullivan average 0.14 per cent cadmium but those from some other mines range up to 0.8 per cent.

Yukon

United Keno Hill Mines Limited in the Mayo district was the only important producer. It shipped zinc concentrates containing about 305,800 pounds of recoverable cadmium to the Trail smelter.

Manitoba and Saskatchewan

Hudson Bay Mining and Smelting Company's refined cadmium production came from its Flin Flon copper-zinc mine on the provincial boundary and from several small mines operated by the company in the Flin Flon area.

Eastern Canada

Zinc concentrates exported by 11 mines in Quebec and 3 mines in other provinces contained an average of about 0.2 per cent cadmium; the largest producer, Barvue Mines Limited, Barraute, Quebec, shipped concentrates averaging 0.325 per cent. No payment is received for the cadmium contained in these concentrates, nor is the amount recovered reported.

Uses

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

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

The second largest use is for bearing alloys used in internal combustion engines specially designed for high speeds and temperatures. There are two types of these alloys: the cadmium-nickel alloy composed of about

Cadmium - Production, Trade and Consumption

	1955		1954	
	Pounds	$	Pounds	$
Production, all forms				
British Columbia	1,515,582	2,576,490	679,331	1,154,863
Yukon	211,808	360,674	252,853	429,850
Saskatchewan and Manitoba	191,691	325,875	154,596	262,813
Total	1,919,081	3,262,439	1,086,780	1,847,526
Production, refined(1)	1,714,965		1,058,624	
Exports				
United States	819,570	1,200,034	164,657	234,147
United Kingdom	608,725	902,035	565,438	913,334
Netherlands	78,400	102,468	44,800	58,333
West Germany	33,600	40,830	-	-
Belgium	22,042	30,105	-	-
Other countries	-	-	1,496	2,541
Total	1,562,337	2,275,472	776,391	1,208,355
Consumption by industries				
Automotive	61,011		39,856	
Electrical	89,364		111,346	
Hardware	12,902		11,553	
Solders	4,957		2,641	
Miscellaneous	52,652		32,290	
Total	220,886		197,686	
Refinery production(2) by principal countries				
United States	9,753,699		9,415,710	
Canada	1,919,081		1,086,780	
France	396,835		312,700	
Italy	442,022		457,675	
Norway	255,496		178,429	
United Kingdom	337,546		288,036	
Tasmania	511,502		515,344	

(1) Includes some metal from foreign ores.
(2) American Bureau of Metal Statistics.

98.5 per cent cadmium and 1.2 per cent nickel and the cadmium-silver-copper alloy containing 98.3 per cent or more cadmium, 0.7 per cent silver, and 0.6 per cent copper.

Cadmium is also used in making low-melting-point solders and fusible alloys of the cadmium-tin-lead-bismuth type for automatic sprinkler systems, fire-detection apparatus, and valve seats for high-pressure gas containers. The addition of about one per cent of cadmium considerably strengthens copper wire without seriously reducing its conductivity. In the field of atomic energy, the metal is used for shielding purposes and in devices for reactor control.

Nickel-cadmium storage batteries have a longer life period than the standard lead-acid battery and are relatively much smaller but more expensive. The use of this type of battery is increasing, particularly for military applications and low-temperature conditions.

Cadmium sulphide and cadmium sulphoselenide are used where bright, high-quality, yellow and red colours, respectively, are required for paints, inks, ceramic glazes, paper, rubber, and glass. Cadmium oxide, cadmium hydrage, and cadmium chloride are used in electroplating solutions. Cadmium bromide and iodide are used to make photographic films, also in photo-engraving and photo-lithography. Cadmium stearate goes into the making of vinyl plastics.

Prices

The New York price of cadmium in commercial sticks was $1.70 a pound throughout 1955.

The average Canadian price in 1955 estimated by the Dominion Bureau of Statistics was $1.70 a pound.

CHROMITE

By W. Keith Buck

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.

Canadian consumption of chromite, which is mainly used in the production of ferrochrome, has continued to decline, the 1955 consumption of 49,270 tons being about 75 per cent of that in 1954. Canadian production of ferrochrome at capacity levels is dependent upon exports, mainly to the United States and United Kingdom. The establishment of production in England and South Africa and the proximity of Scandinavian ferrochrome in the sterling area have cut down the export market.

Chromite - Trade and Consumption

	1955		1954	
	Short Tons	$	Short Tons	$
Imports, chromite				
Philippines	14,986	197,505	8,960	117,325
Cuba	14,165	308,534	-	-
Union of South Africa	9,805	112,597	20,883	267,347
Rhodesia and Nyasaland	7,849	179,254	6,111	120,772
United States	5,029	172,257	1,563	66,540
Russia	110	1,375	-	-
Total	51,854	971,522	37,517	571,984
Exports, ferrochrome				
United States	11,695	2,070,342	14,768	2,632,941
United Kingdom	453	92,019	245	47,643
Belgium	157	38,015	245	50,994
Other countries	49	14,778	46	9,602
Total	12,354	2,215,154	15,304	2,741,180
Consumption of chromite	49,270		65,141	

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 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

In 1954, the estimated world production of chromite amounted to 3,500,000 short tons.

The Union of South Africa with its large reserves of medium-grade ore in the Transvaal was the largest producer. Much of the Union's output is of chemical grade, of which it is the only producer. The second largest producer was Turkey, where most of the production is a very high (52% chromic oxide, Cr_2O_3) metallurgical-grade ore. Russia was the third largest producer and Southern Rhodesia the fourth. Southern Rhodesia competes with Turkey as a major source of metallurgical-grade ore. The Philippines, with very large reserves of ore of metallurgical and refractory grades, occupied fifth position in world production.

In the Americas, the United States was the leading producer, followed by Cuba. Cuba's output comprises both refractory and metallurgical grades. The United States production is not for current consumption, but for stockpile purposes at high-incentive prices.

Consumption and Uses

World consumption of chromium is about three and one-half times the combined consumption of nickel, tungsten, molybdenum, and cobalt, with the United States consuming about one-third of the total.

Approximately 55 per cent of all chromite consumed is metallurgical grade, 30 per cent is 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 to 1 to 3 to 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 mainly consumed 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, separating the silica bricks of the roof and the top of the sides from 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 ore should not contain more than 15 per cent alumina (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 or 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 29, 1955, 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 N.Y., etc.

Rhodesian	
48% Cr_2O_3, 3 to 1 ratio, lumps	\$45 to \$46
48% Cr_2O_3, 2.8 to 1 ratio	\$42 to \$43
48% Cr_2O_3, no ratio	\$33 to \$35
all long-term contracts	
South African (Transvaal)	
48% Cr_2O_3, no ratio	\$31 to \$32
44% Cr_2O_3, no ratio	\$23.50 to \$24.50

Turkish

48% Cr_2O_3, 3 to 1 ratio, lump and concentrates - \$52 to \$53
46% Cr_2O_3, 3 to 1 ratio, lump and concentrates - \$49.50 to \$51

Pakistan (Baluchistan)	
48% Cr_2O_3, 3 to 1 ratio	\$49 to \$50

Ferrochrome per lb of Cr.
High carbon (4-9% c), 65 to 69% Cr, lumps, carloads, f.o.b. destination continental United States - 26 1/4¢
Low carbon, Simplex No. 1, 0.01c - 32 3/4¢.

Chromium metal
per lb. 97% grade, 0.5% c, - $1.25
per lb. 97% grade, 9-11 c, - $1.34
Electrolytic chromium, commercial grade, 99% min., f.o.b. Niagara Falls, N.Y. - $1.25 per lb.

Tariffs

Canadian

Chrome ore - free

Chromium metal - in lumps, powder, ingots, blocks, or bars, and scrap alloy metal containing chromium, when imported by manufacturers for use exclusively for alloying purposes in their own factories - free.

Ferrochrome

British preferential	- free
Most favoured nation	- 5% ad valorem
General	- 5% ad valorem

United States

Chrome ore - free

Chromium metal - 12 1/2% ad valorem

Chromium nickel and chromium vanadium - 12 1/2% ad valorem

Ferrochrome
3% or more carbon on Cr. content - 5/8¢ per lb
less than 3% carbon on Cr. content - 12 1/2% ad valorem

COBALT

By R.E. Neelands

Cobalt production, as represented by shipments of metal, oxides, and matte, derived from ores of Canadian origin increased to 3,318,637 pounds from 2,252,965 pounds in 1954. The value increased by 45 per cent to an all time high of $8,563,700. Exports of cobalt oxides to the United Kingdom were about double those of 1954. In June, the production of refined cobalt was commenced by Sherritt Gordon Mines Limited in its nickel refinery at Fort Saskatchewan, Alberta.

Cobalt - Production, Trade and Consumption

	1955		1954	
	Pounds	$	Pounds	$
Shipments[1] from Canadian ores (contained cobalt)				
In metals, alloys, oxides & salts	3,318,637	8,563,700	2,252,965	5,912,997
Exports				
Concentrates				
Contained cobalt[2]	-	-	3,300	5,693
Cobalt Metal				
United States	1,383,088	3,178,553	1,139,039	3,778,413
Total	1,383,088	3,178,553	1,139,039	3,778,413
Cobalt alloys[3]				
France	10,450	48,246	3,700	16,736
United States	1,753	5,697	4	41
Other countries	154	2,155	1,222	5,525
Total	12,357	56,098	4,926	22,302
Cobalt oxides & salts[3]				
United Kingdom	1,617,445	2,864,130	816,365	1,425,254
United States	20,525	25,732	10,000	11,000
Hong Kong	2,312	4,522	-	-
Other countries	-	-	9,840	18,394
Total	1,640,282	2,894,384	836,205	1,454,648
Imports[3]				
Cobalt concentrates				
United States	37,600	10,386	10,300	1,195
Norway	200	512	100	126
Total	37,800	10,898	10,400	1,321
Oxides				
United States	8,000	20,490	2,675	7,195
United Kingdom	-	-	4,260	7,200
Total	8,000	20,490	6,935	14,395
Consumption[4]				
(Contained cobalt)	287,806		160,342	

(1) Excludes cobalt content of nickel matte shipped to England by International Nickel Company but includes the cobalt content of Falconbridge's shipments of nickel copper matte to Norway.

(2) Refers to cobalt content of ores & concentrates from Cobalt district only.

(3) Refers to gross weight (not cobalt content).

(4) Producer's domestic shipments of black oxide, metal and sulphate.

Consumption of cobalt in Canada recovered to a great extent from the large decrease that took place in 1954.

Production

Cobalt - Gowganda Area, Ontario

Cobalt ore shipments through the agency of the Temiskaming Testing Laboratories, Cobalt, amounted to 1, 293,500 pounds of contained cobalt compared with 1,254,425 pounds in 1954. These shipments were all made to Deloro Smelting and Refining Company Limited, Deloro, Ontario.

The principal shippers of cobalt ore were Silver Miller Mines Limited and Cobalt Consolidated Mining Corporation Limited; smaller amounts were also shipped by Nipissing-O'Brien Mines Limited and Silver Crater Mines Limited. These mines are all in the Cobalt district.

Cobalt ore shipments were sold under a price support plan administered by the Canadian Department of Defence Production on behalf of an agency of the United States government. The prices paid for cobalt ores to companies which participated in the plan were as follows, f.o.b., Cobalt, Ontario:

% Cobalt	Per lb Contained Cobalt
	$
7 - 7.99	1.00
8 - 8.99	1.15
9 - 9.99	1.30
10 - 10.99	1.40
11 - 11.99	1.50
12 plus	1.60

Silver ore shipments through the Temiskaming Testing Laboratories to the Deloro smelter contained 135,938 pounds of cobalt compared with 172,110 pounds in 1954. The cobalt content was purchased by Deloro for its own account and partly used to meet domestic consumption. Low- to medium-grade silver concentrates containing copper and cobalt values were shipped to the smelter of Noranda Mines Limited, Noranda, Quebec. The cobalt contained in these shipments was not recovered.

At mines in the Cobalt area emphasis was placed on the exploration for and development of silver ore rather than cobalt ore since the outlook for a continuation of the price support plan for the purchase of cobalt ores after 1956 was not encouraging.

Sudbury Area, Ontario

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 Company Limited plant 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 a 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.

Falconbridge Nickel Mines Limited produces electrolytic cobalt from nickel-copper matte exported to its nickel refinery at Kristiansand, Norway.

Manitoba

Sherritt Gordon Mines Limited operated its copper-nickel mines at Lynn Lake at capacity. The ores have a low cobalt content and the production of refined cobalt was commenced as a by-product in June 1955 at the company's nickel refinery at Fort Saskatchewan, Alberta. About 14,150 pounds of cobalt valued at $28,300 were produced in the balance of the year.

Northwest Territories

Uranium concentrate shipped from the Crown-owned mine of Eldorado Mining and Refining Limited at Port Radium, Great Bear Lake, contains a small amount of cobalt. In the treatment of this material at the company's refinery at Port Hope, Ontario, a high-cobalt speiss was produced and shipped to the Deloro smelter. Early in 1955, owing to a change in the refining process at Port Hope, the production of cobalt speiss was discontinued.

Domestic Refinery Production

Deloro Smelting and Refining Company operated at its output capacity of 60 to 65 tons a day, treating for the most part stockpiled Canadian cobalt concentrates for United States government account. The smelting of Moroccan ores and Eldorado speiss was discontinued during the year. Products of the smelter include cobalt metal, grey and black cobalt oxide, and amorphous cobalt sulphate.

The International Nickel Company operated the electrolytic cobalt unit of its Port Colborne refinery to produce high-purity cobalt used mainly for high-temperature alloys and permanent magnets. Considerable research was devoted to a new range of nickel-cobalt alloys having special magnetostrictive charactaristics.

Eastern Smelting and Refining Company Limited announced its intention to construct a nickel-copper smelter and refinery at Chicoutimi, Quebec, in which cobalt and platinum-group metals would also be produced. The tentative completion date of this plant was given as July 1957.

The smelter of Cobalt Chemicals Limited, 5 miles south of Cobalt, remained inactive during the year but plans were initiated to install a 2-ton pilot plant within the smelter in order to test all phases of the leaching and acid purification process for the recovery of cobalt, silver, nickel, and copper.

World Mines Production

World Mines Production of Cobalt, 1952 to 1955 (pounds)*

United States[a]	1,363,251	1,258,924	1,996,488	2,609,000
Canada[b]	1,421,923	1,602,545	2,252,965	3,318,637
Northern Rhodesia[c]	1,037,120	1,032,640	940,800	1,510,000
Belgian Congo [c]	15,059,623	18,249,769	18,979,401	18,836,808
French Morocco [c]	2,200,191	1,327,169	1,622,586	1,671,087

* Source: American Bureau of Metal Statistics.

(a) Cobalt content of ore
(b) Cobalt contained in metals, alloys, oxides, salts, and ores exported
(c) Cobalt content of alloys

In 1955, United States production was 31 per cent greater than in 1954.

Uses and Consumption

About 90 per cent of the total consumption of cobalt 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, sulphate, etc.; and organic compounds such as linoleates, naphthenates, and resinates.

The most important use for 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 by industry for radiographic examinations, and also in the 'Cobalt Bomb' for the treatment of cancer.

The largest use for cobalt oxide is for making ground-coat frit to promote adherence of fired enamel 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 are 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 Company Limited, 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, P.Q.; and Canadian Hanson and Van Winkle Company, Limited (electroplating equipment), Toronto, Ontario.

Prices

The commercial prices of cobalt throughout 1955, according to E & M J Metal and Mineral Markets, remained at the 1953 level.

Cobalt metal, $2.60 per pound in the form of rondelles or granules in 500- to 600-pound containers, ex docks or store New York or Niagara Falls, N.Y. In 100-pound containers the price is $2.62 per pound, and in less than 100-pound containers, $2.67 per pound.

Cobalt metal fines, $2.60 per pound of cobalt contained f.o.b. New York or Niagara Falls, N.Y., standard package of 650 pounds.

Cobalt oxide, ceramic grade 72 1/2 to 73 1/2 per cent cobalt, $1.96 per pound east of Mississippi and $1.98 1/2 per pound west. Quotations are for oxide packed in 350-pound containers.

The Northern Miner, Toronto, at the end of 1955 quoted the following prices:

Metal (97 per cent cobalt)	$2.55 per pound
Oxide (70-71 per cent cobalt)	$1.92 " "
Sulphate (35-36 per cent cobalt)	$1.10 " "

Tariffs

Canada

Ore - free; cobalt metal: British preferential - free, most favoured nation - 15% 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¢ per pound; cobalt-oxide - 5¢ per pound; cobalt sulphate - 2 1/2¢ per pound; other cobalt compounds and salts - 30% ad valorem.

COPPER

By E.C. Hodgson

Mine production in 1955 totalled 325,994 tons, about 8 per cent over that of 1954. Copper led all other metals in value at $239,756,455. Ontario contributed 45 per cent of the tonnage, practically all of which came from the copper-nickel ores of the Sudbury area. Quebec produced 31 per cent, and the remainder came from Saskatchewan, British Columbia, Manitoba, Newfoundland, Nova Scotia, and New Brunswick, in that order.

The output of refined copper, which at 289,425 tons increased 14.2 per cent over 1954, came from Canada's two refineries. Blister copper from the smelter of The International Nickel Company of Canada, Limited was refined at Copper Cliff, Ontario, and the refinery at Montreal East, Quebec, operated on material from the smelters of Noranda Mines Limited and Hudson Bay Mining and Smelting Company, and copper scrap.

World mine production of copper in 1955 has been estimated by the American Bureau of Metal Statistics to be 3,388,331 short tons, of which the United States produced 1,104,442, Chile 477,869, Northern Rhodesia 395,307, Russia 372,500, and Canada 325,994.

The production of primary copper in the United States, Chile and Northern Rhodesia was reduced because of labour disturbances. This reduction caused supplies to drop below demand.

Developments at Producing Mines

Newfoundland

Buchans Mining Company Limited, in central Newfoundland, milled 291,000 tons of zinc-lead-copper ore, from which concentrates containing 3,889 tons of copper were produced. Of the ore mined, 63 per cent came from the newly developed Rothermere orebodies.

Nova Scotia

Mindamar Metals Corporation Limited milled 244,329 tons of ore from its Stirling zinc-lead-copper mine in southern Cape Breton Island, from which lead-copper concentrates containing 1,166 tons of copper were produced. Ore reserves at the end of the year were estimated at 86,740 tons, which will be exhausted by April 1956 at the current rate of production.

New Brunswick

Keymet Mines Limited produced a small amount of copper from its lead-zinc-silver mine 18 miles northwest of Bathurst.

Copper - Production, Trade and Consumption

	1955 Short Tons	1955 $	1954 Short Tons	1954 $
Production, all forms*				
Ontario	146,406	107,215,943	140,776	81,343,536
Quebec	101,021	74,502,645	83,930	48,948,202
Saskatchewan	32,945	24,297,063	36,192	21,107,074
British Columbia	22,127	16,267,579	25,088	14,544,212
Manitoba	19,380	14,438,505	12,274	7,161,925
Newfoundland	3,052	2,250,672	3,481	2,029,876
Nova Scotia	1,027	757,758	991	577,868
New Brunswick	36	26,290	-	-
Total	325,994	239,756,455	302,732	175,712,693
Production, refined**	289,425		253,365	
Exports				
In ingots, bars, slabs, etc.				
United Kingdom	69,198	48,236,865	77,867	45,531,448
United States	67,071	48,823,152	60,814	35,661,145
France	8,957	6,904,054	7,728	4,416,620
Australia	3,993	2,769,937	1,126	684,220
India	1,724	1,317,693	2,211	1,368,028
West Germany	937	636,277	404	237,636
Other countries	1,319	961,625	5,980	3,456,419
Total	153,199	109,649,603	156,130	91,355,516
In rods, strips, sheets and tubing				
Switzerland	6,269	4,652,091	4,953	2,968,879
United States	4,321	3,890,384	1,144	965,953
United Kingdom	2,432	2,143,851	-	-
West Germany	1,013	691,760	-	-
New Zealand	1,317	1,376,334	252	269,114
Cuba	693	767,821	675	648,110
Other countries	3,117	2,695,150	2,734	2,107,873
Total	19,162	16,217,391	9,758	6,959,929
In ore and matte				
United States	26,883	18,547,551	34,073	18,399,501
Norway	11,324	7,654,060	10,547	5,695,326
West Germany	1,828	1,279,158	1,716	926,694
United Kingdom	1,130	773,112	1,075	580,635
Belgium	400	309,211	-	-
Total	41,565	28,563,092	47,411	25,602,156

* Blister copper from Canadian ores plus recoverable copper in concentrates matte, etc., exported.

** Production of refined copper from both domestic and imported ores.

	1955		1954	
	Short Tons	$	Short Tons	$
Exports (Cont'd)				
Scrap, slag, skimmings, and sludge				
United States.........	8,237	5,571,682	2,807	866,202
West Germany	7,210	4,761,129	4,177	2,194,387
Spain................	279	160,593	102	50,750
Other countries	2,567	1,600,897	3,850	2,005,097
Total................	18,293	12,094,301	10,936	5,116,436
Consumption, refined .	138,559		102,432	

Quebec

Noranda Mines Limited mined 1,357,020 tons of ore from the Horne mine, from which 27,734 tons of copper and 206,310 ounces of gold were produced. The smelter treated 1,280,000 tons of ores and concentrates, including material from other copper, gold, and silver mines that produced 107,472 tons of anode copper which yielded 104,000 tons of copper, 402,600 ounces of gold, and 2,800,000 ounces of silver. The copper and precious metals were recovered at the electrolytic copper refinery of Noranda's subsidiary, Canadian Copper Refiners Limited, Montreal East.

Gaspe Copper Mines Limited, a subsidiary of Noranda Mines Limited, mined and milled 474,629 tons of ore. Milling began on April 7. A total of 34,430 tons of copper concentrate was produced, of which 17,902 tons were shipped to the Noranda smelter and 8,041 tons were smelted at Gaspè. The concentrates yielded 6,692 tons of copper, 862 ounces of gold, and 81,198 ounces of silver. The first cast of anodes from the new smelter at Gaspè was made on December 9. Ore reserves are estimated at 67,000,000 tons grading 1.3 per cent copper.

Waite Amulet Mines Limited and Amulet Dufault delivered to the Waite Amulet mill 402,265 tons of copper-zinc ore, from which concentrate containing 19,908 tons of copper was produced. The daily capacity of the mill was increased to 2,000 tons of ore. The milling of ore from the West Macdonald Mine was started in August and a total of 83,723 tons from this source was treated.

Normetal Mining Corporation Limited milled 362,173 tons of ore and produced 37,247 tons of copper concentrate containing 8,068 tons of copper. Ore reserves at the end of the year were estimated to be 2,675,100 tons averaging 2.41 per cent copper and 8.24 per cent zinc.

Quemont Mining Corporation Limited milled 842,807 tons of ore and produced 67,812 tons of copper concentrate containing 11,336 tons of copper. Ore reserves at the end of the year were estimated to be 8,440,000 tons averaging 1.40 per cent copper, 2.58 per cent zinc and 45 per cent pyrite. The main shaft was sunk 688 feet to 3,520 feet and levels were opened at 2,820 feet and 3,270 feet.

East Sullivan Mines Limited treated 958,225 tons of ore, producing concentrates containing 8,122 tons of copper. Deepening of the main shaft from 2,950 feet to 4,000 feet was begun. Ore reserves at the end of 1954 were reported to be 3,405,700 tons grading 1.22 per cent copper and 0.98 per cent zinc.

Golden Manitou Mines Limited changed half of its mill capacity from a zinc to a copper circuit. The copper circuit commenced operation in October with a capacity of 530 tons of ore daily. A copper zone between surface and 800-foot level is under development. A second copper zone below the 800-foot level has been indicated by diamond drilling.

Opemiska Copper Mines (Quebec) Limited milled 162,098 tons of ore and shipped the concentrate by truck to St. Felicien and thence by rail to the Noranda smelter. A total of 7,659 tons of copper was recovered from the concentrate. Additions were made to the mill which increased the capacity to 800 tons of ore per day.

Quebec Copper Corporation Limited, a subsidiary of East Sullivan Mines Limited, milled an average of 800 tons of ore daily. Concentrates containing about 3,100 tons of copper were shipped to the Noranda smelter. The shaft is being sunk to 1,875 feet.

Campbell Chibougamau Mines Limited commenced milling operations on June 1 and treated 392,874 tons of ore. Concentrates containing 10,987 tons of copper were shipped to Noranda. The shaft was deepened from 1,228 to 1,450 feet with a final objective of 2,178 feet.

Weedon Pyrite and Copper Corporation Limited shipped copper concentrates to Noranda containing an estimated 1,334 tons of copper. Late in the year a contract was let to sink an inclined shaft to a depth of 2,000 feet.

There was a small output of bulk lead-copper concentrates by Ascot Metals Corporation Limited, in Sherbrooke county.

Ontario

The International Nickel Company of Canada Limited mined 14,247,591 tons of copper-nickel ore from Creighton, Frood-Stobie, Levack, Garson, and Murray mines, and from the Frood open pit, all in the Sudbury area. Ninety per cent of the ore was mined in underground operations. Deliveries of refined copper produced at the company's Copper Cliff refinery totalled 131,595 tons. About 60 per cent of the refined copper production was delivered to rolling mill and wire drawing customers in Canada. Proved ore reserves at the end of the year were reported to be 262,269,185 tons with a combined copper-nickel content of 7,897,830 tons.

Falconbridge Nickel Mines Limited milled 1,679,610 tons of ore from its Falconbridge, East Falconbridge, McKim, Mount Nickel, and Hardy mines and smelted the concentrates in the Sudbury area. The copper-nickel matte produced was shipped to a refinery at Kristiansand, Norway. Deliveries of copper totalled 10,916 tons. Total ore reserves at the end of the year were reported to be 39,847,650 tons grading 0.73 per cent copper and 1.43 per cent nickel.

Nickel Offsets Limited and Nickel Rim Mines Limited, both in the Sudbury area, shipped copper-nickel concentrates to the Falconbridge smelter.

Min-Ore Mines Limited (formerly New Ryan Lake Mines), in the Matachewan district continued production of copper concentrates, which it shipped to Noranda.

Temagami Mining Company Limited commenced production in August by open-pit mining from a small high-grade copper deposit. The ore was shipped to the American Metal Company at Carteret, New Jersey. Underground development of low-grade copper-nickel orebodies is planned.

Manitoba

Hudson Bay Mining and Smelting Company Limited operates four mines, a concentrator, copper smelter, and zinc plant in the Flin Flon area. The Flin Flon copper-zinc orebody lies astride the Manitoba-Saskatchewan boundary. Ore mined at the Schist Lake mine, 3 1/2 miles southeast of Flin Flon, at the North Star mine, 12 miles due east of Flin Flon, and at the Don Jon mine, 1,600 feet east of the North Star, is trucked to Flin Flon for treatment. The output from the Flin Flon mine totalled 1,467,347 tons, a small percentage of which was direct-smelting ore, from the Schist Lake mine 118,206 tons of milling ore averaging 5.30 per cent copper and 8.6 per cent zinc, from the North Star mine 57,115 tons of ore averaging 6.87 per cent copper, and from the Don Jon mine 22,321 averaging 3.2 per cent copper.

The concentrator treated 1,642,943 tons of ore, from which 318,243 tons of copper concentrates was produced. The copper smelter produced blister copper containing 46,909 tons of copper, 130,582 pounds of selenium, 109,314 ounces of gold and 1,675,311 ounces of silver; it was treated at the electrolytic refinery of Canadian Copper Refiners Limited, Montreal East, Quebec. Total ore reserves at the end of 1954 were estimated to be 17,309,844 tons.

Sherritt Gordon Mines Limited operates two copper-nickel mines and a concentrator at Lynn Lake and a chemical metallurgical refinery for treating nickel concentrates at Fort Saskatchewan, Alberta. During the year 761,584 tons of nickel-copper ore were mined and milled at Lynn Lake. Copper concentrates containing 5,659 tons of copper were shipped to a custom smelter. At the end of the year ore reserves were reported to be 13,820,000 tons averaging 1.15 per cent nickel and 0.59 per cent copper.

Saskatchewan

Hudson Bay Mining and Smelting Company Limited. The larger part of the company's Flin Flon orebody is in Saskatchewan and the output of copper and zinc credited to the province comes from this source.

British Columbia

Britannia Mining and Smelting Company Limited treated 878,661 tons of ore at its property on Howe Sound. Approximately 27,470 tons of copper concentrates containing 8,095 tons of copper were produced, and 379 tons of copper was recovered from mine waters. A new precipitation plant was installed at tidewater to recover copper from the waters draining out of the 4,100 level, 300 feet above Britannia Beach. The plant is scheduled for operation early in 1956.

The Granby Consolidated Mining, Smelting and Power Company Limited, at its Copper Mountain mine 12 miles south of Princeton, produced 1,968,409 tons of 0.72 per cent copper ore which was milled in its concentrator at Allenby, 8 miles north of the mine. Concentrates containing 10,385 tons of copper were shipped to a smelter at Tacoma, Washington. Ore reserves at the year end were depleted to 1,160,000 tons. Late in the year higher copper prices made it possible to treat low-grade material that had previously been considered as waste, and to resume the search for new ore.

Other Developments

Newfoundland

Maritime Mining Corporation Limited is preparing its Tilt Cove Copper mine on Notre Dame Bay for production early in 1957. Ore reserves in August were reported to be 2,550,000 tons grading 1.957 per cent copper.

Gullbridge Mines Limited, a subsidiary of Maritime Mining Corporation Limited, plans underground exploration of its Gull Pond property. Diamond drilling has indicated 1,958,771 tons of ore grading 1.93 per cent copper.

New Brunswick

Brunswick Mining and Smelting Corporation Limited owns two main zinc-lead-pyrite deposits with low values in copper in Gloucester county, Bathurst area. Preparation of the Austin Brook orebody for open-pit mining has been completed and underground development of the Anacon-Leadridge orebody is in progress. At Austin Brook a 150-ton pilot mill was placed in operation in February for the purpose of metallurgical research.

Heath Steele Mines Limited, wholly owned by The American Metal Company Limited and International Nickel Company of Canada Limited, continued exploration of extensive lead-zinc-copper orebodies on its Little River property, 30 miles northwest of Newcastle. One shaft was sunk to 450 feet, and a second started. A third orebody is being prepared for open-pit mining.

Quebec

Chibougamau Explorers Limited prepared its copper-gold property in La Dauversière and Rohault townships in the Chibougamau area for production.

A surface plant and mill with a capacity of 500 tons of ore per day were nearly completed at year end. Ore reserves at the end of October were reported to be 546,725 tons averaging 0.93 per cent copper and 0.30 ounces of gold.

Merrill Island Mining Corporation Limited holds a copper-gold property in Obalski and McKenzie townships, Chibougamau area. A part of the property is leased to Campbell Chibougamau Mines Limited, which has milled about 500 tons of ore per day and carried out underground exploration on the leased property. Ore reserves on that part of the property not leased to Campbell were estimated at the beginning of 1955 to be 705,978 tons grading 2.7 per cent copper and 0.15 ounces of gold.

Copper Cliff Consolidated Mining Corporation holds copper-gold claims in Obalski and McKenzie townships. Surface diamond drilling has indicated a considerable tonnage of copper ore in a number of zones. Shaft sinking to an initial depth of 1,000 feet was begun.

New Royran Copper Mines Limited owns claims in Roy and McKenzie townships on which a substantial tonnage of copper ore was indicated by diamond drilling. Shaft sinking to an initial depth of 600 feet was begun.

Bouzan Mines Limited carried out exploration work on its claims in Obalski, McKenzie, and O'Sullivan townships in the Chibougamau area.

Anacon Lead Mines Limited brought the construction of a surface plant and mill to handle 500 tons of ore per day nearly to completion on the property acquired from Chibougamau Explorers Limited, about 20 miles south of Chibougamau Lake. Ore reserves at the end of October were reported to be 546,725 tons averaging 0.93 per cent copper and 0.30 ounces of gold.

Rainville Mines Limited carried out further underground development on its property located in Bourlamaque township, 9 miles east of Val d'Or, and some additional ore was indicated. Ore reserves at the end of the year were estimated at 414,830 tons averaging 2.34 per cent copper. Construction of a mill to treat 300 tons of ore per day was begun.

Rio Canadian Exploration Limited, controlled by Rio Tinto (Canada) Limited and Sogemines Limited, discovered a wide copper-bearing zone in Dufresnoy township, north of Rouyn.

Lyndhurst Mining Company Limited completed the sinking of a shaft to 710 feet on its property in Destor and Poularies townships, 25 miles north of Noranda. Diamond drilling has indicated 382,000 tons of ore grading 1.95 per cent copper.

Duvan Copper Company Limited began sinking a shaft and explored by diamond drilling its property in Desmeloizes township in the Normetal area.

Selco Exploration Company Limited acquired a promising copper-nickel discovery near Delahey Lake about 60 miles west and north of Mont Laurier.

Eastern Metals Corporation Limited has made progress in the underground development of its copper and nickel ores south of the St. Lawrence River in Rolette township, Montmagny county. The shaft was completed to the fifth level at 700 feet and preparation made to continue sinking another 300 feet.

Ontario

Geco Mines Limited, near Manitouwadge Lake, 40 miles northeast of Heron Bay, Lake Superior, advanced plant construction and mine development towards production, which is scheduled for early 1957. A total of 4,850 linear feet of mine development and 22,800 feet of exploratory diamond drilling was done during the year.

Diamond drilling indicated ore reserves of 14,899,000 tons averaging 1.72 per cent copper, 3.55 per cent zinc and 1.73 ounces of silver at the end of 1954. A mill with a daily capacity of 3,300 tons of ore is planned.

Willroy Mines Limited, adjoining Geco to the west, continued exploration of three ore zones on its copper-zinc property. Diamond drilling indicated reserves in two of the ore zones totalling 1,740,000 tons grading 1.34 per cent copper and 6.06 per cent zinc.

Eastern Mining and Smelting Corporation Limited continued underground exploration of a copper-nickel deposit on its Gordon Lake-Werner Lake property in the Kenora district.

Falconbridge Nickel Mines Limited started sinking a shaft to 850 feet to explore its copper-nickel deposit at Populus Lake in the Kenora district.

Consolidated Sudbury Basin Mines Limited explored its lead-zinc-copper properties at the former Vermilion and Errington Mines in the Sudbury area by diamond drilling and underground exploration. Ore reserves as reported at the end of 1954 totalled 10,332,227 tons averaging 1.14 per cent copper, 0.85 per cent lead, and 3.60 per cent zinc.

Coldstream Copper Mines Limited continued underground development of its copper property, situated in the Thunder Bay district, about 90 miles west of Fort William. The shaft was deepened from 350 to about 500 feet.

Manitoba

New Manitoba Gold Mines made an interesting discovery of a low-grade nickel and copper deposit in the Cat Lake area.

Saskatchewan

Hudson Bay Mining and Smelting Company was preparing its Birch Lake mine, 9 1/2 miles southwest of Flin Flon, and Coronation Mine, 13 1/2 miles southwest of Flin Flon, for production. Both deposits are high-grade copper ores.

Anglo-Rouyn Mines Limited continued diamond drilling of its copper-gold property at Waden Bay in the Lac La Ronge area. Indicated ore reserves totalled 3,046,500 tons grading 1.97 per cent copper. A shaft to 500 feet was begun.

Glenn Uranium Mines carried out diamond drilling of its Pitching Lake copper property in the northeastern part of the province.

British Columbia

Granduc Mines Limited's property, 25 miles northwest of Stewart, which is being developed jointly by The Granby Consolidated Mining, Smelting, and Power Company Limited and Newmont Mining Corporation, reported indicated ore reserves of 25,600,000 tons with an average copper content of 1.62 per cent. A long tunnel is planned to provide permanent transportation from the port of Stewart to the mine site, which is situated in a location difficult of access a few miles east of the Alaska boundary. A total of 4,720 feet of lateral development headings was driven and 36,189 feet of diamond drilling done.

Bethlehem Copper Corporation Limited did extensive surface stripping and diamond drilling on its copper-molybdenum-tungsten property 28 miles southeast of Ashcroft. An agreement with American Smelting and Refining Company for financing the property into production was made. The agreement covers 100 of the 116 claims comprising the property.

Cowichan Copper Company Limited continued underground development of its copper property in the Lake Cowichan area, Vancouver Island. Some shipments of development ore were made to the smelter at Tacoma, Washington.

Canam Copper Company Limited continued exploration of its copper property in the New Westminster mining division.

Exploration by Noranda Mines Limited indicated a small copper orebody on the Yreka Mines property in the northwest part of Vancouver Island.

Yukon

Underground development was continued on the Wellgreen property of Hudson-Yukon Mining Company, a subsidiary of Hudson Bay Mining and Smelting Company, Limited, in the Kluane Lake district. About 6,300 feet of lateral development headings were driven and a winze to permit development at greater depth was begun. The ore reserves are reported to be 728,000 tons averaging 1.42 per cent copper and 2.05 per cent nickel, with small amounts of cobalt, gold, platinum, and palladium.

Northwest Territories

North Rankin Nickel Mines, Limited, at Rankin Inlet, on the west coast of Hudson Bay have outlined an orebody estimated to contain 460,000 tons grading 0.81 per cent copper and 3.3 per cent nickel. Plans have been laid to construct a 250-ton mill.

Consumption and Uses

Canadian consumption of prime copper is virtually limited to two rod mills and two brass mills. The rod mills are those of Canada Wire and Cable Company, Limited, at Montreal East, Quebec, and Phillips Electrical Co. (1953) Limited, at Brockville, Ontario. The brass mills are operated by Anaconda American Brass Limited at New Toronto, Ontario, and Noranda Copper and Brass, Limited, at Montreal East, Quebec. Other smaller consumers in Canada are Canadian Arsenals Limited, the Royal Canadian Mint, Aluminum Company of Canada Limited, and several foundries.

About 50 per cent of the world consumption of copper is ultimately used by the electrical industry for conductors such as wire, cable, bus-bars, etc. Increasing quantities of copper tubing are being used in plumbing. The remainder is used in brass, bronze, cupro-nickel, nickel-silver, and other copper alloys and as copper salts.

Prices

The Canadian price of electrolytic copper in Canadian funds increased from 28.98 cents per pound at the beginning of the year to 43.00 cents per pound at the end of the year, averaging 37.00 cents per pound. The changes in price in cents per pound and the date they became effective were as follows:

January 28: 32.00, February 17: 32.375, February 24: 32.50, March 29: 35.375, August 18: 39.375, August 29: 42.375, September 29: 42.50, October 7: 42.675, and October 19: 43.00.

Tariffs

There is no tariff on imports of copper ores or concentrates into Canada. Copper in bars, rods, wire, and semi-fabricated or fully processed products is subject to varying tariff rates.

In the United States the suspension of the United States import tax of 2 cents per pound was extended to June 30, 1958. The bill contained a provision, as in similar preceding measures, that the tax would be restored automatically should the average price for a month drop to 24 cents or less.

GOLD

By W.L. Sebolt

In 1955, Canadian gold production rose to 4,541,962 ounces, valued at $156,788,528. This was an increase of 175,522 ounces in quantity and $8,023,917 in value over 1954.

The major portion of the increase came from Ontario; Quebec, Northwest Territories, Nova Scotia and Alberta showed slight increases. Production elsewhere declined slightly.

Production of Gold

		1955	1954
		Fine Ounces	
Yukon	Placer operations	72,201	82,208
N.W.T.	Placer operations	-	46
	Auriferous quartz	321,321	308,517
	Total	321,321	308,563
B.C.	Auriferous quartz	199,430	210,948
	Placer operations	6,206	7,105
	Base-metal mines	47,343	50,455
	Total	252,979	268,508
Alta.	Placer operations	214	195
Sask.	Placer operations	13	1
	Base-metal mines	83,567	101,784
	Total	83,580	101,785
Man.	Auriferous quartz	99,366	111,648
	Base-metal mines	24,522	23,296
	Total	123,888	134,944
Ont.	Auriferous quartz		
	Porcupine	1,074,916	1,038,919
	Kirkland Lake	393,294	392,787
	Larder Lake	427,193	363,139
	Patricia	409,820	350,576
	Thunder Bay	102,806	96,365
	Sudbury...................	38,046	42,728
	Matachewan	29,806	30,671
	Miscellaneous	-	26
	Total	2,475,881	2,315,211
	Base-metal mines	47,159	46,174
	Total	2,523,040	2,361,385
Que.	Auriferous quartz		
	Bourlamaque area	277,170	282,527
	Malartic area	329,708	329,007
	Noranda area (inc. Belleterre)	163,038	179,870
	Miscellaneous	12	1,045
	Total	769,928	792,449
	Placer operations	-	16
	Base-metal mines	384,594	306,105
	Total	1,154,522	1,098,570
N.S.	Auriferous quartz	128	182
	Base-metal mines	3,752	3,572
	Total	3,880	3,754
Nfld.	Base-metal mines	6,337	6,528
Canada	Auriferous quartz mines	3,866,124	3,738,955
	Placer operations	78,621	89,571
	Base-metal mines	597,217	537,914
	Total	4,541,962	4,366,440
Canada	Total value	$ 156,788,528	$ 148,764,611
	Average value per oz.	$ 34.52	$ 34.070

Two mines closed down in British Columbia, one in Ontario, and two in Quebec. Two new mines came into production, one in Manitoba and one in Quebec.

The decline in value of the Canadian dollar brought the average Mint price for gold up to $34.52 per fine ounce, the highest for several years.

Gold again occupied fourth place in value in Canadian mineral production, following crude petroleum, copper, and nickel. In free world output, Canada retained second place, following South Africa, whose output was 14,602,267 ounces.

Cost-aid payments under the Emergency Gold Mining Assistance Act amounted to $8,799,201. Owing to modifications put into effect for 1955 and 1956, several of the lower-cost mines did not benefit under the Act.

Operations at Producing Mines

Yukon

The decline in production of some 12 per cent was due chiefly to the lower output of the dredging companies. This decline amounted approximately to 5,600 ounces for The Yukon Consolidated Gold Corporation Limited, 1,700 for Yukon Explorations Ltd., 900 for Clear Creek Placers Limited, and 700 for Yukon Gold Placers, Limited. The smaller bulldozer and hydraulic operators produced about the same quantity as in 1954.

British Columbia

Lode gold production decreased slightly, owing to the closing down of the Nickel Plate and French mines of Kelowna Mines Hedley Limited.

Cariboo has appreciably increased both ore reserves and grade and Bralorne Mines Limited is developing large tonnages of high-grade ore on the new lower levels.

Placer production was down, mainly owing to smaller outputs at Noland Mines Limited, which has now suspended operations, and Enterprise Placers at Atlin.

By-product gold from base-metal mining dropped some 3,000 ounces, chiefly owing to a lower output at both the Trail smelter and the Tulsequah mine of The Consolidated Mining and Smelting Company of Canada Limited.

Northwest Territories

Consolidated Discovery Yellowknife Mines Limited turned out a record production of 66,726 ounces. New discoveries of high-grade ore were made during the year, and it is planned to increase mill capacity. The company is also doing development work on the adjoining property of Ormsby Mines Limited, with encouraging results.

Production rose slightly at Giant Yellowknife Gold Mines Limited. It was found to be unnecessary to carry out the planned increase in tonnage, chiefly owing to improved mill recovery. Development results were good on the new levels at 'C' Shaft.

The level of production was maintained at the Con mine and the adjoining controlled Rycon property.

Alberta

All production came from placer operations on the Saskatchewan River just west of Edmonton.

Saskatchewan

Gold output all comes from that portion of the base-metal orebody of the Hudson Bay Mining and Smelting Company, Ltd. lying west of the Manitoba-Saskatchewan boundary. Production was 18 per cent below 1954.

Manitoba

Three lode gold producers are now in operation--Nor-Acme Gold Mines Limited, San Antonio Gold Mines Limited, and Forty-Four Mines Limited. The last-named, which adjoins and is controlled by San Antonio, began production in 1955. Output of lode gold declined 11 per cent below that of 1954.

The by-product gold derived from the Manitoba portion of the Hudson Bay orebody and their nearby smaller base-metal mines was slightly larger than in 1954.

Ontario

The 33 gold mines, together with the base-metal mines of the Sudbury area, again accounted for more than 55 per cent of the Canadian output. The increase of over 161,000 ounces came chiefly from the Larder Lake and Red Lake areas.

In the Porcupine area, Paymaster Consolidated Mines Limited has developed a large tonnage of ore of good grade on a new vein, and Delnite Mines Limited has had better results on the new deep levels. Diamond drilling at the 6,800 ft. level of Central Porcupine Mines Limited gave some encouraging results. The mill at McIntyre Porcupine Mines Limited had to close down for two weeks as a result of an accident in the shaft on March 23.

In the Kirkland Lake area, Wright-Hargreaves Mines Limited was preparing to sink an additional 700 ft. to the 7,900 ft. level. Macassa Mines Limited has opened up a considerable amount of higher-grade ore. Sylvanite Gold Mines, Limited was driving into the old Toburn property on an exploration basis. Kirkland Lake Gold Mining Company, Limited was placed on a salvage basis. At Kerr-Addison Gold Mines Limited grade continued to improve, and output was up more than 60,000 ounces.

Three mines in the Red Lake area--Campbell Red Lake Mines Limited, Madsen Red Lake Gold Mines Limited, and Cochenour-Willans Gold Mines Limited--showed large increases in production. Development throughout the area was excellent in almost all cases, and there is a marked revival of interest in gold.

As the year ended, Young-Davidson Mines Limited in the Matachewan area closed down owing to exhaustion of ore reserves.

Quebec

Two gold mines closed down during the year.

In the Noranda region, Eldrich Mines Limited began shipping ore on a trial basis in December, but was not officially in production. Donalda Mines Limited suspended milling in July and began deepening the shaft to open up the new vein located by recent diamond drilling.

New Senator-Rouyn Limited ceased operations in November, as also did Powell Rouyn Gold Mines Limited, although the latter still had some ore on hand to be shipped in the spring of 1956. O'Brien Gold Mines Limited had enough ore in sight for a few months' operation only in 1956. Beattie-Duquesne Mines Limited expected to mill the last of its gold ore in March 1956, when the mill is to be changed over to handle copper ore.

In the Malartic area, development at East Malartic Mines Limited has indicated excellent ore on the lower levels, and mill tonnage has been raised. At Malartic Gold Fields Limited, results at the new bottom levels have not yet been particularly encouraging.

Bevcon Mines Limited (formerly Bevcourt Gold Mines Limited) in the Bourlamaque area deepened its shaft 4 levels, finding better than average ore. Operations in the area generally were at normal levels.

The output of by-product gold again showed a large increase, in line with the expanded operations of base-metal mines in the Chibougamau and Noranda areas.

Nova Scotia

Production of gold by Mindamar Metals Corporation Limited's base-metal operations was about the same as in 1954. It seemed likely that lack of ore would lead to the closing down of this operation early in 1956.

Newfoundland

The base-metal operations of Buchans Mining Company Limited, as in previous years, accounted for the entire gold production.

Developments at Other Properties

British Columbia

Development work continued at the property of Deer Horn Mines Limited in the Kitimat area, although recent emphasis has rather been on the tungsten content of the ore.

Ontario

In the Red Lake area, McFinley Red Lake Gold Mines Limited, under direction of Little Long Lac Gold Mines Limited, will conduct an extensive exploration and development campaign, and Craibbe-Fletcher Gold Mines Limited has announced plans for diamond drilling early in 1956.

In the Geraldton area, some development is proceeding at Consolidated Mosher Mines Limited, but no production plans have yet been announced.

INDIUM

By R.E. Neelands

Indium is one of the rarer metals that has become increasingly available in recent years. Considerable research has been carried out to find useful applications for it and industrial demands 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, in addition to Canada, it is produced in United States, Germany, Belgium, Italy, Peru, Japan and probably Russia.

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 have been found to contain as much as 1 per cent indium, but normally it is present in very 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 this 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 electrothermically to produce a bullion containing lead, tin, indium and antimony which is treated electrolytically to yield a high indium (20-25 per cent) 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 of indium (99.97 per cent) or a high-purity grade which approximates 99.999 per cent indium.

While 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 made in 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

The potential annual production at Trail is approximately one million troy ounces or 35 tons; and some ten million ounces are contained in stockpiled by-products.

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 handrubbing. It has a relatively low melting point of 156°C. and a boiling point of 2,000°C. 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 and a specific gravity of 7.31 at room temperature which is about the same as iron.

Indium is stable at ordinary temperatures in air. It is attacked by some acid solutions but is resistant to alkalis.

The use of indium is undergoing rapid development. One of its chief applications is in antifriction coatings for bearings used in high-speed aviation engines and as an alloy-layer in the outside surface of the bearings themselves. The standard grade indium (99.97 per cent) is satisfactory for this purpose.

High-purity indium in many shapes and alloys is finding increasing application in the electronics field for transistors, especially in the United States.

Other uses are the inclusion of indium in low-melting-point alloys, glass-sealing alloys, certain solder alloys and dental alloys.

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.

Trade and Consumption

No figures are available on the exports, imports, or domestic consumption of indium. Most of Canada's output is exported to United States and United Kingdom but smaller amounts in 1955 went to Switzerland, France, Germany, Holland and Sweden.

An increasing amount of indium is consumed in Canadian industry.

Prices

The price of indium per troy ounce was quoted at $15 in 1940, in 1941 it had decreased to $12.50, in 1944 to $7.50, and in 1945 to $4.00. Since 1946 the price quoted in E & M J Metal and Mineral Markets has been $2.25 a troy ounce of 99.9+ purity.

IRON ORE

By W. Keith Buck

The 1955 production (shipments) of iron ore amounted to 14,538,551* tons, valued at $110,435,850, an increase of 122 per cent over 1954. This large increase was chiefly due to the operations of Iron Ore Company of Canada in Labrador-New Quebec. However, the 1955 market was an active one, and shipments generally exceeded those of 1954. In the latter year, Canada moved into seventh place as a producer of iron ore, following the United States, Russia, France, Sweden, the United Kingdom, and West Germany. Her share of world production amounted to 2.38 per cent, and the pace of development is such that this should be materially increased when final figures for 1955 are available. On the basis of present developments, production is expected to reach between 45 and 60 million tons annually within the next decade.

Most of Canada's iron ore is exported, chiefly to the United States, where it is in demand because of its high grade and good furnace qualities. Though ore for Ontario blast furnaces is imported from the U.S., this situation arises partly from geographical considerations and partly from company affiliations. Imports from Brazil and Liberia in 1955 consisted of open-hearth lump ore.

* Quantities throughout are expressed in long tons (2,240 lb).

Iron Ore - Production, Trade and Consumption

	1955		1954	
	Tons	$	Tons	$
Production (shipments)	14,538,551	110,435,850	6,572,855	49,666,507
Imports				
United States	3,972,983	30,472,608	2,620,747	19,086,037
Brazil	60,133	875,730	78,885	1,194,361
Liberia	19,365	214,089	10,359	135,202
United Kingdom	9	934	-	-
Total	4,052,490	31,563,361	2,709,991	20,415,600
Exports				
United States	9,983,817	79,713,357	3,327,054	26,261,974
United Kingdom	1,342,153	9,013,015	957,215	5,749,364
West Germany	1,035,820	6,337,071	693,204	3,971,698
Japan	485,186	3,587,694	482,820	3,661,924
Netherlands.........	160,766	1,161,391	10,187	73,780
Norway.............	258	1,578	-	-
Total	13,008,000	99,814,106	5,470,480	39,718,740
Indicated consumption*	5,583,041		3,812,366	
Percentage relationship of domestic production to indicated consumption	260.4		172.4	

* Indicated consumption = Production (shipments) + imports - exports.

The following table lists the companies in production and under development:

Company	Location	Ore	Product
	In Production		
Dominion Wabana Ore Limited	Wabana, Bell Island, Nfld.	hematite	heavy-media concentrates
Quebec Iron and Titanium Corporation	Allard Lake, Quebec (mine); Sorel, Quebec (smelter)	ilmenite-hematite	desulphurized iron
Iron Ore Company of Canada	Labrador-New Quebec nr. Schefferville, Que.	goethite and hematite	direct-shipping ore

Company	Location	Ore	Product
	In Production (cont'd)		
Noranda Mines Limited	Noranda, Quebec (mine); Port Robinson, Ont. (smelter).	pyrite concentrate	by-product iron oxide sinter
Bethlehem Steel Company	Marmora, Ont.	magnetite	pelletized magnetite concentrates
Algoma Ore Properties Limited	Near Jamestown, Ontario.	siderite	sinter
Steep Rock Iron Mines Limited	Steep Rock Lake, Ontario.	goethite	direct-shipping ore
The Argonaut Mining Co. Ltd.	Near Campbell River, B.C.	magnetite	magnetite concentrates
Texada Mines Limited	Texada Island, B.C.	magnetite	magnetite concentrates
	Under Development		
Caland Ore Company	Steep Rock Lake, Ontario.	goethite	direct-shipping ore
The International Nickel Company of Canada Limited	Copper Cliff, Ontario.	pyrrhotite	pelletized by-product iron oxide
The Bristol Mines	Bristol Mines, Que.	magnetite	pelletized magnetite concentrates

Iron Ore Production (Shipments) in Canada By Properties*

	1955	1954	1953
Wabana (beneficiated hematite)	2,377,237	2,155,731	2,399,821
Labrador-New Quebec (direct-shipping ore)	7,721,694	1,781,453	-
Marmora (pelletized magnetite concentrates)	195,776	-	-
Helen and Victoria (sinter)	1,432,455	991,870	1,166,832
Steep Rock (direct-shipping ore)	2,265,555	1,156,654	1,301,377
Quinsam Lake (magnetite concentrates)	335,903	164,338	553,591
Texada Island (magnetite concentrates)	238,641	331,566	333,077

* Based on company data.

About one-quarter of the production in 1955 came from underground mines and three-quarters from open-pit mines. Three underground methods are in use -- room and pillar at Wabana, sub-level stoping at Algoma, and block caving at Steep Rock; at all three, ore is brought to the surface on conveyor belts. At Algoma, however, work was continued on a unique aerial ropeway which will deliver ore from underground directly to the sinter plant.

At the open-pit mines, drilling of the ore is done principally with percussion-type drills, but in at least two instances rotary drills are in use. Transportation is chiefly by diesel trucks of 22-, 34-, and 46-ton capacity. However, open-pit ore is brought to the surface by skip-hoist in one instance and by conveyor belt in another, truck haulage being confined to the pit bottom. At Wabana, the new conveyor belt system has almost completely eliminated truck haulage.

Dominion Wabana Ore Limited

Production of heavy-media concentrates (hematite) from Wabana Mines, located off Bell Island in Conception Bay, amounted to 2,030,227 tons during 1955, a decrease of about 20 per cent from 1954. Of this, 1,870,883 tons were produced from the underground mines and 159,345 by contract mining on the surface. Shipments amounted to 2,377,237 tons, as against 2,155,731 tons in 1954. Of the 1955 shipments, the Dominion Steel and Coal Corporation at Sydney, N.S., took 459,546 tons, the United Kingdom, 857,546 tons; West Germany, 976,965 tons; the Netherlands, 62,180 tons, and the U.S.A. 21,000 tons. Average analysis (dry basis) of the ore shipped during 1955 was 50.46 per cent iron, 13.28 per cent silica, and 1.67 per cent moisture. Phosphorus content remained normal at 0.88 per cent.

The internal exploration slope (Forsyth Slope) extending to the northwest from the bottom of No. 3 Slope was advanced a further 630 feet in 1955. During the latter part of the year, a heavy-media separation (sink-float) plant was completed; this plant is expected to reduce the silica content of the ore by nearly two per cent. Also completed was a 9,000-foot conveyor belt system to transport the concentrated ore across the island to the loading docks; this system replaces diesel-truck haulage of the ore.

Quebec Iron and Titanium Corporation

Shipments of ilmenite-hematite ore during 1955 from the Allard Lake, Quebec, mine of Quebec Iron and Titanium Corporation to the company's electric smelter at Sorel, Quebec, were 396,134 gross tons. The content of the ore is approximately 35 per cent titanium dioxide (TiO_2) and 40 per cent iron. Production figures for the smelting operations at Sorel during 1955 were: ore smelted, 311,230 gross tons; titanium dioxide slag produced, 145,343 tons; slag shipped, 140,516 tons; desulphurized iron produced, 108,314 tons; desulphurized iron shipped, 105,450 tons; and high-sulphur iron shipped, 3,645 tons. The slag contained about 70.5 per cent equivalent TiO_2 and the low-sulphur, low-phosphorus pig-iron contained 1.5 to 2.2 per cent carbon.

The electric smelting furnaces were extensively modified and construction was commenced on a $7 1/2 million beneficiation and rotary kiln plant to treat the ore prior to smelting. These facilities are expected to be in operation during the first half of 1956.

Iron Ore Company of Canada

During 1955, the Labrador-New Quebec operations of Iron Ore Company of Canada were most successful. Tonnage of ore mined and shipped from Sept Iles greatly exceeded estimates. Production came from three mines - the Ruth Lake No. 3, the Gagnon, and the French. A fourth mine, the Gill (formerly known as the Ruth Lake No. 1 deposit) is to be brought into production during the summer of 1956. The mining season commenced on May 11 and extended through to November 14, a total of 188 days. The shipping season out of Sept Iles commenced on April 23 and ended on November 25. The following table shows the tonnage of ore mined and shipped and the average iron content of the ore.

Iron Ore Company of Canada

Iron Ore Shipped from Sept Iles, 1955

	Quantity tons	Iron Content %
Quebec		
Bessemer	961,056	56.59
Non-Bessemer	2,422,313	51.98
Manganiferous	280,212	47.42 (5.07% Mn)
Total Quebec	3,663,581	
Labrador		
Bessemer	35,523	58.37
Non-Bessemer	3,379,815	55.35
Manganiferous	642,775	48.12 (5.11% Mn)
Total Labrador	4,058,113	
Grand Total	7,721,694	

Of the shipments of 7,721,694 tons, 1,101,083 tons were trans-shipped at Contrecoeur near Montreal into small boats for passage through the St. Lawrence canal system to Great Lakes ports. Destinations of 1955 shipments were: United States, 6,728,000 tons; United Kingdom 594,000; Western Europe, 123,000; and domestic 372,000. Shipments in 1956 are expected to reach about 12 million tons.

Bethlehem Steel Company

This company brought its low-grade open-pit magnetite mine at Marmora into production during the year. On April 1, 1955, the crushing, concentrating, and pelletizing plant was placed in operation. Ore shipments were commenced from the Picton dock on May 11, 1955, and continued until

November 30, 1955, during which time 195,776 tons were shipped. From Picton, lake ore carriers transport the pellets to Bethlehem Steel Company's plant at Lackawanna, near Buffalo, about 211 water miles from Picton.

The crude ore contains about 37 per cent iron. Magnetic concentration and pelletizing bring the grade of the finished pellets up to about 64.3 per cent. Designed capacity is 500,000 tons of pellets per year.

Noranda Mines Limited

In September 1954, this company brought its sulphur-iron plant at Port Robinson, Ontario, into partial production. Pyrite concentrates are shipped by rail from Noranda and undergo a double roasting operation to produce elemental sulphur, sulphur dioxide gas, and iron oxide sinter. The plant is designed to handle about 370 tons of pyrite concentrates per day, from which a daily production of 240 tons of sinter analyzing 68 per cent iron, 2.5 per cent SiO_2, and 0.05 per cent S is expected.

Production during 1955 was small and was not considered representative; the company expects to produce 70,000 tons of iron oxide sinter during 1956.

Algoma Ore Properties Limited

This company's production comes from the Helen and Victoria underground mines in the Michipicoten area of Ontario. During 1955, shipments from the sinter plant at Jamestown totalled 1,432,455 tons, a new record and an increase of nearly 45 per cent over 1954. Of this amount, 396,210 tons were shipped by rail to the parent company's (Algoma Steel Corporation) iron and steel plant at Sault Ste. Marie and 1,036,245 tons by vessel to lower lake ports The Helen and Victoria siderite, as mined, contains about 35 per cent iron. The average analysis (natural) of the sinter for 1954 was 50.89 per cent iron, 2.86 per cent manganese and 11.08 per cent silica, and this is considered to be representative of shipments during 1955. Sinter plant capacity is 1,500,000 tons per year.

Near the end of 1953, Algoma commenced a four-year program to develop three more mining levels below the present Helen first and second levels. During 1955, considerable progress was made on this development program, which is known as Helen Underground Stage 3. An integral part of Stage 3 development is a unique underground aerial ropeway haulage system which will transport ore in 3-ton buckets up a 22-degree underground incline for 5,000 feet and then on surface 2 miles to the sinter plant.

Steep Rock Iron Mines Limited

During 1955, shipments of direct-shipping goethite iron ore from the Steep Rock area totalled a record 2,265,555 tons. All production came from the Hogarth Open Pit. Shipments for 1956 are scheduled to reach 3 1/4 million tons, of which 2 1/2 million is to come from the Hogarth and 3/4 million from the Errington No. 1 Underground Mine. The average iron content (natural) of the principal grades of ore shipped during 1955 was: Seine River, 53.264 per cent; Marmion, 53.223 per cent, Rainy Lake, 51.986 per cent; and Steep Rock Lump, 58.028 per cent.

Production at the Hogarth Open Pit was greatly accelerated in 1955 with the construction of a crushing plant in the pit bottom, the extension of the ore conveyor belt system down to that point, and the addition of new equipment. At the Errington No. 1 Underground Mine several years of development work will culminate in 1956, when this mine will go into full production. During the fall of 1955, the two large electric dredges, Steep Rock and Marmion, were moved overland two miles from the Hogarth orebody to the "G" orebody. During 1956, they will be engaged in a dredging program entailing the removal within three years of 50 million cubic yards of silt from the "G" ore zone. Another open pit will be developed in this area, to be followed in future years by an underground operation.

Utah Co. of the Americas

The Iron Hill Mine of the Argonaut Mine Division of Utah Co. of the Americas is about 17 miles southwest of Campbell River, British Columbia, and about 13 miles from the east coast of Vancouver Island. During 1955, the mine operated from March 21 to December 21. Operations are to be resumed in the spring of 1956. Production of magnetite concentrates during 1955 was 343,954 tons and shipments totalled 335,903 tons, principally to Japan. The crude magnetite averaged 38.4 per cent iron and the concentrate 56.3 per cent.

Texada Mines Limited

This company, whose property is located on Texada Island, B.C. mined and milled magnetite ore at a reduced rate compared to previous years. Production of crude ore amounted to 375,644 tons, of which about 56 per cent came from the Prescott Open Pit, 28 per cent from the North and South Paxton Pits, and 6 per cent from the Lake Pit, which was mined out early in the year. The remainder came from the Cameron-Yellow Kid Pit, a new mine that was opened in September. No underground mining took place. Shipments of magnetite concentrates totalled 238,641 tons, with substantial amounts being exported to Japan and West Germany. The grade of the ore, as mined, averaged close to 44.2 per cent iron and 1.19 per cent sulphur, while the mill concentrates averaged 58.5 per cent iron, 1.14 per cent sulphur, and 0.167 per cent copper.

Developments

Caland Ore Company

This company, a subsidiary of Inland Steel Company of Chicago, has under way a large-scale development program of an iron ore deposit located beneath Falls Bay of Steep Rock Lake, Ontario. Dredging of Falls Bay was commenced in the spring of 1955, and by the end of the year the two large dredges, Clarence B. Randall and Joseph L. Block, had moved 16,508,050 cubic yards of silt to the disposal area in Marmion Lake. Dredging is scheduled for completion by January 1, 1960, and production of ore will begin shortly after. Full production of about 3 million tons of direct-shipping ore will not be reached until several years later.

Also during 1955, substantial progress was made on other aspects of the development program such as the Fairweather Dam, and the Margaret Lake Diversion Tunnels and Controls. As the company contemplates both an open-pit and an underground operation, methods for ore handling were being carefully studied.

The International Nickel Company of Canada Limited

At Copper Cliff, Ontario, this company is erecting an ammonia-leaching plant to treat nickel-bearing pyrrhotite concentrate. The first $19,000,000 unit of this by-product iron ore recovery plant was nearing completion by the end of the year and trial operation was under way. Commercial production is scheduled to commence early in 1956. The first unit will treat 1,000 tons of pyrrhotite concentrate daily. After operation of this unit at full capacity, the company plans to expand capacity by the addition of two more units of the same size as the first. Upon completion of the company's construction program, the iron ore recovery plant will have an annual output of about 1 million tons of ore. The finished pellets will contain about 68 per cent iron and 1.5 per cent silica.

The Bristol Mines

The low-grade Bristol magnetite deposit is located near the Ottawa River in Quebec, about 35 miles northwest of Ottawa. During 1955 an announcement was made that the property would be developed by Pickands Mather & Company, on behalf of itself, The Steel Company of Canada Limited, and Jones & Laughlin Steel Corporation. Development will commence in 1956 and production at a rate of 600,000 tons of pelletized magnetite concentrates is scheduled for the latter part of 1957. The finished pellets will contain about 66 per cent iron and 3 per cent silica. One-half the production will move by rail to the Hamilton, Ontario, plant of The Steel Company and the other half by rail to the plants of Jones & Laughlin Steel Corporation and Interlake Iron Co. in the United States.

Prices

Although prices of Canadian iron ores are, in general, negotiated by contract, Ontario and Quebec prices are based on the market price of iron ore from the Lake Superior district of the United States. Prices on most ores, domestic and foreign, are dependent on quality, quantity, commissions, delivery, and other factors of negotiation. The following quotations from the American Metal Market of December 28, 1955, are considered representative of prices throughout 1955, but may have been subject to penalties or premiums, according to the content of impurities, etc. Where unit price is quoted, one unit is equivalent to 1 per cent or to each 22.4 pounds of specified iron content.

Lake Superior Iron Ores (Prices effective March 1, 1955)

Gross ton, 51.50 per cent iron natural, rail or vessel, lower lake ports:

Mesabi non-Bessemer	- $10.10
Mesabi Bessemer	- 10.25
Old range non-Bessemer	- 10.25
Old range Bessemer	- 10.40
Open-hearth lump	- 11.25
High phosphorus	- 10.00

Effective Jan. 1, 1956, prices of the first two grades were increased 75 cents and the last four grades, 85 cents.

Swedish iron ore, Atlantic ports, 60 to 68 per cent, minimum:
Per unit - 22.00 cents.

Brazilian iron ore, Brazilian port, 68 to 69 per cent:
Per unit - 18.00 to 19.00 cents.

Tariffs

Neither Canada nor the United States has tariffs on iron ore.

LEAD

By R.E. Neelands

Canada's total lead production in 1955 was 202,762 tons, 15,733 tons less than in 1954. The decrease resulted mainly from reduced output of refined lead by The Consolidated Mining and Smelting Company of Canada Limited (Cominco) which operates Canada's only lead smelter at Trail, British Columbia. Receipts of both domestic and foreign custom ores at the smelter were less than in 1954. Exports of refined lead dropped 20 per cent to 93,331 tons and lead exported in concentrates declined slightly to 58,163 tons.

Lead consumption of 76,351 tons was considerably more than the amount used in 1954; the quantities required for battery manufacture were almost 6,000 tons greater. The value of lead and lead products imported was 11 per cent higher than in the preceding year, 95 per cent of such imports being tetraethyl lead compounds used in gasoline. Ethyl Corporation of Canada Limited commenced the construction of a tetraethyl lead plant near Sarnia, Ontario, which is expected to supply most of Canada's requirements for tetraethyl lead.

Promising new zinc-lead deposits were discovered in New Brunswick, British Columbia, and Northwest Territories during the year.

Lead - Production, Trade and Consumption

	1955		1954	
	Short Tons	$	Short Tons	$
Production, all forms				
British Columbia	161,492	46,445,214	171,768	45,793,259
Newfoundland	17,855	5,135,085	18,526	4,939,054
Yukon	13,124	3,774,575	16,883	4,500,913
Quebec	5,608	1,612,862	7,817	2,084,271
Ontario	1,927	554,148	1,408	375,321
Nova Scotia	1,990	572,213	2,093	558,013
New Brunswick	766	220,403	-	-
Total	202,762	58,314,500	218,495	58,250,831
Production, refined	148,811		166,005	
Exports				
In ore and concentrates				
United States	31,222	8,147,561	42,466	10,366,861
Belgium	16,523	4,529,419	8,864	2,062,115
West Germany	10,418	2,357,518	8,425	2,139,282
Total	58,163	15,034,498	59,755	14,568,258
Refined lead including scrap				
United Kingdom	56,868	12,946,092	50,528	10,588,283
United States	34,391	8,753,751	60,207	13,973,444
Japan	1,274	310,333	3,484	744,207
Other countries	798	148,936	3,060	655,565
Total	93,331	22,159,112	117,279	25,961,499
Imports, lead and lead products				
Tetraethyl compounds.		12,707,249		11,429,398
Pigs and blocks		30,883		38,677
Manufacturers, n.o.p.		191,090		200,784
Litharge		364,946		326,260
Capsules		59,935		113,894
Miscellaneous........		185,725		117,490
Total		13,539,828		12,226,503

	1955		1954	
	Short Tons	$	Short Tons	$
Domestic consumption refined lead (primary and secondary)				
Ammunition	5,289		5,266	
Foil and tubes.........	171		349	
Heat treating	610		515	
Oxides, paints and pigments	7,764		6,739	
Solders...............	3,033		2,323	
Babbitt	207		158	
Type metal	110		120	
For antimonial lead[a] .	4,827		2,527	
Cable covering	15,397		19,368	
Pipes, sheets, traps and bends	4,012		4,872	
Block for caulking	4,351		2,727	
Brass and bronze	505		450	
Batteries[b]	27,877		22,041	
Other uses	2,198		492	
Total	76,351		67,947	

(a) lead used to make antimonial leadalloy.
(b) lead consumed in battery makers' own plants.

Developments at Producing Properties

British Columbia

The Sullivan zinc-lead-silver mine at Kimberley, owned by Cominco, continued to be Canada's principal source of lead. The tonnage of ore mined at the Sullivan was 2,836,577 compared with 2,681,635 tons in 1954. A major revision of the mine ventilation system was completed.

At Cominco's H.B. zinc-lead mine near Salmo, milling commenced in May and 247,303 tons of ore were treated in the balance of the year. Production at the company's Bluebell lead-zinc mine at Riondell was 241,788 tons and at its Tulsequah zinc-copper-lead mines on the northwest coast 196,700 tons were milled.

All lead concentrates produced at Cominco's four mines were treated at the Trail smelter together with custom concentrates from other mines in B.C., Yukon, and Siam. The refined lead production was 148,811 tons compared to 166,005 tons in 1954. Further progress was made on the project, which was commenced in 1949, of modernizing the smelter without interrupting production.

Giant Mascot Mines Limited, near Spillimacheen, was the largest B.C. lead producer apart from the Cominco mines. It deepened its internal incline shaft and opened two deeper levels.

Canadian Exploration Limited near Salmo increased the daily output from its Jersey zinc-lead mine from 1,000 to 1,700 tons.

In November, Reeves MacDonald Mines Limited resumed production at its zinc-lead mine and 1,000-ton mill near Nelway, 12 miles south of Salmo, which had been closed since July 1953.

Sheep Creek Mines Limited discovered a new zinc-lead orebody at its Mineral King mine, Lake Windermere district.

Yale Lead and Zinc Mines Limited increased the capacity of its mill at Ainsworth from 150 to 300 tons a day.

Other producers of lead concentrate were ViolaMac Mines Limited, near Sandon; Sunshine Lardeau Mines Limited, near Camborne; and Silver Standard Mines Limited near Hazelton.

Ontario

Jardun Mines Limited, 18 miles northeast of Sault Ste. Marie, sank a new 275-foot shaft on the former Victoria mine section of its property and it deepened the No. 4 zone shaft to establish a new level at a depth of 350 feet. Both lead and zinc concentrates were produced.

Quebec

Lead concentrates were being produced at three mines at the end of 1955, the most important of these being New Calumet Mines Limited, situated on Calumet Island, about 60 miles west of Ottawa. The continuation of the Longstreet orebody, offset by faulting below the 1,900-foot horizon, was located on three new levels.

Golden Manitou Mines Limited, Abitibi East county, reduced zinc-lead milling from 1,000 to 500 tons a day in order to treat 500 tons of copper ore from a copper zone on its property. Important new zinc-lead zones were discovered in new deep workings.

Ascot Metals Corporation Limited commenced sinking a new 400-foot shaft to develop two old properties adjoining its Suffield mine, near Sherbrooke.

Anacon Lead Mines Limited, Portneuf county, ceased operations in July when all developed ore had been exhausted.

New Brunswick

Keymet Mines Limited, 15 miles north of Bathurst, which commenced production of zinc and lead concentrates in October 1954, operated its 200-ton mill throughout the year. The mine was closed in February 1956 owing to shortage of developed ore.

Nova Scotia

Mindamar Metals Corporation Limited at Stirling, Cape Breton Island, operated its zinc-lead-copper mine for the production of zinc and bulk lead-copper concentrates. Exploration on the property failed to reveal new ore of any significance.

Newfoundland

Buchans Mining Company Limited milled 291,000 tons of ore to produce zinc, lead, and copper concentrates. Over 60 per cent of the ore was mined in the newly developed Rothermere deposits and mine development continued in this section of the property, where it was planned to sink a new 4,000-foot shaft. The mine was closed for 5 weeks by a strike.

Yukon

United Keno Hill Mines Limited, Mayo district, produced mostly from the Hector mine; it brought its adjoining Calumet mine into production in October. Underground development was carried out at the company's Elsa, Shamrock, and Ladue mines. Silver-lead and zinc concentrates were shipped to the Trail smelter.

Mackeno Mines Limited, adjoining United Keno Hill Mines' Calumet group, carried out development to increase ore reserves. Its 220-ton mill was operated during January and again in September and October.

Other Developments

British Columbia

Better prices for silver and lead stimulated exploration activities in a number of districts, especially in the Slocan-Ainsworth area. In the Trophy Mountain district, 70 miles north of Kamloops, zinc-lead-copper discoveries were made on the adjoining properties of Ormsby Mines Limited and Goldcrest Mines Limited.

Ontario

Consolidated Sudbury Basin Mines Limited continued exploration of its extensive zinc-lead-copper properties 15 miles northwest of Sudbury. Ore reserves were increased to about 14,000,000 tons.

Quebec

Vendome Mines Limited carried out underground exploratory drilling on two zinc-lead-copper zones at its property near Barraute, Abitibi East county.

New Brunswick

Brunswick Mining and Smelting Corporation Limited continued the underground development of its Anacon or No. 12 orebody, 12 miles southwest of Bathurst, and surface stripping of its Austin Brook or No. 6 orebody, 5 miles south of No. 12. Mineral dressing tests on the complex zinc-lead-pyrite ores of the deposits were carried out in a pilot mill constructed near No. 12 orebody in 1954.

Early in 1956 New Larder "U" Island Mines Limited completed sinking a 1,500-foot shaft on its zinc-lead deposit 15 miles south of Bathurst.

Heath Steele Mines Limited, a subsidiary of American Metal Company, commenced underground development on its property 32 miles northwest of Newcastle, where zinc-lead-copper orebodies have been outlined by drilling.

Kennco Explorations (Canada) Limited (subsidiary of Kennecott Copper Corporation) and Middle River Mining Company Limited (subsidiary of Texas Gulf Sulphur Company) each made a discovery of a sizable zinc-lead deposit respectively 20 miles southwest and 10 miles west of the Heath Steele property.

Yukon

Prospectors Airways Company Limited continued exploratory drilling of its extensive flat-lying zinc-lead sulphide deposits 30 miles west of the Canol Road-Pelly River crossing.

Northwest Territories

Preston East Dome Mines Limited and associates acquired a large area near Windy Point, Great Slave Lake, 100 miles southwest of Yellowknife, where widespread lead-zinc mineralization was found in flat-lying formations.

Pine Point Mines Limited, a Cominco subsidiary, did no work in 1955 on its extensive zinc-lead deposit south of Great Slave Lake. Development of the deposit awaits construction of a railway from Grimshaw, Alberta, to Pine Point.

World Production of Lead

The following table from American Bureau of Metal Statistics gives world production on a mine basis for 1953 and 1954.

with low expenditure of power. Magnesium alloys are fabricated by sand casting, permanent mould casting, die-casting, extrusion rolling, drawing, spinning, and forging, and may be joined by torch welding, arc welding, or spot welding. Magnesium is not as resistant to corrosion as aluminum and is in general not as workable at room temperature. Therefore it is more costly to fabricate and is used principally in castings.

Uses

Transportation - Most of the present output of magnesium is used by the transportation industry. In the aircraft field particularly, its light weight is extending flying range and pay load.

Alloying Agent - The second biggest outlet has been the sister aluminum industry, where magnesium is used as an alloying agent.

Titanium Industry - The Kroll process for reducing titanium requires 1.2 pounds of magnesium for each pound of titanium sponge.

Materials Handling Equipment - Light weight and good structural characteristics are contributing to greater use in truck bodies, push carts, and tote boxes.

Nodular Iron - To grey cast-iron magnesium gives properties similar to those of many alloy-steel castings.

Cathodic Protection - The sacrificial use of magnesium for cathodic protection of such steel structures as the hulls of ships, and of water, air, and gas pipe lines, is saving thousands of pounds of steel each year.

Other Uses - Appliances, photo-engraving, dry-cell batteries, luggage, tooling plate, air-borne equipment.

Production and Trade

Information on Canadian production, exports, and imports of magnesium metal is not available for publication.

MANGANESE

By W. Keith Buck

Canada produces no manganese ore, although a small amount of bog manganese has been mined in past years from the bog deposits of New Brunswick. However, the availability of abundant and cheap power has enabled 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 for export. The plant is operated by Electro Metallurgical Company, Division of Union Carbide

Trade and Consumption of Manganese

	1955		1954	
	Short Tons	$	Short Tons	$
Imports - manganese ore				
Gold Coast	56,011	2,296,787	5,600	248,625
United States*..........	46,916	1,919,519	32,304	1,590,348
India	42,199	1,809,801	1,794	70,976
Belgian Congo	11,951	591,004	2,240	96,839
United Kingdom	95	15,338	76	14,123
Netherlands............	35	2,406	-	-
Cuba	5,355	180,352	6,944	255,931
Mexico	3,508	131,074	-	-
France	-	-	5	201
Union of South Africa ...	9,212	391,988	-	-
Total	175,282	7,338,269	48,963	2,277,043
Exports, ferromanganese				
United States	27,659	4,900,051	1,748	327,121
United Kingdom	1,602	286,141	-	-
Colombia	141	20,183	89	14,850
Cuba	1	139	-	-
Mexico	1	180	-	-
Spain	-	-	1,772	207,184
Venezuela	-	-	28	5,869
Mexico	-	-	2	301
Total	29,404	5,206,694	3,639	555,325
Consumption, ore				
Metallurgical grade	110,056		62,916	
Battery grade	3,019		3,136	
Total	113,075		66,052	

* Country of origin not known

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.

Imports of manganese ore during 1955 were more than 3 1/2 times as great as in 1954. Consumption of metallurgical-grade ore was nearly double 1954 consumption; consumption of battery grade was about the same as in 1954.

in an emergency.

Consumption, Uses, and Specifications

Approximately 95 per cent of the world output of manganese ore is used to make manganese alloys for the steel industry. An average of 13 pounds of manganese is needed to produce a ton of steel ingot, this amount being necessary to deoxidize, clean and combine with sulphur so as to produce steel that may be readily rolled and fabricated. As an alloying element, manganese improves the strength and toughness of structural steels and cast-irons. The dry-battery industry accounts for 3 per cent, and the chemical industry for the remainder.

Metallurgical-grade Manganese

Most of the manganese consumed by the steel industry is in the form of high-carbon ferromanganese and the remainder as 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 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 a manganese dioxide (pyrolusite) ore of not less than 75 per cent MnO_2 and not more than 1.5 per cent iron, and should be very low in such metals as arsenic, copper, zinc, nickel, and cobalt.

Chemical-grade Manganese

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

Canadian Consumers

Consumers of metallurgical-grade ore are Electro Metallurgical Company of 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 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 29, 1955, issue of E & M J Metal and Mineral Markets quotes the following manganese prices in the United States.

Manganese ore	
Indian ore	\$1.12 to \$1.17 per long-ton unit of Mn, c.i.f. U.S. ports, duty extra, basis 46 to 48% Mn.
On long-term	contracts for ore from various sources, 46 to 48% Mn, quotations nominal at 94 to 96¢ per long-ton unit c.i.f. U.S. ports, duty extra.
Low iron	48% Mn (max. 2% Fe) \$1.12 per long-ton unit of Mn, duty extra.
Chemical grade,	per ton, coarse or fine, Min. 84% MnO_2, carloads, in drums \$96, burlap bags \$90.50 f.o.b. Philadelphia.
Ferromanganese,	per short tons, 74-76% Mn, \$205, f.o.b. shipping point seaboard and major domestic producing points.
Silico manganese,	per lb carload lots, f.o.b. shipping points, bulk: 65-88% Mn, Max. 1 1/2% C, 18-20% Si, 11.5 cents.
Spiegeleisen,	per gross ton, carload lots, f.o.b. Palmerton, Pa.: 16-19% Mn. 3% Max. Si \$89.50.
Manganese metal,	electrolytic, per lb f.o.b. Knoxville, Tenn., with freight allowed east of Mississippi: Min. 99.9% Mn, carload, 30¢; ton lots 32¢. Premium for hydrogen-removed metal 0.75¢ per lb.

Tariffs

Canada

	British Preferential	Most Favoured Nation	General
Manganese ore	free	free	free
Ferromanganese (per lb of contained Mn)	free	1¢	1 1/4¢
Silicomanganese (per lb of contained Mn)	free	1 1/2¢	1 3/4¢

United States

Manganese ore
Over 10% but less than 35% Mn.
On Mn content - 1/4¢ per lb
- Cuba free

35% Mn and over, battery and chemical grades
On Mn content - 1/4¢ per lb
- Cuba free

Metallurgical grades
On Mn content - 1/4¢ per lb
- Cuba free

Manganese Alloys
Ferromanganese, 30% or more Mn.
Containing not over 1% carbon
On Mn content - 15/16¢ per lb and 7 1/2% ad valorem.
Containing over 1% and less than 4% carbon
On Mn content - 15/16¢ per lb
Containing not less than 4% carbon
On Mn content - 5/8¢ per lb

Manganese silicon (including silicon manganese)
On Mn content - 15/16¢ per lb and 7 1/2% ad valorem.

Spiegeleisen containing not more than 1% carbon and manganese boron.
On Mn content 15/16¢ per lb and 7 1/2% ad valorem.

Manganese metal
On Mn content - 1 7/8¢ per lb and 15% ad valorem.

MOLYBDENUM

By W. Keith Buck

Shipments of 90 per cent molybdenite concentrates during 1955 amounted to 695 tons (contained MoS_2), an increase of 84.8 per cent over shipments in 1954. The sole producer, Molybdenite Corporation of Canada Limited, further increased mill capacity at its property about 25 miles northwest of Val d'Or in northwestern Quebec from 400 tons to 540 tons per day. All shipments in 1955 were exported to Western Europe.

Molybdenum - Production, Imports and Consumption

	1955		1954	
	Short Tons	$	Short Tons	$
Production (shipments)				
Contained MoS_2	695	823,954	376	457,912
Imports				
Molybdic oxide				
United States	329	545,518	211.00	207,656
United Kingdom	-	-	0.25	88
Total	329	545,518	211.25	207,744
Calcium molybdate (grouped with vanadium oxide and tungsten oxide for alloy steel manufacture)				
United States...........	65	174,249	61	73,950
Ferromolybdenum*				
United States...........	88	175,661	35	69,874
Consumption (Mo content)				
Molybdic oxide	235		125	
Ferromolybdenum	63		48	
Calcium molybdate	3		2	
Sodium molybdate	11		7	
Molybdenum metal	4		4	
Molybdenum wire	1		1	
Total	317		187	

* These figures are United States export statistics as reported by the U.S. Department of Commerce. Imports of ferromolybdenum are not recorded separately in the official trade statistics of Canada.

The Molybdenite Corporation property was operated during World War II by a Crown company, Wartime Metals Corporation, which constructed a 275-ton mill on it. Production from May 1943 until July 1945 amounted to 2,739,539 pounds of concentrate averaging 87 per cent MoS_2 and containing 1,429,711 pounds of molybdenum. As there are no Canadian plants equipped to convert molybdenite into primary products, the concentrates were shipped to Langeloth, Pennsylvania, for treatment, and returned to Canadian consumers. The property was returned to the present operating company on

July 15, 1945, and continued in production until December 1947, when operations were suspended.

The company resumed test milling early in 1951 and succeeded in producing a concentrate relatively free of bismuth and containing over 90 per cent MoS_2. By the end of 1951, it had increased the milling rate to about 280 tons per day. During 1952 underground development on the 270-, 375-, and 500-foot levels together with diamond drilling indicated further ore at greater depth and plans to expand production were made.

Operations were suspended at the property during 1953 and early 1954 to permit the opening up of two new levels at the 625- and 750-foot horizons and to prepare the mine for production at the rate of 500 tons per day. Milling operations recommenced in March 1954 and have been continuous since that date. The treatment process is essentially one of crushing, grinding, flotation and leaching. The grade of the ore is approximately 0.5 per cent molybdenite and 0.04 per cent bismuth.

During 1955, about half the ore milled came from No. 87 vein. No. 89 vein, west of No. 87, was opened up during the year and prepared for stoping. Most of the ore milled in 1956 will come from this area. No shaft sinking was carried out in 1955.

A further increase in mill capacity to 600 tons per day is scheduled for 1956. The company is also considering the manufacture of molybdenum products. The first step towards this goal is to be taken in June 1956 when the company expects that it will be ready to ship molybdic oxide from its new roasting plant now under construction. Other molybdenum products may also be produced, if and when market conditions prove favourable.

During 1955, Quebec Metallurgical Industries Ltd. continued development of its property 9 miles north of Shawville, Quebec. A molybdenite-bearing zone 300 feet in length has been opened by an adit. The company feels that this zone gives indications of enough material of moderate grade to supply Canadian requirements in case of emergency.

World Production

World production of molybdenum in ores and concentrates in 1954 amounted to an estimated 32,750 short tons, of which 29,334 short tons, or about 90 per cent, was produced in the United States. The remaining production came mainly from Chile, Yugoslavia, Canada, Japan, Norway and Mexico in that order.

United States production of molybdenum concentrates in 1955 was estimated by the U.S. Bureau of Mines at a record 31,150 short tons. Production came chiefly from Climax Molybdenum Company at Climax, Colorado, and from the mines of Kennecott Copper Corporation. The latter company recovers molybdenite as a by-product in the concentration of its Utah, New Mexico, and Nevada copper ores. Production in the United States also comes from the molybdenite mine of Molybdenum Corporation of America at Questa, New

Mexico; the copper mines of Miami Copper Company at Miami, Arizona; and the tungsten mine of United States Vanadium Corporation at Bishop, California.

In Chile, molybdenite is recovered as a by-product in the milling of copper ores by Braden Copper Company, a subsidiary of the Kennecott Copper Corporation.

Consumption and Uses

About 70 per cent of the total molybdenum used in the United States, by far the world's largest consumer, is used in the form of ferromolybdenum, molybdic oxide, and calcium molybdate in the making of steels and about 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 ship-building industries, shafts for mining and industrial machinery, and castings for pumps and valves.

Varying amounts of molybdenum are used in high-speed tool steels, high-temperature alloys, and stainless steels.

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 castings. They have a limited use in the chemical field. Molybdenite is finding increasing use as a lubricant, as molybdenum disulphide in greases, oil dispersions, resin-bonded films, or dry-powder lubricants.

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

Prices

According to E & M J Metal and Mineral Markets, December 29, 1955, the prices of molybdenum in United States were as follows:

Molybdenum metal, 99% purity $3, per lb

Ferromolybdenum, f.o.b. shipping point per lb of contained Mo:
58-64% Mo, powdered - $1.66
all other sizes - $1.54

Calcium molybdate, f.o.b. shipping point, per lb of contained Mo, $1.34

Molybdic trioxide (MoO_3) f.o.b. shipping point per lb of contained Mo.
bagged - $1.30
canned - $1.31

Molybdenum ore (molybdenite), per lb of contained Mo. f.o.b. Climax, Colo., plus cost of containers, $1.05.

Tariffs

Canada

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

United States

(a) Molybdenum ore and concentrate, 35¢ per lb on Mo content.

(b) Calcium molybdate, ferromolybdenum, metallic molybdenum, molybdenum powder, and all other alloys and compounds of molybdenum, 25¢ per lb on Mo content and 7 1/2% ad valorem.

(c) Material containing over 50% molybdenum: bars, ingots, scrap, and shot, 25% ad valorem: other forms, 30% ad valorem.

NICKEL

By E.C. Hodgson

The production of 349,856,997 pounds of nickel valued at $215,866,007 was the largest on record. The increase over 1954 on a weight basis was about 8 per cent. The three principal producers are The International Nickel Company of Canada, Limited (Inco) and Falconbridge Nickel Mines, Limited from their ores in the Sudbury district of Ontario, and Sherritt Gordon Mines, Limited from its ores at Lynn Lake, Manitoba.

Nickel Rim Mines Limited and Nickel Offsets, Limited are small producers in the Sudbury area. Deloro Smelting and Refining Company, Limited produces a small amount of nickel in the refining of cobalt ores at Deloro, Ontario.

Canadian mines produce about 81 per cent of the free world output. The supply available for civilian applications was limited by increased defense requirements and purchases for the United States strategic stockpile.

Production and Trade

	1955		1954	
	Short Tons	$	Short Tons	$
Production, all forms	174,928	215,866,007	161,279	180,173,392
Exports, by forms				
Matte or speiss	65,954	79,045,411	65,823	72,862,335
Oxide	1,453	1,357,688	1,486	1,463,424
Refined nickel	106,473	134,765,810	91,410	107,828,514
Total	173,880	215,168,909	158,719	182,154,273
Exports, by destination				
United States	116,162	145,828,592	105,906	123,628,706
United Kingdom	33,910	40,156,734	32,016	35,218,056
Norway*............	20,721	24,822,876	19,562	21,666,109
West Germany	636	972,926	212	346,312
Italy	557	733,654	67	77,227
Sweden	557	815,603	29	51,478
Other countries	1,337	1,838,524	927	1,166,385
Total	173,880	215,168,909	158,719	182,154,273

* For refining and re-export

Activities at Producing Mines

The International Nickel Company of Canada, Limited

Deliveries of nickel in all forms amounted to 290,463,934 pounds. The total ore mined was 14,247,591 tons, of which 1,488,109 tons came from open-pit operations. Proved ore reserves at the end of the year were reported to be 262,369,185 tons with a combined nickel-copper content of 7,897,830 tons.

The company operates five mines, two concentrators, two smelters, and a copper refinery in the Sudbury area and a nickel and cobalt refinery at Port Colborne.

Initial test operations with the first unit of the new iron ore recovery plant near Copper Cliff were begun in November. This unit, when in full operation, will treat 1,000 tons of pyrrhotite per day, corresponding to an output of 250,000 tons per year. A feature of this project is the release of smelter capacity for increased nickel production.

Falconbridge Nickel Mines, Limited

The company operates five mines, three concentrators, and a smelter in the Sudbury area. The copper-nickel matte produced is shipped to a refinery at Kristiansand, Norway.

Deliveries of nickel in all forms totalled 41,136,904 pounds. The company treated 1,679,610 tons of ore from its own mines and 65,567 tons of ores and concentrates from two independent mines in the Sudbury area. Developed and indicated ore reserves at the end of the year were reported to be 39,847,650 tons grading 1.43 per cent nickel and 0.73 per cent copper.

The Longvack, Boundary, Fecunis Lake, and Onaping mines are being developed, Longvack is scheduled to start production in 1956.

Sherritt Gordon Mines Limited

The company operates two copper-nickel mines and a concentrator at Lynn Lake, Manitoba, and a nickel refinery at Fort Saskatchewan, Alberta. During the year 761,584 tons of nickel-copper ore were mined and milled at Lynn Lake. The refinery started production in 1954, using a chemical metallurgical process that replaces conventional smelting and refining methods. The plant produced 16,666,574 pounds of nickel and 54,829 tons of ammonium sulphate; in addition, nickel concentrates containing 12,248,385 pounds of nickel were shipped from Lynn Lake to Inco for processing.

Nickel Rim Mines, Limited

The Nickel Rim mines and concentrator are in MacLennan township on the east rim of the Sudbury Basin. The company reported treating ore at the rate of 800 tons per day. Concentrates produced in the mill are sold to Falconbridge Nickel Mines, Limited.

The shaft is being deepened to about 1,200 feet. Over-all nickel reserves are reported at 33,728,000 pounds.

Nickel Offsets, Limited

This property, comprising 51 claims in Foy and Bowell townships, is about 20 miles north of Chelmsford in the Sudbury area. A 300-ton mill is operated and concentrates are sold under contract to Falconbridge. The mill treated about 200 tons of ore per day.

Development and Exploration

Quebec

Underground development of the nickel-zinc-copper deposit of Eastern Metals Corporation Limited in Rolette township, Montmagny county, was continued.

Selco Exploration Company Limited acquired a promising copper-nickel discovery near Delahey Lake about 60 miles west and north of Mont Laurier.

Eastern Mining and Smelting Corporation, Limited, purchased property at Chicoutimi and proposes to erect smelting and refining facilities to treat nickel and copper concentrates.

Ontario

Falconbridge Nickel Mines Limited started sinking a shaft to 850 feet to explore its nickel-copper deposit at Populus Lake in the Kenora district. Underground development of two ore zones on the Gordon Lake-Werner Lake property of Quebec Nickel Corporation, Limited, in the Kenora district continued. Quebec Nickel Corporation,Limited and Eastern Smelting and Refining Company Limited amalgamated in December to form Eastern Mining and Smelting Corporation Limited. In the Sudbury area, Inco carried out 522,836 feet of exploratory diamond drilling.

Manitoba

An exploration shaft was completed to a depth of 1,325 feet at the Moak Lake property of Canadian Nickel Company, an Inco subsidiary, and lateral work was begun. Surface diamond drilling has indicated a large deposit of low-grade nickel ore.

Maskwa Nickel Chrome Mines Limited, a subsidiary of Falconbridge, discontinued investigation of its nickel-copper deposits in the Bird River region until an economic method of producing high-grade concentrate from the complex ore is developed. Drilling has indicated 1,350,000 tons of ore grading 1.15 per cent nickel and 0.34 per cent copper.

Yukon

Underground development was continued at the Wellgreen property of Hudson-Yukon Mining Company, a subsidiary of Hudson Bay Mining and Smelting Company, Limited, in the Kluane Lake district. About 6,300 feet of lateral development headings were driven and a winze was begun to permit development at greater depth. The ore reserves are reported to be 728,000 tons averaging 2.05 per cent nickel, 1.42 per cent copper, with small amounts of cobalt, gold, platinum, and palladium.

Northwest Territories

North Rankin Nickel Mines Limited, at Rankin Inlet on the west coast of Hudson Bay, have outlined an orebody estimated to contain 460,000 tons grading 3.3 per cent nickel and 0.81 per cent copper. Plans have been laid to construct a 250-ton mill.

Uses

The manufacture of stainless and other alloy steels, and nickel cast-iron accounts for approximately 45 per cent of the nickel used in industry. The production of nickel-containing copper, silver, magnesium, aluminum, chromium, brass, and bronze alloys and of malleable nickel consumes about 25 per cent of the available metal. Electro-plating uses about 14 per cent and the balance is used in high-temperature and electrical resistance alloys, catalysts, ceramics, and miscellaneous applications. Nimonia and Inconel alloys play an important part in the field of gas turbines and jet engines.

Prices and Tariff

The Canadian price of nickel in Canada in 1955 was 61.4 cents per pound from January until the beginning of March, when it increased to 62.5 cents per pound. On November 1 the price was further increased to 63 cents per pound and remained at this level for the balance of the year.

In the United States the price for electrolytic nickel remained unchanged at 64.5 cents per pound. This price included the United States import duty of 1 1/4 cents per pound on refined nickel.

Nickel oxide, ore, matte, and scrap enter the United States duty free. The duty on nickel bars, rods, plates, sheets, castings, str ips, and wire is 12 1/4 per cent ad valorem.

NIOBIUM AND TANTALUM

By R. E. Neelands

Canadian production of the pentoxides of niobium (also commonly called columbium) and tantalum in commercial quantities was commenced by Boreal Rare Metals Limited at Cap de la Madeleine, Quebec, in 1954. The output and value of the products in that year and in 1955 were as follows:

	1955		1954	
	Pounds	$	Pounds	$
Niobium (Nb_2O_5)	42	1,032	90	2,294
Tantalum (Ta_2O_5)	390	9,760	77	2,696

Occurrences and Developments

Northwest Territories

Boreal Rare Metals Limited owns a lithium-tantalum-niobium property 70 miles east of Yellowknife on which ore was mined from the surface in 1953 and 1954 and treated on the property in a 100-ton mill. Niobium and tantalum concentrates were shipped to the company's plant at Cap de la Madeleine for refining. Mining operations were suspended when the mill burned early in 1955 but production at the refinery was maintained from the company's stockpile of concentrates and later from foreign ores.

There are about a dozen other scattered occurrences north of Great Slave Lake on which varying amounts of exploration have been carried out. On the Peg property near Upper Ross Lake, 45 miles northeast of Yellowknife, owned by Nationwide Minerals Limited, a 100-ton mill was built in 1946 and a small quantity of tantalite-columbite concentrate was produced from open-pit ore in 1947. The property was diamond drilled in 1954 but is presently idle.

British Columbia

Quebec Metallurgical Industries Limited discovered and developed extensive niobium-uranium-thorium placer deposits on Bugaboo Creek and adjacent creeks about 30 miles southeast of Golden, and it reports that a method has been worked out of separating these metals into commercial forms. Preparations were under way for the erection of a concentration plant at Bugaboo Creek and a pilot chemical plant in Ottawa.

A uranium-niobium occurrence on Moose Creek, a tributary of Beaverfoot river, southeast of Field was investigated in 1954 with inconclusive results.

Near Lempriere on the Canadian National Railway 170 miles north of Kamloops several occurrences of uranium-niobium mineralization in a peculiar carbonate rock were discovered in 1950, but subsequent exploration by St. Eugene Mining Corporation did not reveal ore of any importance.

A niobium occurrence near Manson Creek was tested in 1954.

Ontario

Beaucage Mines Limited continued the development of its Newman Island mine under Lake Nipissing, 7 miles southwest of North Bay, where over 1,000,000 tons averaging 0.73 per cent Nb_2O_5 and 0.054 per cent U_3O_8 have been indicated by drilling. A 50-ton test mill was built near North Bay in which research will be carried out on the recovery of marketable concentrates.

Multi-Minerals Limited has carried out extensive surface work and diamond drilling on its Nemegos property 15 miles east of Chapleau which indicated about 8 million tons in a number of zones averaging 0.2 per cent niobium pentoxide. Laboratory concentration tests were carried out on ore from several zones.

Quebec

Molybdenum Corporation of America in 1954 and 1955 carried out extensive diamond drilling on a niobium deposit near Oka, 40 miles northwest of Montreal, which indicated 30 million tons of commercial ore (Nb values range from 0.1 to 2 per cent). Investigations of concentration methods have been carried out in the United States. Future development is to be conducted jointly by the company and Kennecott Copper Corporation.

Oka Rare Metals Mining Company Limited commenced sinking a 300-foot shaft on one of its properties northeast of the Molybdenum Corporation property.

Other companies which carried out diamond drilling and surface exploration in the Oka district in recent years include Main Oka Mining Corporation, St. Lawrence River Mines Limited, Oka Uranium and Metals Limited, Bouscadillac Gold Mines Limited, Advance Red Lake Gold Mines Limited and a combined development by Coulee Lead and Zinc Mines Limited and Headway Red Lake Gold Mines Limited.

World Production

The principal niobium producing countries of the world, in the order of their output in 1952, are: Nigeria, Belgian Congo, Malaya, Mozambique, Uganda, Madagascar, United States, Brazil and French Equitorial Africa.

The principal tantalum producing countries, based on 1952 output, are: Brazil, Australia, Southern Rhodesia, Union of South Africa and Nigeria.

Uses

Niobium is used principally in the form of ferroniobium (50 to 60% Nb) and ferrotantalum-niobium (40% Nb and 20% Ta) for the fixation of carbon in making stainless steel.

Niobium is also used to impart creep resistance to certain high-temperature alloys such as Inconel "X" which contains 1 per cent niobium. Other uses for niobium are in titanium-niobium carbide for high-temperature electrodes for welding stainless steel, low-voltage rectifiers, and electronic tubes.

Tantalum's most important use is for acid-proof equipment in the chemical and petroleum industries. Tantalum heaters are used extensively in sulphuric acid concentrators and recovery plants, also in metal-pickling tanks and chromium-planting baths.

Owing to its non-irritating effect on living tissues, tantalum can be used for dental plates, bone screws, cranial plates and suture wire. It is also used for rectifiers and in electronic transmitting tubes.

Trade and Consumption

Figures on Canadian exports, imports and domestic consumption of niobium and tantalum products are incomplete or unavailable. In 1954, about 190 pounds of niobium concentrate was imported from the United States. None was imported from United States in 1955 and the quantities and countries from which it was imported are not published. The value of ferrocolumbium imported in 1954 was $47,000. Tantalum imported in semi-fabricated forms amounted to 262 pounds valued at $18,834 in 1954 and 95 pounds valued at $6,871 in 1955.

The more important consumers of niobium and tantalum alloys in Canada are: Atlas Steels, Limited, Welland, Ontario; Shawinigan Chemicals, Limited, Shawinigan Falls, 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.

Prices

The American Metal Market quoted the price of niobium powder at the end of 1955 at $120 a pound and tantalum rod $65 a pound, tantalum sheet $51 a pound and tantalum powder $56 a pound.

E & M J Metal and Mineral Markets, quoted the following prices on December 29, 1955:

Columbite per pound of pentoxide, $1. 35 to $1. 65, basis 50% Nb_2O_5

Tantalum per kilo, base price $137 for rods and $93 for sheet

Ferroniobium per pound of contained Nb (50-55% Nb) $6. 80 to $6. 90

The average indicated Canadian price of both niobium and tantalum pentoxide in 1955 was about $25 a pound, according to the Dominion Bureau of Statistics.

PLATINUM METALS

By W. L. Sebolt

Canada's production of platinum metals in 1955 was 384,746 ounces valued at $23,069,365 compared to 343,706 ounces valued at $20,906,556 in 1954. Platinum production in 1955 was 170,494 ounces, an increase of 10 per cent over the 1954 production. The increase of 12 per cent in production of platinum metals over the 1954 production was due to a similar increase in nickel output, from which all platinum production in Canada is derived.

Canada is first in the output of platinum metals among world producers. South Africa is the next largest producer, with Russia in third position. Colombia and the United States vie annually for fourth and fifth.

The bulk of Canadian production comes from The International Nickel Co. of Canada Ltd. as a result of the treatment of the copper-nickel ores of the Sudbury area. Falconbridge Nickel Mines Ltd., the only other major Canadian producer, has an output of less than 10 per cent of the production of International Nickel. The platinum metals are recovered at Acton, England, in the case of International Nickel and at Kristiansand, Norway, by Falconbridge. The refined platinum metals are sold on world markets, the greater portion going to the United States, the world's largest consumer. Most of the refined metal is returned to Canada for re-export.

There are a number of potential sources of the platinum metals that are still in the exploration and development stages. At the moment, the two most promising prospects are the Gordon Lake-Werner Lake property of Quebec Nickel Corporation Limited in the Kenora District of Ontario and the Wellgreen property of Hudson-Yukon Mining Company, a subsidiary of Hudson Bay Mining and Smelting Company Limited, in the Kluane Lake District, Yukon.

Consumption

The Canadian consumption of platinum metals has been steadily increasing, owing mainly to the great expansion of petrochemical and petroleum plants, where the metals are used as catalysts. The apparent Canadian consumption of platinum metals in all forms was valued at $5,000,000 in 1955. The United States is the principal consumer and generally takes about 75 per cent of the free world's production.

Uses

Platinum metals are used in numerous electrical applications owing to their resistance to oxidation, sulphidation, spark erosion, and high temperatures and also because of their good mechanical properties. They are used extensively in the chemical industry because of their high catalytic activity and resistance to oxidation at high temperatures. Other uses of the platinum metals are in the manufacutre of glass fibre, high octane gas, telephone relay parts, rayon, nitrates for fertilizers, and spark plugs and electrodes for aircraft.

Production and Trade of Platinum and Platinum Metals

	1955 Fine Ounces	1955 $	1954 Fine Ounces	1954 $
Production (shipments)				
Platinum	170,494	14,747,732	154,356	12,950,469
Palladium, rhodium, ruthenium, iridium, and osmium.........	214,252	8,321,633	189,350	7,956,087
Total...............	384,746	23,069,365	343,706	20,906,556
Exports				
Platinum metals in concentrates*		14,533,193		16,173,183
Platinum metals refined and semi-processed**				
United States........		11,697,861		10,936,039
Other countries		72,346		520,533
Total...............		11,770,207		11,456,572
Platinum, old and scrap				
United Kingdom		6,956		9,755
United States........		4,950		-
Total		11,906		9,755
Imports				
Platinum and platinum metals, refined, semi-processed, and manufactured				
United Kingdom** ...		15,519,547		17,537,757
United States........		1,342,379		1,302,077
Other countries		3,237		64,737
Total...............		16,865,163		18,904,571

* To U. K. for refining and processing
** Derived from domestic concentrates refined and processed in U. K.

Owing, to its fine appearance, high density, and workability platinum is used widely by the jewellery trade. Palladium's beautiful white colour places it in great demand for setting diamonds; it has the strength to hold the stones securely and its lightness avoids excessive weight. Rhodium-finished mirrors for projectors are made by electroplating the metal onto other metals. Iridium, ruthenium, and osmium are used as hardeners for pen-tips, and in various alloys.

Prices

According to E & M J Metal and Mineral Markets the United States prices of platinum and platinum metals per fine ounce at the end of 1955 were as follows:

	$
Platinum	97 - 117
Palladium	23 - 24
Rhodium	118 - 125
Iridium	100 - 110
Osmium	80 - 100
Ruthenium	45 - 55

SELENIUM

By E. C. Hodgson

Production of selenium in 1955, at 427,109 pounds, was about 32 per cent greater than in 1954. Canadian output, from two producers, is derived as a by-product from electrolytic copper refinery anode mud.

Canadian Copper Refiners Limited, Montreal East, Quebec, operates the world's largest selenium plant, with a rated annual capacity of 450,000 pounds. Selenium is recovered from the electrolytic refining of copper anodes produced at the Noranda smelter, from copper ores mined in the Noranda area, and from blister copper produced by the Hudson Bay Mining and Smelting Company Limited from its copper-zinc deposits at Flin Flon on the Manitoba-Saskatchewan boundary. In addition to refined and high-purity elemental selenium, iron selenide, selenium dioxide, sodium selenite, and sodium selenate are produced. Research is in progress on the possible recovery of selenium from the pyrite ore at Noranda which is now being treated at a plant at Port Robinson, Ontario, to recover iron and sulphur.

Selenium is present in the copper-nickel deposits of The International Nickel Co. of Canada, Ltd. at Sudbury, Ontario, It is recovered at the Copper Cliff copper refinery in the form of a black, free-flowing, amorphous powder which averages 99.5 per cent selenium. The rated annual capacity of the selenium plant is 270,000 pounds.

Expansion of the electronics industry has been largely responsible for the continued heavy demand for selenium throughout 1955. Selenium has been listed as one of the most critical metals for the United States stockpile.

The United States and Canada are the leading producers of selenium followed by Russia, Sweden, Japan, and Northern Rhodesia in that order.

Production, Trade, and Consumption of Selenium

	1955 Pounds	1955 $	1954 Pounds	1954 $
Production				
Quebec	236,767	1,775,753	135,051	675,255
Ontario	94,465	708,488	94,826	474,130
Manitoba and Saskatchewan	95,877	719,078	93,652	468,260
Total	427,109	3,203,319	323,529	1,617,645
Exports, metals & salts				
United States	185,266	1,423,376	190,686	1,047,623
United Kingdom	141,521	1,051,431	146,853	848,260
Australia	7,020	75,150	2,545	20,000
West Germany	325	5,173	50	400
Netherlands	83	559	-	-
Other countries	-	-	4,158	27,469
Total	334,215	2,555,689	344,292	1,943,752
Approximate Consumption by industries				
Alloy steel	13,474		7,419	
Rubber	4,981		5,971	
Electronic	9,617		3,999	
Glass	6,725		3,560	
Agriculture	57		192	
Total	34,854		21,141	

Uses

The principal uses of selenium are in electrical applications, in pigments, and in metallurgy. Other uses are of relatively minor importance.

The use of selenium in the manufacture of dry-plate rectifiers for the conversion of alternating to direct current is the most important electrical application. Selenium rectifiers are used in radios, television sets, telecommunication equipment, mobile and aircraft D. C. power supplies, battery chargers, circuit breakers, D. C. supplies for electrochemical processes requiring high currents at low voltages, electrostatic precipitators, magnetic brakes, meter protectors, and highspeed computers. The main advantages of selenium rectifiers are their high efficiency, small size, ruggedness, and long life.

Selenium photoelectric cells find many important uses in light-sensitive devices such as electric eyes, photographic exposure meters, colorimeters, and pyrometers. A recent application in photoconductivity is Xerography, a process for the production of a direct positive picture or print. Small additions of selenium to rubber improve resistance to heat, oxidation, and abrasion.

The production of cadmium sulphoselenide pigments provides an important outlet for selenium. The colour of the product varies from intense orange through varying shades of red to a dark maroon. The pigments possess good opacity and staining power, stability to sunlight, and resistance to heat and to chemical attack.

Large amounts of ferroselenium are incorporated into stainless steels to control porosity in castings and to improve machinability without reducing corrosion resistance or the hot-forging and cold-working properties. Small amounts of selenium are used to improve the machinability of copper and copper alloys without affecting other properties.

Prices

According to E & M J Metal and Mineral Markets, selenium metal was quoted at $6 per pound until the beginning of August. At this time the price ranged between $6 and $10 per pound finally settling to regular quoted prices of between $9 and $10 per pound for the balance of the year.

SILVER

By W. L. Sebolt

Canadian production of silver in 1955 amounted to 27,984,204 fine ounces, a decline of 10 per cent as compared to the previous year, when production reached a 41-year peak. Most of the decrease occurred in British Columbia; there was also a large decrease in production from the Yukon, and smaller drops in the output from Northwest Territories, Manitoba, Saskatchewan, Quebec, Nova Scotia, and Newfoundland. Only Ontario and New Brunswick showed increases. Owing to an increase in price, the value showed a decline of 5 per cent only.

Canada held third place in world production following Mexico (45,000,000 oz) and the United States (35,000,000 oz). Handy and Harman estimate world production at 203,700,000 oz, consumption at 217,400,000 oz.

Most of Canada's production is exported, chiefly to the United States. An estimated 21,110,000 oz was so exported in 1955, plus another 1,362,000 oz to other countries; domestic consumption amounted to 5,161,000 oz.

Developments at Producing Mines

Yukon

Production at United Keno Hill Mines Limited in the Mayo district, Canada's largest single source of silver, declined to 5,667,220 oz, owing partly to the winding up of the old mill tailing reclamation project. Development at the Hector and Calumet mine continues to give excellent results, and the company has had encouragement in re-opening the old Elsa mine.

Silver - Production and Trade

	1955 Fine Oz	1955 $	1954 Fine Oz	1954 $
Production by Provinces				
British Columbia and Alberta	8,702,143	7,673,549	10,825,632	9,013,097
Ontario	6,051,017	5,335,787	5,443,721	4,532,278
Yukon	5,712,219	5,037,035	6,992,279	5,821,562
Quebec	4,786,695	4,220,908	4,907,304	4,085,674
Saskatchewan and Manitoba	1,684,707	1,485,575	1,885,495	1,569,806
Newfoundland	701,792	618,840	742,120	617,867
Nova Scotia	262,067	231,091	262,361	218,434
Northwest Territories	58,477	51,565	59,037	49,152
New Brunswick	25,087	22,122	-	-
Total	27,984,204	24,676,472	31,117,949	25,907,870
Production by Sources				
Base-metal ores	23,247,898		26,707,856	
Gold ores	652,554		660,073	
Silver-cobalt and silver ores	4,067,751		3,732,089	
Placer gold operations	16,001		17,931	
Total	27,984,204		31,117,949	
Imports				
Unmanufactured				
United States	87,128	75,345	57,402	48,086
United Kingdom	-	-	2,763	2,317
Total	87,128	75,345	60,165	50,403
Manufactured				
United Kingdom		433,842		421,425
United States		250,275		138,860
Denmark		30,651		21,078
West Germany		18,585		14,243
Other countries		30,078		38,397
Total		763,431		634,003
Exports				
In ore and concentrates				
United States	5,435,110	4,474,212	8,149,943	6,534,774
Belgium	269,502	235,387	122,694	99,995
West Germany	169,261	148,349	399,703	326,319
Total	5,873,873	4,857,948	8,672,340	6,961,088

	1955 Fine Oz	1955 $	1954 Fine Oz	1954 $
Exports (continued)				
Bullion				
United States..........	15,675,242	13,673,969	13,261,017	11,006,103
Other countries	923,335	811,068	1,205,998	985,714
Total.................	16,598,577	14,485,037	14,467,015	11,991,817
Manufactured				
United States..........		43,207		46,450
Other countries		11,275		7,795
Total		54,482		54,245

Milling at Mackeno Mines Limited was not resumed until October 1 and then only for a short time. Production was barely 45,000 oz, most of the effort at this property being directed on development during the year.

Northwest Territories

The output is chiefly a by-product from the three operating gold mines in the Yellowknife district; a small unspecified amount is produced as a by-product from the operations of Eldorado Mining and Refining Limited at Great Bear Lake.

British Columbia

In 1955 this province produced about 31 per cent of the total Canadian output. The plant of The Consolidated Mining and Smelting Company of Canada Limited at Trail is the largest Canadian producer, although most of the silver is produced from custom ores. The Sullivan lead-zinc mine is the main silver producer of the combined operations, and the company's mines at Tulsequah are important contributors.

At Torbrit Silver Mines Limited, near Alice Arm, development results were disappointing. At another important producer, Highland-Bell Limited, at Beaverdell, the remaining ore in the upper mine was nearly mined out by year's end, but encouraging results were obtained from a new low-level (1,100' lower) adit that has reached a favourable area.

Other important producers were ViolaMac Mines Limited in the Slocan area; Silver Standard Mines Limited near Hazelton, which has located new ore; Sunshine Lardeau Mines Ltd. at Camborne; Yale Lead and Zinc Mines Limited at Ainsworth; and the Mineral King mine of Sheep Creek Gold Mines Limited near Invermere.

The balance of the output was made up by the two large copper mines, The Granby Consolidated Mining Smelting and Power Co., Ltd. near Princeton and Britannia Mining and Smelting Company Limited, on Howe Sound, and from a number of small base-metal shippers. A minor amount is obtained as a by-product from lode gold operations.

Manitoba and Saskatchewan

The bulk of the output is derived from the base-metal orebody of Hudson Bay Mining and Smelting Company Limited at Flin Flon on the provincial boundary. Most of the production is credited to the Saskatchewan side.

The remainder of the silver is a by-product from Sherritt Gordon Mines Limited at Lynn Lake, Nor-Acme Gold Mines Limited at Snow Lake, and San Antonio Mines Limited at Rice Lake, all in Manitoba.

Ontario

Output in Ontario rose some 11 per cent in 1955 over 1954, the chief source being the Cobalt-Gowganda area. The principal producers were Silver Miller Mines Limited; Siscoe Metals of Ontario Limited; Castle-Trethewey Mines Limited; and Cobalt Consolidated Mining Corporation Limited.

The International Nickel Company of Canada Limited shipped 1,285,846 oz, a gain of over 133,088 oz over 1954.

The balance of the production came from Jardun Mines Limited, Falconbridge Nickel Mines Limited, and the 33 lode gold mines.

Quebec

The production from Quebec is entirely by-product, mostly from copper mines. These mines ship their concentrates to Noranda, where they are converted into anode copper along with Noranda ores; the anode copper is refined at Canadian Copper Refiners Limited at Montreal, where the silver is recovered. The following mines shipped to Noranda: Waite Amulet Mines Limited; Normetal Mining Corporation Limited; Quemont Mining Corporation, Limited; East Sullivan Mines Limited; Quebec Copper Corporation Limited; Opemiska Copper Mines (Quebec) Limited; Campbell Chibougamau Mines Limited; Weedon Pyrite and Copper Corporation Limited, and Gaspe Copper Mines Limited.

The following base-metal mines also produced substantial amounts of silver: Golden Manitou Mines Limited; Barvue Mines Limited; New Calument Mines Limited; Anacon Lead Mines Limited - now closed; and Ascot Metals Corporation Limited.

The 16 gold mines of Western Quebec added some 140,000 oz of by-product silver to the total.

Development work at Golden Manitou has disclosed a large new good-grade zinc orebody with an average of 10 oz silver per ton.

Nova Scotia

Output was entirely from the base-metal operation of Mindamar Metals Corporation Limited, on Cape Breton Island: unfortunately this operation has ceased owing to lack of ore.

New Brunswick

Keymet Mines Limited produced the small amount of by-product silver recorded from this province, but operations have been temporarily suspended at this property.

Newfoundland

Buchans Mining Company Limited is the only producer, the silver being a by-product of its base-metal operation.

Developments at Other Properties

Yukon

At the Pelly River property of Prospectors Airways Company, Limited over 10 million tons of lead-zinc-copper ore grading about 1.75 oz silver to the ton has been outlined; no production plans have yet been announced.

Ontario

In the Manitouwadge area, Geco Mines Limited is proceeding with development of its 15-million-ton base-metal orebody, grading 1.7 oz silver to the ton, and is constructing a 3,300-ton mill which is expected to be in operation by the end of 1957. Willroy Mines Limited, adjoining, is also working on its orebody of 2 million tons grading about 2 oz silver to the ton, and expects to have a 750-ton mill in operation at about the same time.

Quebec

Coniagas Mines Limited has acquired the 'Dome' property at Bachelor Lake, about 100 miles northeast of Senneterre. The orebody contains 365,000 tons of lead-zinc ore grading 24 oz of silver to the ton, and is being developed with a view to early production.

New Brunswick

In the Bathurst area, development and construction were going ahead on the large base-metal deposits of Brunswick Mining and Smelting Corporation Limited. The American Metal Company Limited has located several large base-metal orebodies running from 2 to 3 oz silver per ton, about 35 miles northwest of Newcastle.

Domestic Refineries

Fine silver is produced by the following:

Quebec: Canadian Copper Refiners Limited, Montreal East.

Ontario: Royal Canadian Mint, Ottawa; The International Nickel Company of Canada Limited, Copper Cliff; Hollinger Consolidated Gold Mines Limited, Timmins; Deloro Smelting and Refining Company Limited, Deloro.

British Columbia: The Consolidated Mining and Smelting Company of Canada Limited, Trail.

Domestic Consumption

Owing to a large reduction in the minting of coins, there was a sharp drop in the use of silver in Canada in 1955:

	1955 (Fine Ounces)	1954 (Fine Ounces)
Coinage	519,453	1,755,393
Silverware	1,577,930	1,388,412
Photography	1,324,464	1,248,804
Plating	1,116,713	978,329
Wire and rod	271,225	291,298
Grain silver	35,000	72,000
Brazing alloys	75,219	47,772
Lead-silver alloys	9,960	8,955
Miscellaneous	231,481	205,600
Total	5,161,445	5,996,563

Prices

The New York price of 85 1/4¢ (equivalent 82.62 Canadian) which had held since January 16, 1953, continued until March 11, 1955. On that date, the Bank of Mexico, which had maintained this price by buying and selling on the market, announced that it had no more silver for sale. The price rose at once to 98 3/4¢ (U.S.) then fluctuated between 87¢ and 92¢ during the balance of the year, closing at 90 1/2¢ U.S. The average price for the year was 88.26¢ Canadian, and on October 6 reached 91 1/2¢ Canadian, the highest price in 35 years.

TELLURIUM

By E. C. Hodgson

Production of tellurium in 1955, at 9,014 pounds, was about 10 per cent greater than in 1954. It occurs in minute quantities in certain copper, gold, and lead ores.

Tellurium is recovered commercially in Canada at the Copper Cliff, Ontario, plant of The International Nickel Co. of Canada, Ltd., and at the Montreal East refinery of Canadian Copper Refiners Limited. At Copper Cliff it is recovered from the slimes formed in the process of refining copper produced from the Sudbury nickel-copper ores. At Montreal East it is obtained from the refining of copper anodes made from the copper ores at Noranda, Quebec, and from blister copper originating from the copper-zinc ores of Hudson Bay Mining and Smelting Company, Limited, at Flin Flon on the Manitoba-Saskatchewan boundary.

Production of Tellurium

	1955		1954	
	Pounds	$	Pounds	$
Quebec	-	-	530	928
Manitoba and Saskatchewan	2,559	4,478	446	781
Ontario	6,455	11,296	7,195	12,591
Total	9,014	15,774	8,171	14,300

The demand for tellurium is limited and producers usually have substantial stocks on hand. Exports to the United Kingdom were approximately 8,300 pounds and constituted over 99 per cent of total exports. Domestic shipments increased to 6,000 pounds from 2,800 pounds in 1954.

Uses

The rubber industry is the largest consumer. Tellurium rubber possesses extreme resistance to heat and abrasion. It is used to cover portable electric power cables used in mining and dredging.

Minute quantities of tellurium are added to molten iron to control the depth of chill in castings. The result is a hard, abrasion-resistant surface which is important in many applications of cast-iron.

Tellurium improves the resistance of lead to corrosion, wear, and vibration. Tellurium-lead alloy is used for marine cable sheathing and in chemical equipment exposed to sulphuric acid.

The addition of 0.5 per cent tellurium improves the machinability of copper. The electrical and thermal conductivity of this alloy are about 90 per cent that of pure copper.

Tellurium is also used to impart bluish or brownish tints in the ceramic and glass industries and as a base for ultramarine-type pigments.

Prices

The price during 1955 remained at $1.75 per pound. There has been little fluctuation from this figure for a great many years.

TIN

By H. D. Worden

Canadian production of tin in 1955 was 273 long tons valued at $521,550, compared with 149 long tons valued at $263,359 in 1954. Production is derived from tailings in the concentration of the lead-zinc-silver ores of the Sullivan mine of The Consolidated Mining and Smelting Company of Canada, Limited, Kimberley, British Columbia. The tin concentrates are shipped to the United States for treatment.

Canadian Occurrences

There are numerous minor occurrences of tin in Canada, principally in pegmatite dykes, but none of sufficient size or grade to be of economic interest. Small amounts of cassiterite (SnO_2) have been found in placer gravels in the Mayo district of Yukon Territory. Tin has also been reported in small amounts associated with the lead-zinc-copper ores in the Bathurst area of New Brunswick.

World Production and Trade

World production of tin (exclusive of Russia) for 1955 reported by The International Tin Study Group was 117,000 long tons of tin in concentrates and 178,500 long tons of metal. Malaya was the largest producer of tin in concentrates and the Malayan smelters, supplemented by concentrates from Burma and Thailand, were the largest producers of pig-tin. Elsewhere the free world's main smelters, located in Europe, obtained the bulk of their concentrates from Indonesia, Bolivia, Belgian Congo, and Nigeria. The United States also imported concentrates from these sources and produced a considerable tonnage of metal, but the major quantity came from smelters in the Netherlands and the United Kingdom.

The major tin producers and consumers of the world, with the exception of the United States and the Federal Republic of Germany, support the International Tin Agreement sponsored by the United Nations Conference on Tin, held at Geneva in December 1953. This Agreement has now been ratified by the required number of countries, and will begin to function under the governing authority of the International Tin Council upon deposit of the requisite signatory documents with the United Kingdom Foreign Office. Its purpose is to prevent excessive fluctuations in the price of tin, and to ensure adequate supplies of the metal at all times.

Tin - Production, Trade and Consumption

	1955		1954	
	Long Tons	$	Long Tons	$
Production				
Tin in concentrates	273	521,550	149	263,359
Imports				
Blocks, pigs, bars				
Belgium	1,173	2,384,347	1,131	2,198,188
Malaya	1,109	2,262,219	824	1,566,722
United States	896	1,824,042	713	1,364,728
United Kingdom	596	1,238,199	415	817,561
Netherlands	543	1,104,737	743	1,474,808
Portugal	-	-	10	19,775
Total	4,317	8,813,544	3,836	7,441,782
Tin plate				
United States	9,622	1,496,416	6,211	1,178,781
United Kingdom	293	101,077	2,905	518,287
Total	9,915	1,597,493	9,116	1,697,068
	Pounds		Pounds	
Tin-foil				
United States	35,057	39,680	28,859	30,959
Other countries	1,448	1,438	-	-
Total	36,505	41,118	28,859	30,959
Babbitt metal				
United States	35,900	29,959	23,800	20,216
United Kingdom	7,100	4,600	2,000	698
Total	43,000	34,559	25,800	20,914
Consumption				
Tin plate	1,344		1,375	
Tinning	586		434	
Solder	1,515		1,358	
Babbitt	264		198	
Bronze	156		132	
Foil	18		16	
Collapsible tubes	13		9	
Galvanizing	45		37	
Other uses	78		45	
Total	4,019		3,604	

Tin Traffic During 1955 In Long Tons*

	Production		Exports	Consumption
	Mines Tin in Conc.	Smelters Metal	Tin in Conc.	Metal
Malaya	61,245	70,631		
Indonesia	33,368		31,768	
Bolivia	27,920		27,812	
Belgian Congo	15,208	2,857	12,331	
Thailand	10,970			
China (e)	8,400	8,400		
Nigeria	8,159		8,250	
United Kingdom		27,241		
Netherlands		26,544		
Belgium		10,432		
American Total				68,844
U.S.A. only				60,010
Europe				62,678
Asia				16,254
Africa				2,200
Oceania				2,890

* Table taken from figures published in March 1956 issue of the Statistical Bulletin of the International Tin Study Group.

e estimated.

Uses and Consumption

Tin is used in the manufacture of tin plate, solder, babbitt, bronze, type metal, foil, collapsible tubes, and chemicals. About 50 per cent of the world consumption is used in the tin-plate industry, where it is being used in ever-increasing amounts for beverage containers, in addition to its long-established use for packing foods.

The Canadian tin-plate industry has increased to the point where it can supply practically all domestic needs. Consumption for tin-plating purposes in 1955 was 1,344 long tons, compared to 1,375 long tons in 1954. In spite of this small decrease, the production of tin plate has been much greater, owing to the increased use of the electrolytic tin-plating process, which uses appreciably less tin per unit than the old hot-dip method. It is estimated that by the end of 1956 approximately 90 per cent of the Canadian tin plate output will be electrolytic.

Prices

According to E & M J Metal and Mineral Markets the price of tin in the United States was 86.500 cents per pound in January 1955, increased to over 90 cents by the middle of the year, and closed at 107.75 cents per pound. The Canadian prices closely approximated these prices.

Tariffs

Tin in blocks, pigs, or bars for use in Canadian manufacturing, and tin-waste and tin-foil enter Canada duty free.

TITANIUM

By W. Keith Buck

Shipments of ilmenite from the Allard Lake deposits in eastern Quebec to the plant of Quebec Iron and Titanium Corporation at Sorel, Quebec, totalled 444,235 tons* compared with 303,348 tons in 1954. Production at Sorel was 162,784 tons of titanium dioxide slag, containing approximately 117,042 tons of titanium dioxide as against the 1954 production of 122,960 tons of titanium dioxide slag, containing 88,408 tons of titanium dioxide. Shipments of ilmenite ore from the St. Urbain area of Quebec totalled 1,400 tons, compared with 1,202 tons in 1954.

Titanium research in all fields from ore to metal continued at the Mines Branch, Ottawa. In industry, The Shawinigan Water and Power Company Limited at Shawinigan Falls, Quebec, operated a pilot plant for the production of titanium sponge. Dominion Magnesium Limited at Haley, Ontario, operated a pilot plant for the production of titanium metal and alloys and titanium master alloys.

Atlas Steels Limited continued to gain experience in the processing of titanium alloys at its Welland, Ontario, plant and, in association with Mallory-Sharon Titanium of Niles, Ohio, U.S.A., it formed a new company Atlas Titanium Limited to improve its over-all position in the field of titanium products. Vanadium-Alloy Steel Canada Limited hot-rolled and cold-finished titanium alloy billets at its plant at London, Ontario. Canadian Steel Improvement Limited at Etobicoke, Ontario, and Thompson Products Limited at St. Catherines, Ontario, were active in the field of titanium alloy forgings.

Commercial titanium sponge production took place in three countries--the United States, the United Kingdom, and Japan, production in the last case being mainly for export. During the year much progress was made in the increased use of titanium metals and alloys and in a reduction of the price.

Despite the great interest in the production of titanium metal, at least 97 per cent of the total world consumption of titanium-bearing minerals is in the titanium dioxide pigment industry. The current consumption of titanium metal is mainly for defence purposes in the aircraft industry; its general use depends on a substantial reduction in price.

* Short tons of 2,000 lb used throughout, unless otherwise stated.

Titanium - Production (Shipments) and Trade

	1955		1954	
	Short Tons	$	Short Tons	$
Production (shipments)				
Ilmenite				
Allard Lake area to				
Sorel	444,235*		303,348**	
St. Urbain area	1,400	9,982	1,202	8,750
Total	445,635		304,550	
Titanium dioxide concentrate				
Allard Lake ilmenite				
smelted at Sorel	162,784		122,960	
Titanium dioxide				
content of above	117,042	5,192,810	88,408	3,841,270
Imports				
Titanium dioxide and pigments containing not less than 14% titanium				
United States..........	25,315	6,536,335	22,714	5,747,907
United Kingdom	10,484	3,968,607	9,392	3,381,482
Total.................	35,799	10,504,942	32,106	9,129,389

* 64 tons shipped from Sorel to various customers for experimental purposes.

** 339 tons shipped from Sorel to various customers for experimental purposes.

Ilmenite ($FeTiO_3$), rutile (TiO_2), and sphene ($CaTiSiO_5$ - also called titanite) are the most abundant of the titanium minerals. The principal ores are ilmenite, ilmenite-magnetite, ilmenite-hematite, and rutile. Rutile contains up to 60 per cent titanium and is the more desirable ore, but ilmenite, which may contain 31.6 per cent titanium (52.7 per cent TiO_2), is cheaper and more plentiful. Sphene contains up to 41 per cent TiO_2; it is mined in Kola Peninsula, Russia.

Production

Quebec Iron and Titanium Corporation

The Allard Lake ilmenite deposits are located 22 miles north of Havre St. Pierre, a port on the north shore of the Gulf of St. Lawrence, 570 miles northeast of Montreal.

The presence of ilmenite in the Allard Lake area was first reported in 1941 by J.A. Retty, then of the Quebec Department of Mines. The deposits were discovered in 1946 by the prospectors of Kennco Explorations, Limited, and are held by the Quebec Iron and Titanium Corporation, a subsidiary of Kennecott Copper Corporation (2/3) and New Jersey Zinc Company (1/3), both of the United States of America. They are the largest known deposits of ilmenite in the world, with about 150 million tons of ore averaging about 35 per cent TiO_2 and 40 per cent iron. The most important orebody is to be found at Lac Tio, where the estimated reserves exceed 125 million tons of ilmenite.

Exploration, carried on by Kennco Explorations from 1943 to 1947, included prospecting, geological mapping, a topographic survey, and an aeromagnetic survey. In October 1948, the newly incorporated Quebec Iron and Titanium Corporation commenced construction of a 27-mile railway to connect Lac Tio with Havre St. Pierre. Construction of wharves and terminal facilities commenced in 1949. In 1950, the railroad and harbour facilities were completed and the first shipments of ore were made to Sorel, Quebec.

At Sorel, the company has constructed its own docks and unloading equipment and a large electric smelting plant containing 5 special electric ilmenite ore treatment furnaces each designed to treat 300 tons of ore per day. Power is obtained from the La Trenche plant of Shawinigan Water & Power Company on the upper St. Maurice River. The company commenced test operations with one furnace in 1950 and since that time it has made continuous studies of the process and the operation of the furnaces.

In 1955, three smelting furnaces were operated during the first quarter of the year and four during the balance of the year. The ore smelted analyzed approximately 35.0 per cent TiO_2 and 40.0 per cent Fe. The slag produced contained 70.5 per cent equivalent TiO_2, and the low-sulphur, low-phosphorus iron produced contained 1.5-2.2 per cent carbon.

During the year the electric smelting furnaces were extensively modified and construction commenced on a $7,500,000 beneficiation and rotary kiln plant to treat the crude ore prior to smelting. These ore treatment facilities are expected to be in operation during the first half of 1956.

Most of the slag produced during the year was exported to the United States for the titanium pigment industry. Some small shipments were made to companies conducting experimental work in the use of slag for production of titanium metal.

Production from Quebec Iron and Titanium Corporation

	1955	1954
	(Gross Tons)	
Ore blasted	413,061	233,154
Overburden removed	64,873	40,233
Ore crushed	368,883	275,870
Ore shipped	396,134	271,192
Ore smelted	311,230	239,410
TiO_2 slag produced	145,343	109,786
TiO_2 slag shipped	140,516	106,511
TiO_2 content of slag shipped	99,204	
Desulphurized iron produced	108,314	80,859
Desulphurized iron shipped	105,450	89,740
High-sulphur iron shipped	3,645	3,492

Baie St. Paul Titanic Iron Company Limited

From the St. Urbain area of Quebec, this company made shipments of ilmenite totalling 1,400 tons in 1955, compared with 1,202 tons in 1954.

Exploration

Hollinger (Quebec) Exploration Company Limited, which acquired by staking and option to purchase in 1953 and 1954 a large iron-titanium prospect at Marybelle Lake, Saguenay county, Quebec, dropped its option in November 1955 and allowed its claims to lapse. The company has retained a group of iron-titanium claims in Arnauld township, Quebec, on which it carried out metallurgical test work in 1955. Canadian Javelin Limited holds under development licences a large iron-titanium property in Laurentides Mining District, Quebec; metallurgical research on the separation of the iron from the titanium was continued in 1955. Titanium Development Corporation holds an ilmenite property adjoining the old Ivry mine in Quebec. Laurentian Titanium Mines Ltd. continued diamond drilling on its titaniferous magnetite property, which is situated in Welford and Chertsey townships, Terrebonne and Montcalm counties, Quebec. Dominion Mines and Quarries, a subsidiary of Union Carbide Canada Limited, in the spring of 1955 took an option on an ilmenite-hematite property in Charlevoix county, Quebec. Gravimetric Surveys Limited investigated rutile showings in the Little Pinnacle Mountain area, Eastern Townships, Quebec.

Other Occurrences

Ilmenite and titaniferous magnetite occur in Quebec in a number of places, usually in association with bodies of anorthosite. In the St. Urbain area of Quebec, there are at least five known ilmenite deposits - the Coulombe, Furnace, General Electric, Bignell, and Joseph Bouchard (Glen). The mineral was noted in the St. Urbain area as early as 1666, and there has been a small production from the various properties since 1908. During World War II, production reached substantial proportions to help meet the demand created by the interruption of shipments of Indian ilmenite to the United States. In addition to the areas to which reference has already been made, titaniferous magnetite occurs near the Bay of Seven Islands; in the Natashquan black sands; and in the Chibougamau district. It also occurs in a number of areas in Ontario, the occurrence at Mine Centre being possibly the best known. It occurs at Burmis, Alberta, and near St. Georges, Newfoundland. Titanium-bearing minerals have been reported near White Bay on the northeast corner of Newfoundland, and in the Ramsay Brook district about 35 miles south of Campbellton, New Brunswick.

World Production*

Titanium Ores and Concentrates

Rutile: world production of rutile concentrates amounted to about 57,800 short tons in 1954, of which 50,018 tons came from Australia, the largest producer; next largest was the United States with a production of 7,411 tons. For 1955, rutile production and shipments in the United States are estimated at 8,400 and 8,100 tons respectively. In Australia, the rutile is mined from beach sand deposits along the east coast. In the United States, it is produced from beach sand along the Atlantic coast of Florida and from sand deposits in Aiken county, South Carolina. Smaller amounts of rutile concentrates originate in the French Cameroons, India, and Norway.

Ilmenite: world production of ilmenite concentrates in 1954 was estimated at 1,097,000 short tons. Chief producers were: United States, 547,711 tons; India, 186,612 tons; Norway, 164,448 tons; Canada, 124,162 tons; and Malaya, 50,114 tons. United States production and shipments in 1955 are estimated at a record 584,100 and 573,600 tons, respectively; the titanium dioxide content of shipments ranged from 45 to 66 per cent, the total content amounting to 299,600 tons; ilmenite included a quantity of mixed product containing altered ilmenite, leucoxene, and rutile. About one-half of the United States production comes from the National Lead Company's mine near Tahawus, New York State, about one-third from beach sand deposits near Starke and Jacksonville in Florida, and the remainder from Virginia, Idaho, and South Carolina. India is the next largest producer, the ilmenite being derived principally from black sands in Travancore. The output of the third largest producer, Norway, comes principally from deposits south of Stavanger. Ilmenite is also produced from black sands in Malaya, Senegal, and Australia, and in Japan, Spain, Portugal, and Eygpt.

The following table indicates the approximate TiO_2 content of the ores from some of the important producing areas, and the approximate TiO_2 content of the concentrates prepared from them.

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* Statistics: United States Bureau of Mines, MMS No. 2439, November 4, 1955; MMS No. 2454, January 3, 1956.

Approximate TiO_2 Content of Crude Ore and Concentrates of some of the Important Producing Areas

Producing Area	Mode of Occurrence	Approx. % TiO_2 in Crude Ore	Form of Concentrate	Approx. % TiO_2 in Conc.
Tahawus, U.S.A.	magnetite-ilmenite (titaniferous magnetite)	17	ilmenite-concentrate	44.7
East coast of Florida, U.S.A.	beach sands	1.30	ilmenite concentrate mixed leucoxene, ilmenite and rutile concentrate	63 80
Travancore, India	beach sands	40 - 45	ilmenite concentrate	59.5
Allard Lake, Canada	ilmenite-hematite	35	titanium dioxide slag	70.5
Sokndal, Norway	magnetite-ilmenite (titaniferous magnetite)	17	ilmenite concentrate	44
Otanmaki, Finland	magnetite-ilmenite (titaniferous magnetite)	12 - 15	ilmenite concentrate	45
West coast of Queensland and New South Wales, Australia	beach sands	26 - 37	rutile	96
Tisur, Mexico	rutile	15 - 20	rutile	95

Consumption and Uses

Titanium dioxide (titanium white), the most important compound of titanium, has wide use as a pigment in paints and in the manufacture of ceramics, cosmetics, food products, paper, and rayon. In 1954, in the United States, for instance, about 96.5 per cent of the total consumption of titanium-bearing minerals was in the pigment industry; 99 per cent of the ilmenite and 99.8 per cent of the titanium dioxide slag consumption was in the pigment industry. A small amount of titanium is used in the iron and steel industry as ferrotitanium and ferrocarbontitanium, to purify and harden steel. The production of titanium metal from titanium dioxide is increasing rapidly, but the amount of titanium dioxide consumed in this manner is very small compared with that consumed in the pigment industry. It should be noted, also, that this production is mainly for research and defence purposes and that the general use of titanium metal awaits both the development of an inexpensive method of extracting it from its ores and improvements in the quality of the metal. Some considerable progress was made in this direction during 1955.

Titanium dioxide, in the natural form of rutile, is used commonly as a coating for welding rods; in the United States during 1954, approximately 41.4 per cent of the total consumption of rutile was used in the preparation of welding rod coatings, a decrease of nearly 10 per cent from 1953. Artificially prepared crystals of titanium dioxide have a very high index of refraction and are being used as gem stones in place of diamonds. Small amounts of titanium tetra-chloride are used for purifying alloys of aluminum. Titanium carbide is one of the ingredients of carbide high-speed cutting tools, usually with tungsten carbide. About 20 per cent of the 1954 consumption of rutile in the United States was used in the production of carbides and alloys.

Because of the high strength-weight ratio of titanium the metal and its alloys have a special application in jet aircraft and guided missiles. The air-craft industry has, in fact, been largely responsible for the rapid growth of the titanium industry, and still uses the greater part of all titanium metal and alloys produced. Titanium is also used in alloys of stainless and heat-resisting steels. Certain alloys with cobalt and nickel are used as filaments in vacuum tubes.

In Canada, the consumption of titanium metal and alloys is currently limited to prototype aircraft engines and air frames in the basic form of bars, forgings, sheet, and wire. Forged parts such as turbine blades, compressor discs, and spacer rings are used in aircraft engines. Sheet products are used in such application as fire walls, nacelles, linings, baffles, tailcones, and shrouding. Bar and wire find uses in fasteners, hardware, and welding rod.

The following table shows the consumption of TiO_2 and ferrotitanium in Canada during 1952 and 1953, by industries. There is no production in Canada of refined TiO_2 or ferrotitanium. However, Canadian Titanium Pigments Limited, a wholly-owned subsidiary of National Lead Company, has commenced construction of a plant at Varennes, Quebec, to manufacture titanium dioxide pigments. Construction schedules call for completion in late 1957.

Consumption* of Refined Titanium Dioxide, Rutile, Extended TiO_2 Pigments, and Ferrotitanium in Canada
(short tons)

	1954	1953	1952
Refined titanium dioxide (TiO_2)			
Paints	11,479	10,595	7,878
Polishes and dressings	140	113	103
Pulp and paper	1,247	1,161	871
Rubber goods	598	533	534
Linoleum	2,016	1,770	1,911
Misc. non-metallic mineral products	331	387	241
Toilet preparations		3	4
Primary plastics		62	35
Misc. chemical products			13
Rutile, ilmenite, and titanium slag			
Abrasives industry		1,443	70
Estimated TiO_2 content		973	67
Extended TiO_2 pigments			
Paint industry	13,155	12,907	12,773
Estimated TiO_2 content	3,946	3,901	3,832
Ferrotitanium			
Primary iron and steel	171	213	229

* Dominion Bureau of Statistics.

The following table, prepared by U.S. Bureau of Mines, shows the consumption of titanium concentrates (ilmenite, rutile and titanium dioxide slag) in the United States in 1954, by products. It indicates the relative size and economic importance of the principal titanium-consuming industries.

Consumption of Titanium Concentrates
in the United States in 1954, by Products
(short tons)

	Ilmenite		Titanium Slag		Rutile	
	Gross Weight	Estimated TiO_2 Content	Gross Weight	Estimated TiO_2 Content	Gross Weight	Estimated TiO_2 Content
Pigments (manufactured titanium dioxide)[a,b]	673,506	349,857	100,670	70,993	c	c
Welding rod coatings[b]	845	501			8,817	8,169
Alloys and carbides	4,904	2,394			3,258	3,104
Ceramics	9	5			372	348
Miscellaneous	8	4	155[e]	109[e]	8,847[d]	8,404[d]
Total	679,272	352,761	100,825	71,102	21,294	20,025

a Includes a mixed product containing altered ilmenite, leucoxene, and rutile, used to make pigments and metal.
b "Pigments" include all manufactured titanium dioxide, consumption of which in welding-rod coatings was 1,192 tons in 1954.
c Included in "Miscellaneous", to avoid disclosure of individual company operations.
d Includes consumption for chemicals, metal, and fibreglass.
e Includes consumption for welding-rod coatings and research purposes.

Tariffs and Prices

Neither Canada nor the United States maintained tariffs on titanium ores during 1955.

The E & M J Metal and Mineral Markets of December 29, 1955, quotes the following United States prices:

Ilmenite: per gross ton, 59.5% TiO_2 f.o.b. Atlantic seaboard -- $20 nominal.

Rutile: 94 per cent TiO_2, per lb -- 7 to 7 1/2 cents at the beginning of 1955 increasing to 8 to 8 1/2 cents in April and 9 to 10 cents in June and again to 10 to 15 cents in September. This last prevailed for the balance of the year.

TUNGSTEN

By W. Keith Buck

Shipments of tungsten concentrates amounted to 1,471 tons in 1955, an increase of about 36 per cent over 1954 shipments. The major producer continued to be Canadian Exploration Limited, which operates a property near Salmo, British Columbia. In addition, some shipments were made from the New Brunswick property of Burnt Hill Tungsten and Metallurgical Ltd.

Tungsten - Production, Trade and Consumption

	1955		1954	
	Short Tons	$	Short Tons	$
Production (shipments)				
WO_3	1,471	5,508,437	1,085	5,795,781
Imports				
Scheelite[a]				
United States	46	126,137	4	6,164
Ferrotungsten[b]				
Portugal	21	80,403	11	30,957
United States	20	62,625	1	3,615
United Kingdom	16	64,287	31	90,849
Total	57	207,315	43	125,421
Exports				
Scheelite (W content)				
United States	844		612	
United Kingdom	11		-	
Other countries	-		7	
Total	855		619	

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

	1955		1954	
	Short Tons	$	Short Tons	$
Consumption (W content)				
Scheelite	24		7	
Ferrotungsten	42		31	
Tungsten metal and tungsten metal powder	22		14	
Tungsten carbide and tungsten carbide powder...	47		26	
Tungsten wire and miscellaneous(c).........	6		7	
Total....................	141		85	

(a) WO_3 content not known.
(b) W content not known.
(c) Miscellaneous includes tungsten chemicals.

Production and Developments

Canadian Exploration Limited

In 1955, the company mined 151,912 dry tons of scheelite ore with an average grade of 0.77 per cent WO_3 (tungsten trioxide) from its Emerald, Dodger, and Feeney orebodies and produced 97,002 short-ton units* of WO_3. Under the company's sales contract, shipments of 105,928 short-ton units WO_3 were made to the United States.

The tungsten orebody at the Emerald mine was discovered in 1942 and was brought into production as a wartime measure by Wartime Metals Corporation, a Crown company. It was operated until late in 1943. In 1947, the mine and plant were sold to Canadian Exploration Limited, a subsidiary of Placer Development Limited, and operations were carried on during most of 1947 and 1948. In 1948, mining and milling of scheelite ceased and the mill was changed over to treat lead-zinc ores from the nearby Jersey mine. Late in 1950, during the Korean crisis, the federal government purchased the remaining tungsten ore reserves in the Emerald mine and constructed a 250-ton mill.

In 1951, Canadian Exploration discovered a large tungsten orebody (the Dodger) about 1/2 mile east of the Emerald orebody. The company purchased the new mill from the federal government and, effective October 1, 1952, it repurchased the remaining ore reserves. The mill commenced operations on November 27, 1951 and has been in operation almost continuously since that date. Mill capacity has been steadily increased.

During 1955, the Dodger Mine was developed along almost its complete strike length, and production was increased. The inclined shaft in the Emerald Mine was deepened 652 feet and three more levels were started. Favourable ground for additional exploration and development is being probed by diamond drill.

* Short tons unit = 20 lb

There were no major changes in the concentrator during the year. Research continued and the flow sheet was altered in minor detail for improved performance. Early in 1956, grinding capacity was increased to about 700 tons per day.

Burnt Hill Tungsten and Metallurgical Ltd.

At the junction of the Miramichi River and Burnt Hill Creek, York county, sixty miles northeast of Fredericton, New Brunswick, this company began in 1953 to re-open a long-known wolframite property. Considerable lateral development from an adit level has been carried out and a 150-ton concentrator has been operated intermittently since May 1955. Two small shipments of wolframite concentrates were made and plans were announced to carry on a development program at depth which, if successful, would call for an increase in the size of the mill. Metallurgical studies are being conducted on the further processing of the concentrates.

Domestic Refinery Production

A plant operated by a division of Kennametal Incorporated 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 ores in 1954 amounted to 76,700 short tons of concentrates containing 60 per cent WO_3, of which an estimated 19,842 tons was produced in China, the largest producer. Other relatively large producers were the United States, Russia, Bolivia, Portugal, Republic of Korea, Australia, and Spain, listed in the order of estimated production. Production in 1955 in the United States, the largest producer in the free world, is estimated by the U. S. Bureau of Mines at a record 15 million pounds of contained metal. The Bureau also estimates that the present U. S. Government purchase program will be completed in mid-1956.

Consumption and Uses

Tungsten is utilized as scheelite, ferrotungsten, 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 turbo-jet 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.

The commercial applications of chemical compounds of tungsten are numerous, some of the more important being: flame-proofing 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 (Canada) Limited; Kennametal of Canada Limited; Deloro Smelting and Refining Company Limited; 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 29, 1955, tungsten prices in the United States for 1955 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 - \$33 to \$33.50
Scheelite - \$ 34 to \$34.50

Domestic ore remained at \$63 f.o.b. mine

Tungsten metal, per lb 98.8% min., 1,000-lb lots - \$4.30 effective December 1; hydrogen-reduced, 99.9% plus - \$5.

Ferrotungsten, per lb of W contained, 72-82% W - \$3.30 in lots of 5,000 lb or more.

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

United States

Tungsten ore and concentrates, on tungsten content - 50¢ per lb

Tungsten metal, tungsten carbide, and combinations containing tungsten carbide in lumps, grains, or powder, on tungsten content - 42¢ per lb plus 25% ad valorem.

URANIUM

By A. H. Lang

Increased production of uranium in Canada, and development of large tonnages of ore that will greatly increase future production, occurred during 1955. The highlights were the beginning of production at the Gunnar mine in Saskatchewan and the Pronto mine in Ontario; the negotiating of contracts for large production from other mines in Ontario; the commencement of large-scale plant expansion at the operation of the Crown-owned Eldorado Mining and Refining Limited at Beaverlodge Saskatchewan; and the completion of expanded and improved facilities at the Port Hope refinery in Ontario.

The value of sales of refined uranium oxide during 1955 was about $23,000,000. Additional production from mines, not yet refined and sold by the end of the year, brought the total value of production to about $26,000,000. Uranium has thus reached a high place among metals produced in Canada and the value of this production will soon be a much more important factor in the Canadian economy, when additional mines being prepared for production are operating. In August, the Right Honourable C. D. Howe announced that there is a limit on the amount of uranium that will be purchased under special price agreements, and that, on the basis of present information, it is unlikely that such special price contracts will be negotiated after March 31, 1956. As explained in the review on uranium for 1953, Eldorado was empowered to make contracts for delivery of uranium at special prices, above the guaranteed schedule, in such cases as a property with a large proven tonnage of material that would not be economic to mine at the guaranteed price, or a property where it was planned to produce a high-grade product that would require large expenditures for plant. All commercial production and contracts for future production have been on the basis of such special arrangements. The contracts now in force call for delivery, by March 31, 1962, of uranium compounds to the value of more than $586,000,000. The announcement caused increased activity at several advanced prospects, particularly in Ontario, in the hope that sufficient results could be obtained to permit obtaining contracts before the expected deadline, and it also caused some decline in prospecting and early-stage testing of prospects. If it is not possible to negotiate special prices in future, interest in prospecting and exploration for uranium will probably be concentrated on the higher-grade and more readily treated kinds of deposits, such as high-grade pitchblende deposits and those containing important amounts of readily concentrated crystalline uraninite. It will, therefore, probably be even more desirable than formerly for prospectors to have some knowledge and experience in these matters.

At the end of the year 417 exploration permits from the Atomic Energy Control Board were in force, but about 260 of the properties so covered were inactive. The permits were distributed as follows: Ontario, 201; Saskatchewan, 129; Quebec, 36; Northwest Territories, 32; British Columbia, 8; Alberta, 4; Manitoba, 4; New Brunswick, 3. Underground exploration was done on about 45 properties, more than 1,000 feet of diamond drilling was done on about 120, and smaller amounts on about 30.

Four mining permits were in force or issued during 1955. These were held by Consolidated Nicholson Mines Limited, Gunnar Mines Limited, Pronto Uranium Mines Limited, and Rix Athabasca Uranium Mines Limited. Two other properties shipped development ore under amended exploration permits.

At the end of the year it was estimated that the total number of radioactive properties (claim groups or unstaked occurrences from which an assay of 0.05 per cent U_3O_8 equivalent or more had been obtained, or from which a radioactive mineral was identified) was about 1,500. Most of the properties contain several individual occurrences and a few contain hundreds, and on this basis the number of known occurrences is estimated to be between 8,000 and 10,000. Some of these are occurrences of thorium rather than uranium, but most contain uranium. Although many are or were sufficiently encouraging to warrant exploration most appear to be too small or too low grade to be of interest under present conditions.

The principal developments in the main uranium districts are summarized below, as are lesser activities in other parts of the country. Because of the large number of properties explored, it is possible to mention by name only those in production, those for which contracts for production were negotiated, and those at which underground exploration was done. The last is not a completely satisfactory differentiation because several drilling projects were more extensive and gave better results than did some undergound explorations.

Saskatchewan

The first private treatment plant in Saskatchewan, at the Gunnar mine in the Beaverlodge area north of Lake Athabasca, began operation late in August and was opened officially in October. This 1,250 ton-a-day leaching plant is served by a large plant for manufacturing sulphuric acid from elemental sulphur brought in by barge. Mining was begun from a large open pit, and a 1,200-foot shaft to permit deeper operation was commenced. Extensive mine buildings and accommodations have been built at this property, which is also served by a nearby airstrip.

At Eldorado's Beaverlodge operation, the Fay shaft was deepened to the 16th level (2,000 feet), additional exploration and development were done on the Ace orebodies, and exploration was continued at the Verna section of the mine where ore was developed that will be mined and treated when additions to the treatment plant are completed. Under agreement, Eldorado explored ground held by Radiore Uranium Mines Limited adjoining the Verna claims and it was stated that about one-third of the ore outlined for the Verna operation is on Radiore ground. Preparations were begun for increasing Eldorado's Beaverlodge treatment plant to a rated capacity of 2,000 tons per day; this is scheduled for completion early in 1957. Consolidated Nicholson, National Explorations, Nesbitt LaBine, and Rix-Athabasca shipped ore to the Eldorado plant during 1955, the largest shipments being from the last-named property. A few years ago Eldorado undertook to accept ore from properties that did not build their own treatment plants for treatment at its Beaverlodge plant if it could accommodate them. Because it did not appear that the plant would be able to accommodate additional shippers, Eldorado proposed recently that if further companies in the district wished to operate on a shipping basis they consider the establishment of joint privately owned treatment plants.

The following companies also carried out underground explorations during the year, all within the Beaverlodge region: Beta-Gamma, Black Bay, Caba Uranium, Cayzor Athabasca, Don Henry, Goldfields Uranium, Gulch, Jesko Uranium, Lake Cinch, Lorado Uranium Meta Uranium, New Mylamaque, Pitch-Ore, St. Michael Uranium, and Uranium Ridge. Explorations on the Lake Cinch and Lorado properties were reported to have reached a point where plans for building treatment plants were being considered. More than 1,000 feet of diamond drilling was done on 42 properties and smaller amounts on about 10 additional properties. Almost all of the properties diamond drilled are in the Beaverlodge region, but drilling was also done on one property in each of the following regions: Stony Rapids, Haultain-Mujatik, Foster Lake, and LaRonge. Prospecting was carried on chiefly in the Beaverlodge region and about 20 additional properties having discoveries were reported.

Northwest Territories

Production continued at the normal rate at the Eldorado mine at Port Radium and was derived partly from the re-treatment of old tailings. The annual report of the Company for 1954 stated that the results of exploration, which was concentrated on the lower levels, was disappointing, and that unless orebodies of some importance were found, it was not proposed to deepen the mine below its present lowest (16th) level. "Ore in short lengths, sometimes, of excellent grade, was developed in many parts of the mine between levels, and this type of orebody may be expected to be found for several years".

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Twenty-one additional radioactive properties were reported from the Northwest Territories during 1955. More than 1,000 feet of diamond drilling was done on 7 properties and smaller amounts were done on 3 others. The principal activity on private properties was in Marian River region where considerable undergound exploration and drilling were done on the Beta group of Rayrock Mines Limited. This company planned to erect a plant capable of treating 100 to 150 tons of ore a day by 1957, much of the equipment having been bought from a former gold producer at Yellowknife. In the same region a shaft was sunk to permit further exploration of the Sun group of Consolidated Northland Mines Limited. These two properties are at present served by winter tractor roads from Great Slave Lake. At Hottah Lake, underground exploration was continued at the Pitch 8 group of United Uranium Corporation Limited. This property was formerly held by Consolidated Indore. Pitchblende discoveries were reported from the vicinity of MacInnis Lake, in the region between Lake Athabasca and Great Slave Lake.

Ontario

Very important advances took place in the Blind River region, where conglomerate ore blocked out by drilling is considered to be among the largest reserves of uranium ore in the world, if not the largest. However, the ore is relatively low-grade. The Pronto mine began production late in August where its leaching plant with a capacity of 1,250 tons a day was brought into operation, the official opening being in October. Early in 1955 it was announced that Algom Uranium Mines Limited had negotiated a contract with Eldorado for delivery of uranium precipitates to the value of $206,910,000 and that arrangements for additional financing of the Algom properties had been arranged with Rio Tinto (Canada) Limited. Shafts were sunk on Algom's Quirke Lake and Nordic Lake properties, and construction of 3,000 tons-a-day leaching plants was begun at each property. The Quirke Lake operation is scheduled for production in 1956, and the Nordic Lake in 1957. Consolidated Denison Mines Limited negotiated a contract for sale of precipitates to the value of $182,250,000. Two shafts were commenced on this property, which adjoins the Quirke Lake claims, and preparations were made for building a leaching plant with a capacity of 5,700 tons a day to be completed in 1957. Many other properties in the Blind River region were explored and by the end of the year large tonnages of uranium-bearing conglomerate had been outlined on some of these and discussions were commenced with Eldorado relative to negotiating contracts.

Near Bancroft in the Grenville sub-province of the Canadian Shield, Bicroft Uranium Mines Limited proceeded with construction of a 1,000 tons-a-day leaching plant planned for completion in 1956. In August this company negotiated a contract for delivery of precipitates to the value of $35,805,000. This property is an amalgamation of the former Centre Lake and Croft properties. At the end of the year Faraday Uranium Mines Limited was finishing negotiations for a contract, and in January 1956 it announced that a contract for delivery of precipitates to the value of $29,754,800 had been made. Preparations were made for sinking a shaft and erecting a treatment plant with a capacity of 750 tons a day. Nu-Age Uranium Mines Limited completed a concentrator with a rated capacity of 300 tons a day using a new, dry process, and tests were made in the use of this equipment. Also in the Bancroft region underground exploration was carried out on the Cardiff Uranium, Dyno Uranium, Bluerock, Halo, Cavendish Uranium, Kenmac, and Rare Earths properties. The deposits in this region are, in general, of the pegmatitic type, but the more important ones differ considerably from typical radioactive pegmatites.

Underground work was continued on the property of Beaucage Mines Limited near North Bay with a view to production of niobium (columbium) and uranium. The concentrating part of a 50-ton pilot plant was completed and test work was begun.

The property of Campbell Island Mines and Explorations Limited near Hawk Lake in the Kenora region was explored by diamong drilling and an adit. Several additional pegmatitic occurrences were reported from the regions of Kenora and Fort Frances.

British Columbia

Considerable diamond drilling and some additional underground exploration were done at the Rexspar property near Birch Island. The company reported that the two main zones on this property were estimated to contain a total of 1,000,000 tons averaging 1.75 lb of U_3O_8 per ton, and that plans for building a treatment plant to recover uranium and rare earths were being considered.

Prospecting and preliminary exploration of prospects were done in several parts of the province, and thirty-one new radioactive properties were reported during the year. Much of the work was in the vicinity of Lytton where occurrences of uranium were found in altered sedimentary strata. A short adit was driven to explore one of these, on the property of Rose Mining Company Limited.

Occurrences of pyrochlore, mainly of interest for niobium (columbium), were investigated in several regions.

Quebec

About fifty new properties were reported from the Grenville geological sub-province. These are principally in the region between the Ottawa and Saguenay Rivers. Those whose types are known belong to the general pegmatitic and contact-metasomatic classes. An adit was reported to have been driven on the property of Yates Uranium Mines Incorporated in Pontiac county. More than 1,000 feet of diamond drilling was done at five properties and small amounts of drilling at ten others.

Alberta

Some new occurrences, mainly pegmatitic, were reported from the Precambrian region in northeastern Alberta.

Manitoba

A few new occurrences, which appeared to be mainly pegmatites, were reported. These are chiefly in the region of Manigotagan Lake, southeast of Lake Winnipeg.

Maritime Provinces

A few new occurrences were reported from New Brunswick and Nova Scotia, and surface exploration was continued on a few previously known properties. There are now at least five known occurrences of pitchblende or 'thucholite' in widely scattered parts of New Brunswick, therefore, it is possible that other and perhaps larger deposits of these kinds will be found. One of the occurrences, consisting of nodules containing very fine-grained uraninite (probably pitchblende) associated with hematite, in Carboniferous sandstone, caused some interest in searching for similar deposits in Palaeozoic formations in New Brunswick and Nova Scotia.

In February 1956, it was announced that more than 20 possible uranium deposits were found in Labrador in an area about 100 miles long between Makkovik on the coast and Seal Lake in the interior, roughly 75 miles north of Goose Bay. It was reported that pitchblende was found in 6 of these. This area lies in concessions granted by the Government of Newfoundland.

ZINC

By R. E. Neelands

Canada's production of zinc, both refined and in concentrates exported, was the highest on record, chiefly owing to a 29-per-cent increase in refined zinc output by The Consolidated Mining and Smelting Company of Canada Limited (Cominco). The output of 433,357 tons valued at $118,306,466 compared with 376,491 tons valued at $90,207,285 in 1954.

Canada's two zinc plants, operated by Cominco at Trail, British Columbia, and Hudson Bay Mining and Smelting Company Limited at Flin Flon, Manitoba, produced about 257,000 tons of refined zinc compared with 213,775 tons in 1954.

Zinc concentrates from provinces east of Manitoba were all exported to United States or Europe. Most of the zinc concentrates produced by British Columbia mines other than Cominco's were exported to the United States; the remainder, as well as concentrates from United Keno Hill Mines in Yukon, were treated at Trail.

(Continued on page 115)

Zinc - Production, Trade and Consumption

	1955		1954	
	Short Tons	$	Short Tons	$
Production, all forms[a]				
British Columbia	215,886	58,936,877	151,539	36,308,784
Quebec	101,431	27,690,668	107,001	25,637,532
Saskatchewan	48,960	13,366,168	50,670	12,140,475
Newfoundland	28,636	7,817,635	30,002	7,188,595
Manitoba	17,966	4,904,725	16,253	3,894,226
Yukon	10,912	2,978,881	11,823	2,832,741
Nova Scotia	1,548	422,555	8,493	2,034,810
Ontario	8,018	2,188,957	710	170,122
Total	433,357	118,306,466	376,491	90,207,285
Production, slab zinc[b]	257,008		213,775	
Exports				
Refined metal				
United States	113,306	26,802,730	105,212	21,518,369
United Kingdom	95,598	19,420,800	91,127	15,943,953
India	3,260	575,567	6,238	1,057,161
Pakistan	1,026	177,752	-	-
Other countries	647	130,454	3,461	668,894
Total	213,837	47,107,303	206,038	39,188,377
Zinc contained in concentrates				
United States	168,069	20,529,375	148,140	16,726,601
United Kingdom	8,245	866,008	9,007	698,986
Belgium	7,488	819,361	14,080	684,555
France	4,613	534,598	1,787	144,084
Norway	2,170	239,141	7,158	584,662
Total	190,585	22,988,483	180,172	18,838,888
Zinc scrap				
Belgium	2,292	151,655	3,668	200,654
Netherlands	1,260	89,352	407	22,953
United States	1,208	145,696	420	54,390
West Germany	546	39,433	447	60,579
Other countries	160	36,078	172	26,290
Total	5,466	462,214	5,114	364,866
Zinc manufactures				
United States		92,734		23,428
Mexico		29,533		64
Netherlands		27,563		-
Other countries		12,358		53,453
Total		162,188		76,945

(a) Refined zinc produced from domestic ore only plus recoverable content of zinc conc. exported.

(b) Slab zinc ~~produced from domestic and imported ores~~.

	1955 Short Tons	1955 $	1954 Short Tons	1954 $
Imports, zinc and zinc products				
Blocks, pigs, bars, plates		27,928		31,538
Strips, sheets		788,994		526,408
Dust		127,357		82,708
Zinc mfgrs. n.o.p.		2,108,492		1,740,685
Slugs or discs		346,078		386,829
Zinc chloride		28,299		27,722
Zinc sulphate		143,508		123,535
Zinc white		208,784		262,149
Lithopone		265,224		350,149
Total		4,044,664		3,531,723
Consumption				
Electro-galvanizing	1,091		491	
Hot-dip galvanizing	26,955		23,920	
Zinc die-cast alloy	10,464		6,713	
Brass and bronze	9,350		6,778	
Other alloys	678		771	
Rolled and ribbon zinc	1,395		1,265	
Zinc oxide	7,141		7,154	
Zinc castings	603		(c)	
Other uses	797		192	
Total	58,474		47,284	

	1954 Short Tons	1953 Short Tons
World zinc production, mine basis		
United States	514,671	542,340
Canada	433,357	376,491
Australia	241,376	237,701
Russia	300,000*	250,000*
Mexico	296,959	246,638
Peru	183,072	172,631
Poland	154,500	132,000
Italy	110,738	110,759
West Germany	101,557	103,877
Japan	119,786	120,579
Other countries	565,713	459,799
Total	3,021,729	2,752,815

(c) included in other uses in 1954.

* estimated.

The domestic consumption of zinc was 58,474 tons compared with 47,284 tons in 1954. In Hamilton, Ontario, both Steel Company of Canada and Dominion Foundries and Steel Company started using continuous-strip galvanizing lines during 1955.

There was an increasing world demand for zinc in 1955, particularly in the United States, where consumption reached an all-time high of about one million tons. The price of Prime Western zinc rose from 11.5 cents to 13 cents a pound during the year.

Promising zinc-lead discoveries were made in New Brunswick, British Columbia, and the Northwest Territories.

Developments at Producing Mines

British Columbia

Cominco's Sullivan mine at Kimberley continued to be Canada's principal source of zinc. The tonnage of zinc-lead ore mined there was 2,836,577 compared with 2,681,635 tons in 1954.

At Cominco's H.B. zinc-lead mine near Salmo, production was commenced in May in a 1,000-ton mill constructed in 1953; during the remainder of the year 247,303 tons were treated. The tonnage treated at the company's Bluebell lead-zinc mine at Riondell was 241,788 and at its Tulsequah zinc-lead-copper mines on the northwest coast 196,700.

All of the zinc concentrate produced at Cominco's 4 mines in B.C. was treated at Trail together with custom ores or concentrates from other mines in B.C., Yukon, and Siam. Cominco reported its refined zinc production from all sources at 190,910 tons.

Canadian Exploration Ltd. near Salmo increased the daily ore output from its Jersey zinc-lead mine from 1,000 to 1,700 tons during the year.

Reeves MacDonald Mines Limited, near Nelway on the U.S. border, resumed production in November. The mine and 1,000-ton mill had been idle since July 1953.

Britannia Mining and Smelting Company Limited milled 878,660 tons of ore from its copper-zinc mine on Howe Sound.

Sheep Creek Gold Mines Limited discovered a new orebody at its Mineral King zinc-lead mine, Lake Windermere district.

Other producers of zinc concentrate included; Sunshine Lardeau Mines Limited, near Camborne; ViolaMac Mines Limited, near Sandon; Yale Lead & Zinc Mines Limited, Ainsworth; Silver Standard Mines Limited near Hazelton and Giant Mascot Mines Limited near Spillimacheen.

Manitoba and Saskatchewan

Hudson Bay Mining and Smelting Company, Limited mined 1,467,347 tons of copper-zinc ore from its Flin Flon mine on the provincial boundary. At the company's zinc plant 122,615 tons of zinc concentrates and 43,934 tons of fume and stack dust were treated to produce 67,355 tons of slab zinc, the highest output to date. There were also produced 49,778 tons of zinc plate residue, most of which was treated in the copper smelter for the subsequent recovery of zinc oxide from the fuming of copper smelter slag. A pilot plant for the recovery of smelter stack dust was installed. This dust is treated in the oxide section of the zinc plant for the recovery of contained zinc and cadmium.

At the company's Schist Lake mine, 3 1/2 miles southeast of Flin Flon, 118,206 tons of ore averaging 5.3 per cent copper and 8.6 per cent zinc were mined and trucked to Flin Flon for treatment.

Ontario

Jardun Mines Limited, 18 miles northeast of Sault Ste. Marie, sank a new 275-foot shaft on the Victoria mine section of its property and deepened its original No. 4 zone shaft to establish a new level at 350 feet. Both zinc and lead concentrates were produced.

Quebec

Zinc concentrates were produced at mines operated by the following companies, most of which also produced copper or lead concentrates.

Company	Location of Mine	Type of Ore
Anacon Lead Mines Limited	Portneuf county	zinc-lead
Ascot Metals Corporation Limited	Sherbrooke	zinc-lead-copper
Barvue Mines Limited	Abitibi East county	zinc
East Sullivan Mines Limited	Abitibi East county	copper-zinc
Gold Manitou Mines Limited	Abitibi East county	zinc-lead-copper
New Calumet Mines Limited	Pontiac county	zinc-lead
Normetal Mining Corporation Limited	Abitibi West county	copper-zinc
Quemont Mining Corporation, Limited	Rouyn-Noranda county	copper-zinc
Waite Amulet Mines, Limited	Rouyn-Noranda county	copper-zinc
Weedon Pyrite and Copper Corporation Limited	Wolfe county	copper-zinc
West Macdonald Mines Limited	Rouyn-Noranda county	zinc

The Anacon Lead mine was closed in July, owing to the exhaustion of commercial ore.

Ascot Metals commenced sinking a 400-foot shaft in September to develop the Silver Star and Howard properties adjoining to the north of the Suffield mine. Barvue continued to be the largest producer of zinc concentrate in Quebec. It commenced underground trackless mining methods in September.

East Sullivan resumed production of zinc concentrate in March. Golden Manitou reduced its zinc-lead mill circuit from 1,000 tons to 500 tons in order to treat 500 tons a day of copper ore from copper zone lying to the north of its main orebodies.

Mill capacity at Waite Amulet was increased from 1,800 to 2,000 tons a day to provide for the treatment of 1,000 tons a day of West Macdonald ore which came into production on September 1st. West Macdonald is 6 miles east of the Waite Amulet mill and the ore is transported by aerial tramway. Ore production at Waite Amulet was reduced to 1,000 tons a day.

New Brunswick

Keymet Mines Limited operated its property 15 miles north of Bathurst throughout the year, producing zinc and lead concentrates. No zinc concentrates were shipped. There were indications that the mine might close in 1956 owing to lack of developed ore.

Nova Scotia

Mindamar Metals Corporation Limited operated its zinc-lead-copper mine at Stirling, Cape Breton Island, for the production of zinc and bulk copper-lead concentrates. Exploration efforts have so far failed to reveal new ore.

New foundland

Buchans Mining Company Limited milled 291,000 tons of ore and produced zinc, lead, and copper concentrates. Over 60 per cent of the ore came from the newly developed Rothermere deposits and most of the mine development continued in this section of the property. Preparations were commenced to sink a new 4,000-foot circuit shaft to develop the deepest of the known Rothermere orebodies. The mine was shut down for 5 weeks during the summer by a strike.

Yukon

United Keno Hill Mines Limited, Mayo district, derived most of its production from the Hector mine. The Calumet mine was brought into production in October, and underground development was carried out at the Elsa, Shamrock, and Ladue mines. Silver-lead and zinc concentrates were shipped to the Trail smelter.

Mackeno Mines Limited, adjoining United Keno's Galena Hill properties, carried out underground development to build up ore reserves. Its 220-ton mill was operated in January and from mid-September through October 1955.

Other Developments

British Columbia

Significant zinc-lead-copper discoveries were made on the adjoining properties of Ormsby Mines Limited and Goldcrest Mines Limited, Trophy Mountain district, near the C. N. R. main line 70 miles north of Kamloops.

A considerable revival of exploration activity took place in the Slocan-Ainsworth silver-lead-zinc area.

Saskatchewan

Hudson Bay Mining and Smelting Company commenced construction of a 14-mile railroad from Flin Flon to its Coronation copper-zinc mine. A power line to the property was completed and shaft sinking was started.

Manitoba

At the Osborne Lake property 86 miles east of Flin Flon, owned by Hudson Bay Mining and Smelting Company, reserves of copper-zinc ore were increased by exploratory drilling to 443,000 tons.

Ontario

At Manitouwadge, 40 miles northeast of Heron Bay, Lake Superior, Geco Mines Limited commenced underground development of its large copper-zinc deposits with production at a rate of 3,300 tons a day planned for 1957. Branch railways were built to Manitouwadge by both the C. N. R. and the C. P. R. from their main transcontinental lines.

Willroy Mines Limited, adjoining the Geco property to the west, outlines 3 copper-zinc zones by drilling and made plans for production in 1957.

Consolidated Sudbury Basin Mines Limited continued exploration of the large zinc-lead-copper deposits on its Vermilion Lake and Errington properties 15 miles northwest of Sudbury; a substantial increase of ore reserves resulted.

Quebec

Vendome Mines Limited carried out underground exploratory drilling of two zinc-lead-copper zones on its property near Barraute, Abitibi East county.

At Bachelor Lake, about 100 miles northeast of Barraute, The Coniagas Mines Limited resumed exploration on a zinc-silver property formerly owned by Dome Mines Limited. The Canadian National line under construction from Barraute to Chibougamau will pass through the property.

Rio Canadian Exploration Ltd. discovered a new copper-zinc deposit about 10 miles northeast of Noranda.

Ungava Copper Corporation Limited outlined over a million tons of low-grade copper-zinc ore at its Soucy prospect near Gerido Lake, 25 miles south of Leaf Bay, Ungava Bay area.

New Brunswick

Brunswick Mining and Smelting Corporation Limited continued the underground development of its Anacon or No. 12 orebody, 12 miles southwest of Bathurst, and surface stripping of its Austin Brook or No. 6 orebody 5 miles south of No. 12. Mineral dressing tests on the complex zinc-lead-pyrite ores of the deposits were carried out in a pilot mill constructed near No. 12 orebody in 1954.

Early in 1956 New Larder "U" Island Mines Limited completed sinking a 1,500 foot shaft on its zinc-lead deposit 15 miles south of Bathurst.

Heath Steele Mines Limited, a subsidiary of American Metal Company, commenced underground development on its property 32 miles northwest of Newcastle where 3 zinc-lead-copper orebodies have been outlined by drilling.

Kennco Explorations (Canada) Limited, a subsidary of Kennecott Copper Corporation, and Middle River Mining Company Limited, a subsidiary of Texas Gulf Sulphur Company, each made a discovery of a sizable zinc-lead deposit respectively 20 miles southwest and 10 miles west of the Heath Steele property.

Nova Scotia

Cape Breton Metals Limited continued the exploration of its large concession in the northern part of Cape Breton Island, where numerous zinc occurrences have been found. A 560-foot exploration adit was completed near Meat Cove.

Newfoundland

Maritimes Mining Corporation Limited acquired full control of the old Tilt Cove copper property on the northeast coast. Underground sampling and exploratory drilling indicated about 2 million tons averaging 2.6 per cent copper and over 1.0 per cent zinc.

Nama Creek Mines Limited acquired the inactive York Harbour copper-zinc mine near Corner Brook.

Yukon

Prospectors Airways Company, Limited continued exploratory drilling of its extensive flat-lying zinc-lead sulphide deposits 30 miles west of the Canol Road-Pelly River crossing.

Northwest Territories

Preston East Dome Mines, Limited and associates acquired a large area near Windy Point, Great Slave Lake, 100 miles southwest of Yellowknife, where widespread lead-zinc mineralization was found in flat-lying formation.

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.

Uses

Zinc has a wide range of industrial uses, the more important being in galvanizing, die-casting, and brass products. In 1955 the United States consumed about 1,075,000 tons and the United Kingdom, the second largest consumer, 388,000 tons: in both cases, the figures include some scrap.

Zinc is marketed in grades that vary according to the content of impurities such as lead, iron, and cadmium. The principal grades produced are 'Special High Grade', chiefly used for die-casting; 'Regular High Grade', used for making brass and miscellaneous products; and 'Prime Western' for galvanizing. In Canada, zinc is refined by the electrolytic process only, by which most Special and Regular zinc is produced. To meet requirements for Prime Western the higher grades are debased by adding lead.

In galvanizing, zinc is applied as a coating to protect iron and steel against rusting. This is done usually by hot-dipping methods, but for some purposes electro-plating is used.

Zinc-base alloys, prepared from "Special High Grade" zinc to which is added 3.5 to 4.3 per cent aluminum, up to 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.

Brass, a copper-zinc alloy containing up to 40 per cent zinc, has many diversified uses in industry and the arts.

Rolled zinc is used principally for making flashlight battery cups, also for articles exposed to corrosion, such as weather-stripping, roofing drains, and gutters, and as anti-corrosion plates for boilers and ships' hulls. Zinc dust is used to make zinc salts and compounds, in purifying fats, in manufacturing dyes, and to precipitate gold and silver from cyanide solutions. Zinc oxide is used in compounding rubber and in making paint, ceramic materials, inks, matches, and many other commodities. Among the more industrial important compounds of zinc are zinc chloride, zinc sulphate, and lithopone, a mixture of barium sulphate and zinc sulphide used for making paint. In recent years, zinc compounds in paints have been increasingly replaced by titanium dioxide.

Prices

The Canadian price of Prime Western zinc was 11.5 cents a pound in January. It increased to 12 cents in April, to 12.5 cents in June and to 13 cents in September, remaining at this level for the balance of the year. Regular and Special High Grades were respectively an additional 1.35 and 1.5 cents a pound. The average price of all grades of Canadian zinc, as calculated by the Dominion Bureau of Statistics, was 13.63 cents a pound.

ABRASIVES

By T. H. Janes

Except for a small output of grinding pebbles there has been no production of natural abrasives in Canada for many years. Occurrences of certain abrasive materials are on record and some deposits have been operated in the past but it is unlikely there will be further production unless demand increases considerably or there is dire need for an abrasive, such as corundum, under special conditions, such as war.

The term 'natural abrasives' covers a very wide range of materials and includes all naturally occurring rocks or minerals capable of abrasive action. Natural abrasives, from this definition, occur in all countries. They are frequently grouped in order of their hardness with diamond, corundum, emery, and garnet being classed as 'high grade'; and the various forms of silica or silicates that include quartz, quartzite, flint, sandstone, pumice, pumicite, and ground feldspar being classed as 'low grade'. Mild abrasive materials, used for their polishing and mild abrasive qualities, include diatomite, the 'soft silicas' (such as tripoli, microcrystalline silica, and rottenstone), chalk, china clay, and bath brick.

In this review brief notes are given on corundum, emery, garnet, crushed quartz, grindstnones, oilstones, pulpstones, pumice, pumicite, and grinding pebbles.

Corundum (Al_2O_3)

Consumption, Deposits, and Trade

In 1955 Canada imported 100 tons of corundum valued at $24,659, from the United States. Most of this material was fine-grained corundum for grinding glass and probably originated in the Transvaal, Union of South Africa, the chief source of the world's corundum for the past thirty years.

From the early 1900's to about 1925 Canada supplied a major portion of the world's corundum from deposits in eastern Ontario. The increased use of artificial abrasives and the discovery of higher grade, more extensive deposits in the Transvaal, brought about the suspension of operations at deposits in Ontario. Some fine-grained corundum was recovered from the tailings of the old operation at Craigmont mine, northeast of Bancroft, from 1944 to 1946.

In southeastern Ontario there are three easterly trending corundum-bearing zones in which many small deposits occur. The main or northern, belt is by far the largest of the three areas and consists predominantly of syenites containing feldspars, nepheline, biotite, hornblende, and pyroxene. This main belt is about 100 miles long with a maximum width of about 6 miles. Practically all of Canada's output of corundum came from the Craig and Burgess mines in this belt. There are many small, scattered deposits within the belt but the corundum content rarely reaches an average of 5 per cent, compared to perhaps 20 per cent in deposits of the Transvaal.

South Africa and India, in that order, supply nearly all the world demand for corundum which has been estimated to range from 8,000 to 10,000 tons annually for the past several years. American Abrasive Company, Westfield, Massachusetts, the only dealer in corundum in North America, purchases hand-cobbed ore from independent producers in South Africa and ships the material to its plant at Westfield for up-grading, sizing, and distribution.

Uses and Prices

Grain corundum is chiefly used in making grinding wheels, and very coarse grain is used in 'snagging' wheels. Both types of wheels are used in the metal trades, where the hardness of corundum, coupled with its characteristic of fracturing into sharp cutting edges, makes it an ideal cutting tool. The finest corundum (flour grades) is used for fine-grinding lenses and other optical components.

Quotations on crude corundum concentrates and on graded grain have varied little in recent years. Crude corundum imported into the United States varies from $90 to $110 a ton, depending upon grade, with a minimum of 90 per cent corundum (Al_2O_3) being desired. Prices of graded grain, per pound, in ton lots, are: - grinding wheel grain - 12 1/4¢, delivered; optical grain, sizes 120 and coarser - 10 1/2¢, f. o. b. ; optical grain, sizes 140 and finer - 11 1/2¢, f. o. b. ; optical powders, size 500 and finer - 31 1/2¢, f. o. b.

Emery

There is no record of emery production in Canada. There are some deposits of corundum reported east of the Madawaska river in Ontario that are so closely mixed with magnetite that they might be classed as a coarsely crystalline emery.

True emery is an intimate mixture of corundum and magnetite, with or without hematite, and varies in hardness and toughness according to the amount of iron oxide present. Emery is massive, nearly opaque, and dark grey to blue-black with a reddish tint depending upon the amount of hematite present. The iron oxide is physically inseparable from the corundum, and while it detracts from the efficiency of emery as an abrasive, it adds to its polishing action. The grain shape of emery is more or less round and for this reason its cutting action is slight; it is, in fact, more of a polishing agent than a cutter.

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

Canadian imports of emery in powder, grains, and grits amounted to 1,214 tons valued at $108,698 in 1955 compared to 1,177 tons valued at $106,800 in 1954. A large part of United States' production of about 10,000 tons a year is used as the 'nonskid' agent in concrete and asphalt floors, stair treads, and pavements in industrial plants and public buildings. The balance of the output, together with imports from Greece and Turkey, is used in abrasive products such as grinding wheels, abrasive sticks, and coated papers.

According to E & M J Metal and Mineral Markets, quotations on crude domestic ore per short ton for first grade ore was $12 to $14 f.o.b. New York. Grain emery per pound, in 350-lb kegs, f.o.b. Pennsylvania, was quoted in the same publicatinn as follows: Turkish and Naxos - 10 cents; American - 5 cents.

Garnet

Canadian requirements of garnet grain for making coated abrasive papers, amounting to about 400 tons a year, is imported from the United States. Barton Mines Corporation supplies practically all the graded grain for coated abrasive use from a deposit near North Creek in New York state. Garnet from this company's operations has the valuable property of breaking into thin, sharp edged plates rather than wearing down into rounded grains, or fracturing easily in use.

Garnet is a common constituent of rocks, particularly contact metamorphic rocks. However, garnet from such occurrences in schists or gneisses is generally badly fractured and breaks down readily in use. This type of garnet is not accepted by manufacturers of coated paper nor is garnet found in beach sands used for this purpose.

The garnet property of Cubar Uranium Mines Limited, formerly owned by Niagara Garnet Co., Ltd., about twenty miles north of Sturgeon Falls, Ontario, was not operated in 1955. Many garnet occurrences are on record.

Production of garnet in the United States, for all uses, has ranged from 10,000 to 14,000 tons a year over the past several years. In addition to the production from Barton Mines, from 2,000 to 6,000 tons of garnet a year has been produced, mainly from beach sands in Idaho, for sandblast and metal spraying purposes. For this use the price of garnet must be competetive with silica grain which is the usual abrasive for sandblasting of building facings and metal spraying for foundry work.

Prices

The cost of ungraded garnet concentrates suitable for 'sandpapers', according to the E & M J Metal and Mineral Markets, in 1954, was $95 a ton f. o. b. New York. Prices of graded garnet grain range up to $160 a ton.

Crushed Quartz, Quartzite, and Sandstone

Crushed and sized quartz or quartzite is used for the abrasive coating on the cheapest of coated papers -- 'flintpapers' or 'sandpapers'. These are used primarily for working with soft woods as opposed to the more expensive garnet papers that are used for finishing of hard woods. Canadian requirements of graded silica are imported from the United States.

Silica sand from sandstone and beach sands is used extensively for sandblasting, metal spraying, initial grinding or surfacing of plate glass. Most of the sand for these uses is imported from the United States but some small foundries make use of local deposits of beach sand.

Grindstones, Oilstones, Pulpstones, Etc.

Suitable materials for these stones occur in certain sandstone beds in Nova Scotia, New Brunswick, and on the coast of British Columbia. Many years ago, production from these sources was considerable, but has now almost ceased, owing chiefly to competition by artifical abrasives.

Pulpstones of natural sandstone for use in grinders of pulp mills have been replaced by segmental pulpstones made of bonded silicon carbide grain by makers of artificial abrasives. Most of those in use in Canada are supplied by Norton Company of Canada Limited in its plant at Hamilton, Ontario. Pulpstones sold by Canadian Carborundum Company Limited are made in the company's United States' plant and imported into Canada.

Natural grindstones (sandstone) imported from the United States amounted to 314 tons valued at $31,422 in 1955 compared to 291 tons valued at $20,766 in 1954. Whetstones, sticks, files, and blocks of natural abrasives weighing 11 tons, valued at $19,487 were imported in 1955, compared to 13 tons, valued at $18,216 in 1954.

Pumice and Pumicite

Pumice is a highly cellular material that has been ejected during a volcanic eruption. It is an aluminum silicate that carries minor amounts of calcium, magnesium, and iron oxides and has a composition close to that of normal rhyolities. Pumice is used mainly as a lightweight concrete aggregate and is imported into the Vancouver area from nearby Washington and Oregon for the manufacture of lightweight concrete blocks, slabs, etc. Pumice costs from $6 to $8 a ton in the Vancouver area.

Pumicite, also called volcanic dust and ground pumice, is a natural glass thrown into the air during volcanic eruption to settle ultimately in beds that may be hundreds of miles from its source. Of white to yellowish to greyish colour, it occurs as finely divided powder composed of small, sharp, angular fragments of volcanic glass. It has the same origin and composition as pumice. The most important use for pumicite is in making scouring compounds and cleansers. It is used in hand soaps, and sometimes as a carrier for insecticides; its use as an extender in concrete is increasing.

Widespread deposits of pumicite occur in Saskatchewan, Alberta, and British Columbia, but, owing to thinness of beds and distance from, or lack of, markets, there has been no production for many years. Small operations to supply local markets for cleaners, etc., have been undertaken from time to time but nothing of a permanent nature has resulted. Pumice occurs over a widespread area in the Bridge River district British Columbia to a depth of about one foot just under the grass roots.

Imports of pumice, pumicite, volcanic dust, lava, and calcareous tufa are grouped in import statistics and amounted to $214,358 in 1955 compared to $163,028 in 1954. Most of the imports come from the United States. Throughout 1955, according to E & M J Metal and Mineral Markets, pumice stone, per pound, f.o.b. New York or Chicago was 6 to 8 cents for lump, and 3 to 5 cents for powdered (pumicite or valcanic dust).

Grinding Pebbles

Hard, tough, rounded pebbles, usually of flint or quartz, are used in cylindrical or conical mills for the grinding of ores, minerals, and clays where iron contamination from the usual steel grinding balls would be detrimental.

Production of grinding pebbles in Canada has for many years been confined to Alberta, where W. May of Elkwater ships pebbles from field deposits in the Cypress hills area, which extends eastward from Medicine Hat into Saskatchewan.

Other Natural Abrasives

In addition to the natural abrasive materials briefly reviewed here, there are a number of other abrasives that are grouped together in United States' exports to Canada under "All Other Natural Abrasives". This grouping probably includes tripoli, diatomite, feldspar, pumicite, and perhaps others. In 1955 there were 13,811 tons of these abrasives, valued at $719,277, exported to Canada compared to 13,004 tons, valued at $717,938, in 1954. United States exports statistics to Canada also showed 92,516 carats of diamonds in grinding wheels valued at $418,855, and 103,098 carats as powder valued at $256,775 in 1955. Origin of diamond grit and powder for abrasive purposes is, of course, from sources other than the United States.

LIGHTWEIGHT AGGREGATES

By H. S. Wilson

The construction boom that began after the second world was has resulted in a steadily expanding market for lightweight aggregates. As pumice, a naturally occurring lightweight aggregate, has not been found in quantity in Canada, artificial lightweight aggregates are used to supply the Canadian market. Cinders, obtained from the burning of lump coal, have been used for many years in lightweight concrete but supplies are not nearly adequate to meet demand and have been diminishing as oil, gas, and pulverized coal have been displacing lump coal as an industrial fuel.

The first plant to produce a lightweight aggregate in Canada commenced operations in 1927, with shale as the raw material; the first plant to produce expanded vermiculite was put into operation in 1938. Perlite and expanded-slag aggregates entered the field after the war. By 1955, there were 24 plants producing various types of lightweight aggregate compared to 20 in 1954 and 2 in 1938. Output was valued at $3,325,000 in 1955.

Production of Lightweight Aggregates*

	1955		1954	
From domestic raw materials	Cu. Yd.	$	Cu. Yd.	$
Clay and Shale	171,000	958,000	130,000	900,000
Expanded slag	201,000	444,000	113,600	246,000
From imported raw materials	Cu. Ft.		Cu. Ft.	
Perlite	1,800,000	437,000	1,950,000	585,000
Pumice		117,000		56,300
Vermiculite		1,369,000		1,419,000
Total		3,325,000		3,206,300

* Vermiculite from Dominion Bureau of Statistics: other data from producers.

Types of Lightweight Aggregate

There are two types of lightweight aggregate. The first includes aggregates such as pumice, expanded clay, shale and slag that possess sufficient compressive strength to be used in load-bearing concretes. The second type includes aggregates that cannot be used in load-bearing concrete owing to low compressive strength. This type consists of expanded perlite and vermiculite, which are important for their extremely low densities and good insulating properties.

Raw Materials

Clays and shales are the most widespread of the raw materials consumed in the production of lightweight aggregate. The types used are the "common" clays and shales, such as are used in making brick and tile. The materials are usually fairly high in iron and have a comparatively low vitrification temperature. Suitable deposits have been found in all the provinces except Newfoundland. Test work on these materials has been published in the following reports, available at 50 cents a copy from the Mines Branch in Ottawa.

Preliminary Reports on Coated Lightweight Aggregates from Canadian Clays and Shales:

Memorandum	Series	No.	117 - Alberta
"	"	"	120 - Manitoba and Saskatchewan
"	"	"	121 - Ontario
"	"	"	122 - New Brunswich and Nova Scotia and Prince Edward Island
"	"	"	126 - Quebec
"	"	"	128 - British Columbia

Expanded slag is produced from blast furnace slag processed in the molten state as it is tapped from the blast furnace.

Pumice, a highly vesicular volcanic material, has been found only in very limited quantities in Canada, the main source of Canadian supply being the western United States.

Vermiculite is a type of mica which exfoliates when heated to form a highly cellular material possessing good insulating qualities. As no deposits of sufficiently high quality have been found in Canada, ore is imported and expanded for domestic consumption. Most of the imports come from the United States where the main sources are Montana, North and South Carolina, Wyoming, Colorado, and Georgia. Some vermiculite is imported from Transvaal, Union of South Africa.

Perlite is a glassy, volcanic material which "pops" when heated, giving a white cellular product of very low density. Deposits of this material occur in central British Columbia but have not been developed commercially. California and New Mexico are the main Canadian sources.

Lightweight Aggregate Plants in Canada

Plants in Operation	Location	Aggregate
The Cooksville Co. Ltd.	Cooksville, Ontario	Expanded shale
Lightweight Aggregates of Canada Limited	Calgary, Alta.	" "
Renn Expanded Aggregates Ltd.	Calgary, Alta.	" "
Literock Ltd.	Edmonton, Alta.	Expanded clay
Atlas Light Aggregate Ltd.	St. Boniface, Ma.	" "
Aggregates and Construction Products Ltd.	Regina, Sask.	" "
Light Aggregate (Sask.) Ltd.	Regina, Sask.	" "
Clayburn Co. Ltd.	Abbotsford, B. C.	Expanded shale
Dominion Iron and Steel Ltd.	Sydney, N. S.	Expanded slag
National Slag Ltd.	Hamilton, Ont.	" "
McCleery and Weston Ltd.	Vancouver, B. C.	Pumice
Perlite Products Ltd.	Winnipeg, Man.	Perlite
Perlite Industries Reg'd.	Ville St. Pierre, P. Q.	"
Montreal Perlite Industries	Montreal, P. Q.	"
Canadian Perlite Corp.	Montreal, P. Q.	"
Gypsum, Lime and Alabastine (Canada) Ltd.	Caledonia, Ont.	"
Western Perlite Co. Ltd.	Calgary, Alta.	"
F. Hyde and Co. Ltd.	Montreal, P. Q.	Vermiculite
F. Hyde (Ont.) Ltd.	Toronto, Ont.	"
Vermiculite Insulating Ltd.	Montreal, P. Q.	"
Siscoe Vermiculite Mines Ltd.	Cornwall, Ont.	"
Insulation Industries (Canada) Ltd.	Winnipeg	"
	Calgary	"
	Vancouver	"

Plants under Construction		
Winnipeg Light Aggregate Ltd.	Transcona, Man.	Expanded clay
Perlite Industries Ltd.	New Westminster, B. C.	Perlite

Production Methods

Lightweight aggregate can be produced from clay or shale by two methods - the rotary kiln and sintering processes.

The rotary kiln process is similar to that used in the cement industry. If shale is the raw material, it is usually crushed to size prior to being fed into the kiln counter-current to the heat flow. The maximum temperature utilized is usually within the range 1900° to 2,100°F. The discharge from the kiln is as separate particles, or, if these agglomerate during the firing, as clinkers. The type of raw material and the temperature govern the type of product. If the charge agglomerates, it must be crushed to give the desired size of aggregate. If the aggregate is discharged from the kiln as separate particles, some crushing may be necessary.

If clay is the raw material, it will usually require pelletizing before firing, since most clays are not sufficiently compact to retain the feed size desired. The pelletizing can be done by means of a horizontal drum pelletizer, an extrusion machine, or any apparatus in which the clay can be mixed with a suitable amount of water and formed into small pellets.

The sintering process for the production of lightweight aggregate is not used in Canada. In the United States, the process has been adapted from the iron and steel industry, where ore fines are sintered to form lumps large enough to be processed in a blast furnace. In the production of sintered aggregates the clay or shale is crushed fairly fine, mixed with about 5 to 10 per cent coal or coke, and pelletized. The sintering machine may be a travelling grate or rotating hearth type. The travelling grate machine is an endless chain of grates, whereas the rotating hearth machine is a circular hearth divided into pie-shaped segments; the hearth rotates in a horizontal plane. In both machines the charge of pelletized material is ignited at the surface and as it moves through the cycle an induced draft draws the ignition zone down through the charge. The fuel in the charge is sufficient to heat the material to the bloating temperature. The resulting product is discharged as a sintered cake which is crushed to the desired particle size.

Expanded slag is produced from the slag as it is flushed from the blast furnace, or from slag ladles in the molten state. One method of expanding the slag is to run it into a shallow concrete pit where a controlled quantity of water is introduced. The water causes the slag to froth and, on cooling, a vesicular material results. Several machines have been developed to introduce water, steam, and air into a stream of slag, to create a frothing or foaming condition. When the expanded slag cools it is crushed to the desired particle size.

Perlite is a type of volcanic rock composed of small spheriods. It contains 3 to 4 per cent water, and it is this combined water which gives perlite its peculiar "popping" characteristic when heated. On being heated to the softening point, perlite will expand from 4 to 20 times its original volume. Firing is generally done in horizontal kilns (stationary or rotary) or stationary vertical kilns at temperatures from 1,600° to 2,300°F. The ore is crushed and screened to size at the mine site and is received at the expanding plant ready for the "popping" process.

Vermiculite, which is similar in appearance to mica, contains from 6 to over 20 per cent water. The process of exfoliation is due to the evaporation of this water when the ore is heated rapidly to temperatures between 1,600° and 2,000°F. The expansion, accordian-like, may be as high as 20 times the original volume. Many types of furnaces for expanding vermiculite have been used, but the vertical kiln, containing baffles to retard the descent of the material, is most common. The furnaces are usually gas or oil-fired.

Properties and Uses

Expanded shale, clay, slag, and pumice aggregate usually prossess sufficient strength to be used in load-bearing lightweight concrete. In Canada approximately 80 per cent of these aggregates was used in 1955 in the production of concrete block, and about 15 per cent in the production of other pre-cast shapes. Three per cent was used in ready mix concrete, and small quantities were used for insulation fill and roof gravel. Concrete made with these aggregates is approximately 30 per cent lighter in weight than concrete made with conventional aggregate. The thermal and acoustical insulation properties are improved over the heavier conventional concrete.

Perlite finds its greatest use as aggregate in plaster owing to its whiteness and to its low density which may vary from 6 to 12 pounds per cubic foot. In 1955, approximately 75 per cent of the output was used for this purpose. About 10 per cent was used as an additive in oil-well drilling muds. The remaining 15 per cent was consumed as aggregate in concrete blocks and slabs, and in ready-mix concrete, in such places as roof decks and floor slabs.

Vermiculite is quite similar to perlite in weight, strength and insulating properties, and is used mainly as loose and plastic insulation and in non-load-bearing concrete. It is used also as insecticide carrier, soil conditioner, acoustic plaster, etc.

Prices

Expanded clay and shale aggregates sell within the range of $5.00 to $6.50 per cubic yard. Expanded slag sells at $2.00 to $3.25 per cubic yard. Perlite and vermiculite are marketed at about 20 cents to 40 cents per cubic foot, in bags of 4 cubic feet.

ARSENIC TRIOXIDE

By T. H. Janes

Arsenic in the form of the mineral arsenopyrite ($FeAsS_2$) is commonly associated with silver-cobalt ores and all of Canada's production of refined white arsenic (arsenic trioxide) originates from this source as a by-product. Deloro Smelting and Refining Company, Limited, at Deloro, Ontario, remains the sole producer, recovering arsenic from the treatment of silver-cobalt ores from the Cobalt-Gowganda areas of northern Ontario and from French Morocco, and from the processing of residues from the Eldorado Mining and Refining Limited's plant at Port Hope, Ontario. The capacity of the Deloro refinery is about 100 tons of refined white aresenic per month. Domestic production of 786 short tons of white arsenic valued at $69,159 was reported in 1955 compared to 590 tons valued at $48,333 in 1954. Exports amounted to 470 tons valued at $40,794 compared to 711 tons valued at $58,871 in 1954. There have been no imports since 1953 when about 16 tons of arsenic trioxide and arsenic sulphide were imported. Production, consumption, and export figures are seldom in balance for any year as shipments are governed by demand and stocks can be stored for indefinite periods of time.

White Arsenic - Production, Trade, and Consumption

	1955		1954	
	Pounds	$	Pounds	$
Production (refined)				
As_2O_3	1,571,787	69,159	1,180,350	48,333
Exports[a]..................	940,600	40,794	1,422,600	58,871
	1954		1953	
Consumption by Industry				
Glass industry	337,071		343,279	
Insecticides, wood preservatives, and miscellaneous[b]...........	13,389		88,804	
Alloys...................	28,292		36,515	
Total	378,752		468,598	

a Does not include arsenic content of gold ores exported for refining.
b In addition to these quantities of refined white arsenic, 501 tons of arsenic pentoxide (As_2O_5) were consumed in making insecticides in 1953 and 698 tons in 1954.

Other Canadian Production

In western Quebec, Beattie-Duquense Mines Limited, Duparques township, and O'Brien Gold Mines Limited, Cadillac township, recover crude white aresenic (about 70 per cent As_2O_3) as a by-product in the roasting of arsenical gold ores. The material is stored at the mine sites as consumer demand does not warrant its refining.

Gold-arsenic concentrates produced by Bralorne Mines Limited and other gold mines in British Columbia are shipped to Tacoma, Washington, for refining but no payment is received for the arsenic content. Several gold mines find it necessary to roast arsenical gold ores to effect improved gold recovery in cyanidation. The disposal of arsenic, in these cases, presents a problem and no effort is made to recover the arsenic content for marketing.

World Production

World production of white arsenic averaged 56,000 metric tons in the 1944-48 period with a peak production since then of 63,000 tons recorded in 1951. Practically all of it is obtained as a by-product from the treatment of precious and base-metal ores. United States is the leading producer and consumer of white arsenic, with production averaging about 15,000 metric tons annually since World War II. Other major producing countries, according to United States Bureau of Mines, include Sweden, Mexico, Belgium, France, Japan, and West Germany. Small amounts are produced in many other countries.

Uses

Major uses of arsenic and its compounds in order of importance are: as insecticides and weed killers, in the manufacture of glass, and in wood preservatives. Lead arsenate, calcium arsenate, and paris green are the principal arsenic insecticides. Sodium arsenite is used as a weed killer, as sheep dip, and for control of such pests as termites and grasshoppers. In Canada, the glass industry is by far the largest consumer of refined white arsenic, which is used as a decolourizer. Large amounts of white arsenic are used in wood preservatives such as Wolman salts (25 per cent sodium arsenate) and zinc meta-arsenate.

Prices

Refined white arsenic was quoted at 5 1/2 cents per pound (powdered, in barrels, car lots) throughout 1955 according to the Oil, Paint and Drug Reporter. This price has been in effect since August 1952, when it was reduced from 6 1/2 cents per pound on the same basis.

ASBESTOS

By H. M. Woodrooffe

The year 1955 was a record for the Canadian asbestos industry. Fibre shipments of this widely exported commodity exceeded the previous peak established in 1951 and were 15 per cent above those of 1954. To meet the strong demand for almost all grades, production (shipments) totalled 1,063,802 tons valued at $96,191,317 compared with 924,116 tons at $86,409,212 in 1954.

Of the several fibrous minerals referred to in commerce as asbestos, chrysotile is the only variety mined in Canada. Domestic needs for amosite and crocidolite, two other varieties, are met by imports from South Africa.

Since requirements of Canadian industry are relatively small, most of the output is exported. Although the United States was the destination of 57 per cent of the exports (dollar value) in 1955, there has been a proportionately greater growth in shipments to other countries in the last few years.

Principal developments in the industry occurred in the Eastern Townships of Quebec where the expansion and modernization program begun in 1950 was continued throughout 1955. By the time it is completed in 1958 the industry will have spent nearly $100,000,000. In the past year, construction of the Normandie mine was completed and it came into production. Considerable progress was reported in draining Black Lake in preparation for mining an orebody there. The discovery of a major orebody near East Broughton was followed by the decision to develop it for production. A new mill is being constructed at the site. Remarkable progress has been achieved in the relocation program at Thetford Mines which will increase the potential asbestos reserves of the mines concerned.

Canada continues to be the major source of the world's asbestos supply, and production is currently estimated at 63 per cent of world output. Other important producers, Russia, Southern Rhodesia, and South Africa, offer Canada strong competition in marketing fibre in certain countries. Canadian production is principally from the Eastern Townships of Quebec; Ontario and British Columbia also contribute. Other occurrences are known in Canada.

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. Although fibres as long as five inches occur, 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 East Broughton area is of this type.

Production in the Eastern Townships has been continuous since 1878. The persistence of the mineral at depth, as established by drilling, indicates that reserves will be sufficient for many years.

Fibrous tremolite, actinolite, and anthophyllite occur in various places in Canada. The fibres of these varieties are usually weak and not suited for the manufacture of textiles. There are however certain uses for which their chemical natural and physical characteristics are suited. During the war a small production of tremolite was reported in eastern Ontario. Recently, in the iron ore region near the Labrador-Quebec boundary, an occurrence of crocidolite has been reported and is currently under examination by one of the asbestos companies.

Developments and Production

Newfoundland

Several occurrences of chrysotile have been reported from Labrador and the Island of Newfoundland. One of these, in the St. Georges-Port au Port district in the southwestern part of the Island, was being explored by Newfoundland Asbestos Limited.

Asbestos - Production and Trade

	1955		1954	
	Short Tons	$	Short Tons	$
Production (shipments)				
Crude	724	608,052	725	645,608
Milled fibres	395,096	65,462,260	326,653	56,724,585
Shorts and refuse	667,982	30,121,005	596,738	29,039,019
Total	1,063,802	96,191,317	924,116	86,409,212
Exports				
Crude				
United States	250	204,927	304	254,228
United Kingdom	112	104,895	72	86,080
West Germany	89	66,034	75	62,040
France	69	48,719	93	92,650
Japan	29	22,523	34	25,097
Other countries	37	33,515	63	58,285
Total	586	480,613	641	578,380
Milled fibres				
United States	169,107	28,347,582	150,816	24,689,159
United Kingdom	37,698	7,694,097	25,058	5,153,004
West Germany	24,660	4,270,714	15,568	2,803,952
Australia	20,868	3,440,967	19,535	3,206,323
France	18,709	3,463,594	20,054	3,823,540
Belgium	15,358	2,810,499	11,062	2,010,244
Japan	12,801	1,937,314	12,162	1,855,626
Other countries	66,779	11,470,238	58,589	10,333,805
Total	365,980	63,435,005	312,844	53,875,653
Shorts				
United States	524,212	24,697,990	482,666	22,929,217
United Kingdom	38,668	1,677,424	33,613	1,336,130
West Germany	24,543	1,347,759	19,756	1,241,038
France	9,057	527,152	7,314	449,330
Belgium	7,959	500,256	5,880	396,545
Japan	7,002	549,645	6,368	481,559
Other countries	23,820	1,587,771	18,646	1,278,637
Total	635,261	30,887,997	574,243	28,112,456
Manufactures				
United States		2,281,227		856,618
Mexico		162,151		44,008
Argentina		112,962		7,464
Colombia		71,010		62,710
Indonesia		43,665		23,514
Union of South Africa		37,336		35,391
Other countires		193,866		272,669
Total		2,902,267		1,302,374

	1955		1954	
	Short Tons	$	Short Tons	$
Imports				
Manufactures				
Packing		243,760		243,769
Auto brake linings		395,979		271,723
Auto clutch facings......		381,491		259,560
Brake linings and clutch facings N.O.P. ..		160,326		127,818
Miscellaneous		2,872,276		2,636,262
Total		4,053,832		3,539,132

Quebec

The main deposits of chrysotile occur in the Eastern Townships, south of the St. Lawrence River east of Montreal in the counties of Richmond, Megantic, Arthabaska, and Beauce. Eleven producing mines are located at, or near, 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 originally an open pit mine current production is principally from underground block caving. An extensive construction program by the company has resulted in the completion of the first unit of a new mill, with the remaining units scheduled for completion in 1956. This, together with developments underground, is expected to increase the company's annual capacity for producing fibre to 625,000 tons.

The 4,000-ton mill of the Normandie Mine, Ireland township, Asbestos Corporation Limited, reached full-scale operation in the fall of the year. Asbestos rock is recovered from an open pit. On February 12th, the open pit at Vimy, nearby, ceased operation. The company also operates the underground King Mine at Thetford Mines and the Beaver and British Canadian open pits at Thetford and Black Lake respectively.

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; by Nicolet Asbestos Mines Limited at St. Remi de Tingwick; and by Quebec Asbestos Corporation Limited at East Broughton. The last-named is developing a major orebody recently discovered east of its present mine; it has under construction a 2,000-ton mill scheduled for operation late in 1956.

Lake Asbestos of Quebec Limited is currently preparing for production an orebody at Black Lake. Considerable progress has been made in draining the lake and 6,000,000 cubic yards of silt have been removed by dredging. Construction of a 4,000-ton mill is expected to start during 1956 and to be in operation two years later.

National Gypsum (Canada) Ltd. acquired an asbestos property east of Thetford Mines and is preparing it for production in 1958. It will be operated by a subsidiary - National Asbestos Mines Ltd.

Ontario

Canadian Johns-Manville operates an open pit in Munro township, east of Matheson, northern Ontario. The fibre is particularly suited to the manufacture of asbestos-cement products. Sinking of a shaft to develop an underground orebody is proceeding.

British Columbia

Cassiar Asbestos Corporation Limited recovers long-fibred asbestos from a deposit on McDame Mountain in northern British Columbia. The fibre is shipped over the Alaska Highway to Whitehorse, from there on the White Pass and Yukon Railway to Skagway, thence by boat to Vancouver. Construction of an aerial tramway to transport rock from the mine to mill was virtually completed by the year's end.

World Review

Current world production of asbestos fibre is appraoching 1,700,000 tons annually. Of this, Canada contributes more than 60 per cent. Russia is known to have large deposits of chrysotile and, although definite information on production is lacking, it is sufficient to enable exports to be made to European countries. Southern Rhodesia, an important producer of long-fibre chrysotile, reported a marked increase in production. In 1955 it amounted to 105,261 short tons of chrysotile valued at more than $20,000,000. South Africa supplies most of the world's crocidolite and amosite and produces chrysotile as well. The mineral is mined in several other countries on a smaller scale.

Uses and Prices

Asbestos is an important industrial raw material and a world-wide trade has developed in Canadian asbestos. Longer fibres can be spun like organic fibres, and are woven into textiles, packing, and certain insulating materials and heat-resisting friction materials. Shorter fibres are used in the asbestos-cement industry for the manufacture of pipe, shingle, tile millboard, siding, and other building materials. The very short varieties have physical characteristics of use in the manufacture of protective coatings, plastics, lubricants, and other specialized products.

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.

The ability of asbestos cement products to resist corrosion has resulted in rather wide application of asbestos pipe in the installation of water and sewage distribution systems.

Late in 1955, prices of Canadian fibre were increased for the first time in about four years. According to E & M J Metal and Mineral Markets bulletin of January 12, 1956, the prices per short ton in U.S. funds were:

		$
Crude No. 1	-	1,410 to 1,725
Crude No. 2	-	760 to 1,100
Spinning fibres		
3F	-	565 to 650
3K	-	460 to 485
3R	-	408 to 410
3T	-	380 to 385
3Z	-	350
Shingle stock	-	172 to 190
Paper stock	-	114 to 145
Waste	-	82
Shorts	-	39 to 72

Per short ton, f.o.b. Vancouver, U.S. funds:

Spinning fibre (3K)	-	460
Shingle fibre (4K)	-	185
AAA Grade	-	750
AC Grade	-	300

BARITE

By V. A. Haw

Production of barite in Canada for 1955, as recorded by mine shipments, amounted to 253,736 tons valued at $2,277,166. This represents a 15 per cent increase in output over 1954 and an all time record. The barite deposit at Walton, Nova Scotia, accounted for the major portion with a small mine at Brisco, British Columbia, contributing the remainder.

About 95 per cent of production was exported. Markets are located mainly along the east and Gulf coasts of the United States and in South America. The United States tariff of $3 per long ton on crude and $6.50 per long ton on ground barite has resulted in the location of grinding plants along the coast of the United States where the crude is imported and ground for use in nearby oil wells. Ground barite is exported mainly to Trinidad and Venezuela.

Production and Trade of Barite

	1955		1954	
	Short Tons	$	Short Tons	$
Production (mine shipments)				
Crude	182,195	1,182,831	163,497	1,158,833
Ground	71,541	1,094,335	57,975	844,963
Total	253,736	2,277,166	221,472	2,003,796
Imports (ground)				
United States	830	31,787	827	29,751
West Germany	619	14,230	376	8,616
Italy	-	-	33	897
Total	1,449	46,017	1,236	39,264
Exports (crude)*				
United States	187,355	1,364,285	165,612	1,177,616

* Not reported separately in the official Canadian Trade Statistics. The figures shown here are reported in the United States Import Statistics. In addition, smaller quantities were exported to other countries, mainly South American.

Consumption

Consumption of barite in Canada for 1955 is estimated to have been about 12,000 tons for oil-well muds, and 2,500 tons for other uses.

Domestic Producers

Nova Scotia

The barite property at Walton, Nova Scotia, has been acquired from Baryman Company Limited by Magnet Cove Barium Corporation. The property was purchased outright with the exception of the mineral lease. The lease is to be sub-let to Magnet Cove on a royalty basis of $1.15 per ton, U.S. funds.

The deposit is a massive body of high-grade barite. It is located three miles southwest of Walton, Nova Scotia, and one and a half miles inland from the head of the Bay of Fundy. The deposit occurs in sedimentary rocks of Mississippian age. The barite as mined is stained a reddish-brown owing to the presence of iron oxides. However, it is very pure, having graded in excess of 90 per cent barium sulphate in most of the material so far produced. The barite is obtained by open quarry and is trucked to Walton for crushing and washing and, in the case of about 20 per cent of the output, for the further stage of grinding. The quarry has now reached a depth of 300 feet and plans for underground development are underway. All production is shipped by boat directly from Walton.

British Columbia

Mountain Minerals Limited, with grinding plant at Lethbridge, Alberta, operates two properties, Brisco and Parson. Entire production for the year, however, was reported to have come from Brisco. The plant at Lethbridge produces ground barite mainly for use in well-drilling muds, although minor quantities are marketed for other uses in nearby localities.

Other Occurrences

A witherite (barium carbonate) deposit occurs in northern British Columbia at Liard River Crossing. The deposit is flat-lying at a contact between Devonian shales and limestones. Up to 20 feet in thickness, it is composed of an intimate mixture of witherite, fluorite, quartz and barite.

Investigation of two other barite properties was continued during the year; one is on McKellar Island, 25 miles from Port Arthur in Lake Superior, and the other in the Lake Ainslie district of Nova Scotia. In the Lake Ainslie occurrences, fluorspar is also an important constituent of the ore and the developing company hopes to produce both barite and fluorspar as co-products.

In addition, numerous other occurrences of barite are widely distributed throughout Canada, mainly in Nova Scotia, Quebec, Ontario, Manitoba, and British Columbia.

World Sources

World production of barite is estimated at slightly more than two million tons a year. The United States, by far the largest producer, accounts for about 50 per cent of this output. Other major producers in addition to Canada are West Germany, United Kingdom, Italy, Yugoslavia, France and Russia.

Uses and Specifications

The principal use of barite is in oil-well drilling muds with bentonite and other minor conditioning agents. In the United States, which consumes more than half the world's total production of barite, about 75 per cent of total consumption is used in drilling muds. Barite is used also as a pigment and filler in paints, rubber, linoleum, and papers; in the manufacture of barium chemicals; as an additive to glass batches; as an aggregate in concrete where additional weight is required such as in coatings for underwater pipes, or where shielding is required against radiation such as in X-ray rooms or atomic energy plants.

Titanium dioxide has continued to supplant lithopone (70% $BaSO_4$, 30% ZnS) as a white pigment in paints and enamels. This has greatly decreased the market for barite for this purpose, although some white barite is now used together with titanium dioxide.

Specifications for barite vary widely, depending on use and on agreement between producer and consumer.

In drilling muds, which are used to combat high pressures of gas and water in wells and to float drill cuttings, the specific gravity and grain size of the barite are important factors. The usual specifications require a minimum specific gravity of 4.2, and a grind of 98 per cent minus 325-mesh. A minimum of 90 per cent $BaSO_4$ is also usually demanded. Soluble salts are objectionable because of their flocculating tendencies.

The chemical trade demands a minimum of 95.0 per cent $BaSO_4$, with the Fe_2O_3 content not in excess of 1.75 per cent. The material is required in lump form, and colour is not important.

As a filler for paints, rubber, paper, etc., an almost pure white colour is essential, and usually a grind of 200-mesh or finer is required. A minimum of 95 per cent $BaSO_4$ is specified.

For the glass trade, barite serves as a fluxing agent, deoxidizer, and decolourizer. For this purpose a minimum of 98 per cent $BaSO_4$ may be specified, and a very low iron content - about 0.20 per cent or less. Grain sizes up to 20-mesh are required with a minimum of minus 200-mesh.

Barium Compounds

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

Consumption in Canada of the main barium compounds in the chemical and allied products industry in 1953 was as follows:

barium chloride	437,037 pounds
" nitrate	197,792 "
barytes (barite)	2,672,802 "
blanc fixe	494,611 "
lithopone	6,120,315 "

Imports of Barium Compounds

	1955		1954	
	Short Tons	$	Short Tons	$
Imports				
Lithopone (70% $BaSO_4$)				
United States	994	150,749	1,411	209,610
United Kingdom	549	69,547	910	114,012
West Germany	235	32,347	187	21,727
Other countries	116	12,581	33	4,800
Total	1,894	265,224	2,541	350,149
Blanc fixe (precipitated) $BaSO_4$				
West Germany	299	19,473	102	7,635
United States	208	25,440	123	12,973
Belgium	68	5,415	26	1,891
United Kingdom	24	4,559	61	11,528
Total	599	54,887	312	34,027

Prices and Tariffs

Prices

The E & M J Metal and Mineral Markets quoted the United States prices of barytes at the end of 1955 as follows:

Georgia, f.o.b. mines

Crude, jig and lump - $15.00 per net ton.
Beneficiated - $17.00 to $19.00 per net ton in bulk and $21.50 in bags.

Missouri

Water-ground and floated, bleached - $41.35 per ton, car lots, f.o.b. works.

Crude ore, minimum 94% $BaSO_4$, less than 1% iron - $14.25

Canada

Crude, in bulk, f.o.b. shipping point - $11.00 per long ton.

Ground, in bags - $16.50 per short ton.

67462-2—10½

Tariffs

Canada

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

United States

Crude	- $3.00 per long ton
Ground or manufactured	- $6.50 per long ton

BENTONITE

By T. H. Janes

Production of bentonite in Canada is derived from two locations in Western Canada -- from near Morden, 60 miles southwest of Winnipeg, Manitoba, and from the Drumheller area of Alberta. The bentonite from near Morden is the non-swelling (high calcium) type and is used either as natural bentonite or acid-activated bleaching earth for decolourizing mineral, vegetable, and animal oils. The bentonite from the Drumheller area is the swelling (high sodium) type and is used mainly as a dusting agent in fungicides with smaller amounts being used as an aid in diamond drilling and as foundry-sand bond.

Figures on the output of bentonite in Canada are not available for publication. Statistics on the imports of bentonite, practically all from the United States, are incomplete. Imports of activated bentonite for decolourizing oils were reported to have a total value of $1,247,355 in 1955 compared to $835,433 in 1954. Tonnage figures were not reported but activated bentonite for this market might command from $90 to $100 a short ton, delivered to the consumer, or from $60 to $70 a short ton, f.o.b. producers' plant. No figures are available on the imports of swelling bentonite from the United States but Canadian requirements of this material have been increasing steadily for several years and would amount to perhaps 35,000 short tons in 1955.

Production and Occurrences

In Manitoba, Pembina Mountain Clays Limited, 945 Logan Avenue, Winnipeg, mines a non-swelling (calcium) bentonite near Morden and ships the dried, crushed clay to its Winnipeg plant where it is ground and activated with sulphuric acid. The bentonite seams occur near the base of the Pembina member of the Vermilion River formation which is of Upper Cretaceous age. This horizon is quite pronounced from the United States border northwestward to Miami, a distance of about 35 miles. The dried, ground bentonite possesses good oil decolourizing properties and the activated earth compares favourably with the best imported bleaching earths. Most of the company's output is used for mineral oil clarification and the remainder is used in decolourizing vegetable and animal oils.

In Alberta, thin seams of swelling (sodium) bentonite are frequently found associated with coal beds but are generally too narrow to be of economic interest. Of recent years Mr. G.K. Kidd has shipped raw, lump bentonite from the Drumheller area to Alberta Mud Company Ltd. at Calgary where it is dried, ground, bagged, and shipped to consumers in Western Canada. Most of it is used as a carrier in the manufacture of dusting agents for weed killing. The remainder is used as an aid in diamond drilling through overburden, as a foundry sand bond, and in sealing irrigation ditches. Thicker beds of fair quality swelling bentonite have been reported from the vicinity of Busby, north-west of Edmonton.

In British Columbia beds of slightly swelling bentonite up to 15 feet thick occur in gently dipping, Tertiary sediments. The larger occurrences are located at Quilchena Creek, about two miles south of the Quilchena post office, at the outskirts of Princeton on Copper Mountain Railway, and about five miles south of Princeton on the same railway. There has been no significant production from any of these deposits.

In Saskatchewan, the Department of Natural Resources has tested bentonites from the St. Victor, Pelly, and Moosomin areas. The results are fully reported in two of that department's publications, 'Improving Saskatchewan Swelling Bentonite by Chemical and Mechanical Treatment' and 'Acid Activation of Saskatchewan Bentonites', issued in 1954.

No deposits of bentonite have been found east of Mantioba. Bentonite is thought to be formed by the weathering or alteration of volcanic ash, and such material is not known to occur east of Manitoba.

Consumption

Figures on the consumption of bentonite by specified industries are incomplete. From statistics available an estimated 50,000 tons of bentonite was used in Canada in 1955, the greater part of which was imported from the United States. It is estimated that 25,000 tons is used in the drilling of oil wells, 13,000 tons in filtering and decolourizing oils, 6,000 tons as foundry-sand bond, 2,500 tons in pelletizing operations, and the remainder in a minor way in the manufacture of a variety of products including soaps and washing compounds, pulp and paper, cement products, polishes and dressings, fungicides, and chemicals.

Production and Consumption in United States

The Bureau of Mines, United States Department of the Interior, reported that 1953 production of bentonite, the latest year for which figures are available, amounted to 1,269,971 short tons valued at $16,180,242. End-use consumption of bentonite, in short tons, for 1953 is reported as follows:

End Use	1953
Rotary-drilling mud	583,373
Filtering and decolourizing oils	251,107
Foundry-sand bond	347,056
Miscellaneous	88,435
Total	1,269,971

The Wyoming-South Dakota district accounted for 69 per cent of the total bentonite production in 1953 (Wyoming, 53 per cent and South Dakota, 16 per cent); Mississippi for 15 per cent; Arizona 10.5 per cent; Texas 4 per cent; and other states the remainder.

Uses

Bentonite is used chiefly to control the viscosity of oil-well drilling muds; for the bleaching, or decolourizing and filtering, of mineral, animal, and vegetable oils; and as the bonding agent in foundry-sand moulds.

Non-swelling bentonite, both natural and activated, is used almost entirely for filtering and decolourizing oils. Small amounts are also used in the clarification of food products such as wine, vinegars, corn syrup, and sugar.

The colloidal, or swelling type of bentonite, besides its major uses in controlling the viscosity of drilling fluids, and as the bonding agent in foundry-sand moulds, has a wide range of minor uses. It is used in the bonding and plasticizing of ceramic and refractory bodies; as a filler in paper, rubber, and other products; as a detergent in soaps and cleaners; as a stabilizer in various hydraulic cements; as a carrier for insecticides, fungicides and herbicides; and in toiletries and medicinal preparations. It is used for grouting dams and irrigation ditches and to prevent water seepage around foundations of buildings. Considerable quantities of swelling bentonite may, in future years, be used in the pelletizing of the magnetic, filtered concentrates derived from the treatment of taconites (low-grade magnetic iron ores). Bentonite has proved successful on a pilot-plant scale as a binder for producing pellets suitable for blast-furnace feed. Treated bentonite is used as a desiccant to prevent atmospheric moisture from entering packaged goods, and for coating small seeds to increase their bulk and to facilitate sowing.

Prices

Bentonite prices vary within wide limits according to the grade of the material and the amount of processing it requires. Wyoming and South Dakota standard, swelling, minus 200-mesh bentonite sells for $14.00 a ton, bagged, in carload lots at the processing plant.

Activated bentonite costs from $60 to $80 per short ton in carload lots, delivered to points in Ontario and Quebec. The price of Alberta bentonite, ground to 90 per cent minus 200-mesh, remained unchanged at $40 a short ton, f.o.b. Calgary in 1955.

CEMENT

By R. A. Simpson

In 1955, cement plants in Canada continued to operate at full capacity, with production reaching an all-time record. During the year 25,168,464 barrels of cement were produced valued at $65,650,025 increases in production of 2,730,987 barrels and in value of $6,614,381 over the previous year.

In spite of increased output, shortages of cement occurred, and 2,959,370 barrels were imported to help satisfy the demand. Imports were valued at $8,443,415, which amounts to $2.85 per barrel as against $2.49 per barrel for domestic cement. Canada does not manufacture white portland cement, but during the year 79,928 barrels of white portland cement clinker were imported and the clinker was ground to size at Paris, Ontario, for distribution to consumers.

Shortages of cement are expected to occur again in 1956. According to figures published by the Department of Trade and Commerce*, capital expenditures in construction in 1956 will amount to $5,162 million as against $4,273 million in 1955. This is an increase of $889 million or 20.8 per cent. Thus it appears that demand for cement in 1956 will be considerably higher than in 1955. Increases in production in 1956 to meet this demand will depend upon completion of three additional kilns and facilities - one each in Quebec, Ontario and Alberta. However, they are not expected to be in operation until late in the year and the impact of this additional production will not be fully felt until 1957. Therefore, to meet the expected increase in demand, it will be necessary to depend largely upon imports of foreign cement.

Consumption

The apparent consumption of cement in 1955, exclusive of imported clinker, was 27,162,649 barrels which was 2,556,617 barrels above 1954 consumption.

Cement is consumed mainly by the construction industry so that trends in quantity of construction are indications of what demands will be. Residential building was up considerably in 1955 and appears to be headed for a further increase; 68,641 housing units were under construction on January 1, 1955, compared to 59,967 on the same date in 1954; 138,276 units were started during 1955 compared to 113,527 during the previous year; and 127,552 units were completed in 1955 against 101,965 units in 1954. This is, of course, only a continuation of successive annual increases that are expected to continue into 1956 and beyond, if the increase in national population continues as predicted. The number of dwelling units under construction as of December 31, 1955, was 79,716 which is over 16 per cent greater than the number under construction at the same time in 1954. Thus, 1956 will start off with over 11,000 more housing units under construction than at the beginning of the previous year.

* Private and Public Investment in Canada, Outlook 1956.

The boom in engineering construction continued in 1955 and it too is expected to continue through 1956. Developments such as the St. Lawrence Seaway and Power Project require large quantities of cement. This project alone, it is estimated, will consume 6.6 million barrels.

Cement - Production, Trade and Consumption

	1955		1954	
	Barrels of 350 lb	$	Barrels of 350 lb	$
Production*	25,168,464	65,650,025	22,437,477	59,035,644
Exports				
United States	964,885	3,138,343	123,307	494,708
Others	300	1,155	338	1,350
Total	965,185	3,139,498	123,645	496,058
Imports				
West Germany	1,076,917	2,700,906	763,962	1,868,380
United Kingdom	867,956	2,081,167	866,480	2,067,489
United States and Alaska	696,349	2,735,975	588,890	2,130,761
Sweden	111,148	236,911	157	831
Denmark	89,662	297,361	6,356	30,856
Switzerland	51,847	141,633	47,250	146,250
Netherlands	38,713	132,861	-	-
Belgium	22,762	93,644	16,248	43,070
France	4,016	22,957	2,857	29,253
Total	2,959,370	8,443,415	2,292,200	6,316,890
Imports (clinker)				
United States	78,928	254,624	79,886	233,542
Apparent Consumption (exclusive of clinker)	27,162,649		24,606,032	

* Producers' shipments plus quantities used at their own plants.

The concrete products industry is becoming a major user of cement. For instance, in 1949, 2,580,347 barrels of cement were consumed by this industry and in 1954, five years later, 7,516,499 barrels were consumed, an increase of over 190 per cent. In 1954, the increase was 38 per cent over the previous year.

Chief among the manufactured concrete products is ready-mix concrete which in 1954 was valued at $42,753,235. Output of concrete blocks was second with a value of $27,339,924, concrete pipe of all kinds third at $11,631,582, and concrete brick fourth at $4,220,514. Ready-mix concrete in particular is more in demand, and in 1954 3,360,704 cubic yards were produced - a 55 per cent increase in production over 1953. Production of concrete bricks which offer the architect a variety in colour, shape, and size was up 29 per cent over the previous year, over 102 million being produced. Other items include artificial stone, chimney blocks, laundry tubs, burial vaults, repairs, and other related products. Total value of factory shipments in the industry amounted to $102,098,151.

Developments

Plans for increased production in the cement industry called for a total of nine new kilns by 1957, representing an increase in capacity of 14,000,000 barrels a year, and a total capacity of 37,350,000 barrels.

During 1955, the increase in capacity was 3,000,000 barrels a year, that planned for 1956 is 3,900,000 and for 1957 is 7,100,000. Details of this expansion program are given in the following table:

Plans for Increased Capacity in Canada's Cement Industry

Company	1955 Barrels	1956 Barrels	1957 Barrels	Total Capacity of Plants as of 1957 Barrels
Canada Cement Company				
Montreal East, P.Q....	-	1,500,000	-	7,500,000
Fort Whyte, Man.	1,500,000	-	1,500,000	4,500,000
Woodstock, Ont.	-	1,500,000	-	1,500,000
Havelock, N.B.	-	-	-	800,000
Hull, P.Q.	-	-	-	1,100,000
Belleville, Ont.	-	-	-	4,000,000
Port Colborne, Ont.....	-	-	-	1,200,000
Exshaw, Alberta	-	-	-	3,000,000
				24,600,000
St. Lawrence Cement Co. Ltd.				
Villeneuve, P.Q.	1,500,000	-	-	1,500,000
Clarkson, Ont.	-	-	3,000,000	3,000,000
St. Mary's Cement Co. Ltd.				
St. Mary's, Ont.	-	-	750,000	3,000,000
Inland Cement Co. Ltd.				
Edmonton, Alberta	-	900,000	-	900,000

Company	1955 Barrels	1956 Barrels	1957 Barrels	Total Capacity of Plants as of 1957 Barrels
(Continued)				
Saskatchewan Cement Corp. Ltd. Regina, Sask...........	-	-	850,000	850,000
British Columbia Cement Co. Ltd.*.......	-	-	1,000,000	3,200,000
North Star Cement Limited, Cornerbrook Newfoundland	-	-	-	600,000
Le Ciment Quebec Inc. St. Basile, P.Q.........	-	-	-	700,000
Total	3,000,000	3,900,000	7,100,000	37,350,000

* Two and one-half year expansion program announced in 1955.

CLAYS AND CLAY PRODUCTS

By J. G. Phillips

The output of clay products from domestic and imported clays has increased steadily in the past few years. This is attributable mainly to an increase in demand for such ceramic construction products as building brick, structural tile, sanitary ware, wall tile, etc. In addition, the demand for refractories of various kinds and for certain types of electrical insulators continues high.

Plans for increasing production capacity were general throughout the industry, particularly in the field of structural clay products. New sewer-pipe plants were established in Ontario and Alberta, a modern building-brick plant was established in southern Ontario, and other operations in various regions of Canada were under serious consideration. Indicative of the interest shown in expanding the clay products industry in Canada and in making higher-grade products were the relatively large number of samples submitted to the Mines Branch for investigation and a similar increase in the number of requests for advice on technical matters pertaining to the industry.

Common clays or shales used in the manufacture of brick and tile cannot economically be transported over long distances as the costs would be prohibitive. This does not pertain, however, to high-grade clays, such as those used in the production of sewer pipe, ornamental terra cotta, flue liners, quarry tile, etc. In some cases, particularly in eastern Canada, imported clays are used as an admixture with local material. Higher-priced ceramic products such as those classified as "whitewares" (tableware, sanitary ware, electrical porcelain, floor and wall tile, etc.) require the use of china clay, which is imported. Ball clay is also usually used in whiteware bodies to enhance workability, and this type of clay, particularly in eastern Canada, is imported also (see under China and Ball Clay).

Large quantities of china clay are used in the paper and rubber industries, and sizable amounts of bleaching clays are used in oil refineries.

Common Clays and Shales

Clays or shales suitable for the production of good quality brick and tile occur in all provinces and are not too distant from the more thickly populated areas, but the better grades are not plentiful. Sources of new or better raw material are therefore constantly being sought.

The investigation of the making of lightweight aggregate from Canadian clays or shales was continued in the Mines Branch. Before World War II there was only one plant in Canada producing lightweight aggregate from such materials. In 1955, there were eight, with one under construction. Output in 1955 was valued at $958,000.

Stoneware Clays

Southern Saskatchewan is the largest producer of stoneware clay in Canada. The clay is selectively mined and is shipped mainly to Medicine Hat, Alberta, where a variety of stoneware products such as sewer pipe, crockery, etc., are made. The kilns are fired by natural gas from local wells. Tableware, including vitreous hotel ware, is also made, with imported china clay as part of the body composition.

The stoneware clays or semi-fireclays that occur associated with the fireclays in the Sumas Mountain, south of Vancouver, British Columbia, 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, and 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 in limited amounts for the production of pottery, certain stoneware products, and low-temperature refractories. The opening in 1955 of the Shubenacadie deposits on a large scale makes available a local source of good-grade stoneware clay that should be suitable for the production

Clay and Clay Products - Production and Trade

	1955	1954
	$	$
Production from domestic clays		
Clays including bentonite..........	521,919	396,360
Clay products		
From: Common clays	28,913,159	26,933,343
Stoneware "	4,731,121	4,191,934
Fireclays	820,817	546,968
Other products..................	272,754	291,493
Total	35,259,770	32,360,098
Production from imported clays		
From: Stoneware clays	884,997	840,700
Fireclays	2,783,536	2,263,244
China clay	14,725,857	12,881,611
Total	18,394,390	15,985,555
Grand total	53,654,160	48,345,653
Imports of Clay		
Fireclay	421,205	396,336
China clay	1,902,470	1,527,075
All other, including activated, filtering, and bleaching clays	1,726,341	1,281,803
Total	4,050,016	3,205,214
Imports of clay products		
United States	23,040,013	21,981,595
United Kingdom	13,878,775	13,539,058
Other countries	2,893,679	1,802,077
Total	39,812,467	37,322,730
Exports of Clay		
United States	93,681	34,866
Other countries	1,004	-
Total	94,685	34,866
Exports of clay products		
United States	1,654,546	1,297,328
Sweden	185,567	164,967
Belgium........................	96,990	103,115
W. Germany	95,601	-
Brazil	75,255	128,341
Union of South Africa............	72,244	41,491
New Zealand	71,958	16,845
Other countries	306,849	436,081
Total	2,559,010	2,188,168

of good-quality buff-face brick, sewer pipe, and stoneware products.

Fireclays

Firebrick and other refractory materials are made on a large scale at a plant about 50 miles southeast of Vancouver from the moderately plastic fireclay that is extracted by underground mining from the clay beds in the Sumas Mountain. Smaller enterprises have also been established in this area in recent years for the manufacture of refractories or like products from material obtained from these deposits. Some of this material is exported to northwestern United States for use in making refractories.

A plant at Claybank, Saskatchewan, utilizes the highly plastic refractory clays obtained by selective mining of the "Whitemud" beds in the southern part of the province.

The clay found at Musquodoboit, Nova Scotia, is suitable for the production of stove linings and for certain foundry purposes, and the opening of the clay deposits near Shubenacadie, Nova Scotia, in 1955 makes available a local source of fireclay suitable for moderately high-temperature refractory purposes.

The relatively extensive deposits of plastic fireclays that occur on the Mattagami, Missinaibi, and Abitibi Rivers in northern Ontario have not been developed commercially owing to their remoteness and to difficulties in extracting uniform, high-quality material.

Fireclays imported from the United States enter Canada duty free if not processed further than by grinding. Producers of fireclay types of refractories in Ontario and Quebec import their raw materials.

China and Ball Clay

China clay is an essential raw material in making such ceramic products as electrical insulators, sanitary ware, tableware and floor and wall tile. Large quantities are also used by the paper industry for coating and filling. The only production on a commercial scale in Canada was at St. Remi d'Amherst, Papineau county, Quebec, several years ago, but this project was abandoned because of mining and operational difficulties. Several other deposits of kaolinized material occur in Quebec. One is near Point Comfort, Thirty-one Mile Lake, the others being near Brebeuf, Lac Labelle, and Chateau Richer. None of these, however, is of sufficient size and uniformity to warrant development.

Deposits containing rather high-grade clay of the china-clay type are located about 25 miles north of Prince George, British Columbia. The beds are variable in quality, however, and the extent and uniformity of the high-grade material present has not been definitely established.

The Saskatchewan Government is continuing an extensive program of exploration of its ball-clay resources, particularly in the southern part of the province, largely in the hope that markets for western ball clays may be expanded in Eastern Canada and the United States. In Eastern Canada, it has been necessary to import ball clay, which, as indicated earlier, is an important ingredient in ceramic whiteware.

Prices

Average prices for the various kinds of clay are difficult to obtain, because of the variability in quality. An indication of the 1955 prices per ton, f.o.b. shipping point, for three kinds of imported clay is as follows:

		$
Fireclay	-	4.50 to 6.00
China clay	-	9.00 to 30.00
Ball clay	-	6.00 to 20.00

DIATOMITE

By T. H. Janes

Diatomite, also known as diatomaceous earth and as kieselguhr, consists of microscopically small, opaline silica, skeletal remains of water organisms known as diatoms. The purest varieties of diatomite are chalklike in appearance, free from grit, porous, and friable, and have an apparent specific gravity under 1 when dry.

There has been no significant production of diatomite in Canada for many years. In 1953 and 1954, about 100 tons of a dried, ground, bog diatomite was produced in the Muskoka district of Ontario for sale as livestock feed additive and was inadvertently reported as diatomite production. This material cannot be considered as diatomite in the industrial sense.

Domestic requirements are imported from the United States with the exception of occasional minor amounts from Denmark or from deposits in Canada. In 1955, imports amounted to 22,157 tons valued at $788,503 compared to 19,373 tons valued at $664,016 in 1954. The gradual rise in imports over the past several years is attributed to the steadily expanding economy.

Occurrences in Canada

The largest deposits of diatomite known to occur are in the Quesnel area of British Columbia, along the banks of and adjacent to the Fraser River. They are of freshwater origin, Tertiary age geologically, and occur in compact beds up to 40 feet thick. The diatomite is white to cream in colour, practically free from grit and vegetable matter, and composed mainly of the skeletal

Production, Trade and Consumption of Diatomite

	1955		1954	
	Short Tons	$	Short Tons	$
Production (sales)	16	352	4	192
Imports				
United States	22,133	787,651	19,373	664,016
Denmark	24	852	-	-
Total	22,157	788,503	19,373	664,016
Consumption*				
Fertilizer dusting	9,652		8,840	
Filtration	8,726		7,706	
Fillers	2,626		2,033	
Insulation	169		55	
Miscellaneous	90		-	
Total	21,263		18,634	

* Based on information supplied to the Mines Branch by distributors and consumers.

remains of small barrel-shaped diatoms. Minor amounts of this diatomite, from time to time, have been used for insulation and concrete admixture purposes in the Vancouver area. The dried, ground material appears suitable for fertilizer dusting, insulation, and filler purposes, but transportation difficulties have hindered development of the deposits. The diatomite does not appear to be suitable for good grade filtration material.

There are several hundred known occurrences of bog diatomite in Canada. These consist of grey to brown to black mud, or peat, in bogs or on the bottoms of small ponds in Nova Scotia, New Brunswick, Quebec, Ontario and British Columbia. The deposits are of Recent (geologically) origin, and are forming at the present time. However, deposits of this type cannot be operated economically, at present, to produce marketable grades of diatomite for industrial purposes.

World Production

In 1955, estimated world production of diatomite amounted to 640,000 tons, of which the United States produced more than half. California continued to be the leading state in diatomite production, followed by Oregon, Nevada, and Washington. United States' reserves of diatomite for all uses appear adequate for many years.

Many other countries, including Denmark, West Germany, Algeria, Union of South Africa, France, and Japan, produce diatomite.

Uses and Specifications

Diatomite is one of the more important industrial minerals, and is indispensable in manufacturing processes involving filtration. It has for years occupied an important place in such industries as sugar refining, liquor distilling, dry cleaning, syrup making, municipal water filtration and purification, and gold milling. More recently, it has become a necessary aid in the manufacture of antibiotics. For good filtration performance, size, shape, purity, and density are important considerations.

As a mineral filler diatomite is used in rubber, paper, asphalt products, plastics, explosives, insecticides, paints, and many other products. Diatomite is also used as concrete admixture and as the mild abrasive in metal polishes and dentifrices. Important properties of diatomite to be considered for such uses include colour, freedom from grit, low density, inertness, and particle size. It supplies bulk with little increase in weight, along with desirable physical properties to the end products.

On account of its porous nature, high melting point, and particle stability, diatomite is used for many construction and industrial purposes.

Acceptance of diatomite by consumers depends mainly upon the physical properties of the mineral in relation to intended use. Examination under the microscope, coupled with testing for grit, density, etc., can generally determine to what use any material submitted may be put.

In Canada, the major use of diatomite is in the manufacture of ammonium nitrate fertilizers (nitraprills), where it is used as a dusting agent for coating the prills to prevent caking and sticking. Specifications call for uncalcined material of 95 per cent minus 325-mesh and with less than 5 per cent moisture content. About 9,000 tons of diatomite a year are used by fertilizer manufacturers in plants at Warfield, British Columbia, Calgary, Alberta, and Welland, Ontario.

Prices

Prices for diatomite vary widely according to type and grade. Chemical and Engineering News reported that in 1955, at United States eastern ports, domestic (U.S.) diatomite in bags, in carload lots, sold from $52 to $55 a short ton, and 'purified' grades sold at $65 a ton. Filtration grades of diatomite, f.o.b. Toronto or Montreal, sell from $100 to $160 per ton in ton lots, and filler grades somewhat less at $75 to $110 per ton. Diatomite for nitraprill coating, insulation, concrete admixture, and other purposes varies from $30 to $60 per short ton, f.o.b. producer's plant. Diatomite insulation bricks from England, Denmark, and the United States range from $50 to $200 per thousand depending on grade, source, and insulating properties. These prices have not changed materially over the past few years.

FELDSPAR

By G. F. Carr

Production (shipments) of feldspar in 1955 amounted to 18,152 tons valued at $355,879, about 13 per cent greater in volume than in 1954. Output is limited to producers in Quebec.

Feldspar - Production, Trade and Consumption

	1955		1954	
	Short Tons	$	Short Tons	$
Production				
Quebec	18,152	355,879	14,305	278,997
Ontario	-	-	1,791	22,052
Total	18,152	355,879	16,096	301,049
Imports, ground				
United States	137	3,106	398	8,078
Exports				
United States	1,419	37,553	1,053	27,946
W. Germany	7	572	1	80
Colombia	-	-	2	180
Total	1,426	38,125	1,056	28,206
Consumption				
Glass	4,612		4,037	
Cleansers	1,399		933	
Abrasives	11		5	
Clay products	5,839		5,291	
Enamelling	874		703	
Heating and cooking apparatus	1,663		105	
Iron castings	22		19	
Electrical apparatus	767		180	
Total	15,187		11,273	

Producers

Quebec

Canadian Flint and Spar Company Limited*, Ottawa, operating in Derry township, Quebec, continued to be the largest single producer of crude and operated its mill at Buckingham for the production of ground spar, mainly for the domestic pottery, glass, enamelling, and cleanser trades. Mill feed was drawn from its own and numerous other mines located chiefly in Derry and Buckingham townships.

Bon Ami Limited, Montreal, produced ground feldspar for its own use.

* Name changed to International Minerals and Chemical Corporation (Canada) Limited as of December 12, 1955.

Two pegmatite deposits on the north shore of the St. Lawrence River, one near Tadoussac, the other at Baie Johan Beetz, opposite Anticosti Island, were investigated by Spar-Mica Corporation Limited, of Montreal, Quebec, during the year, and at last report a shipping dock was being constructed at the latter locality.

Uses and Specifications

Feldspar is used chiefly by the ceramic industry in the manufacture of glass, pottery, and enamelware and by the cleanser trade in making scouring soaps and powders. A limited quantity of select material is used in the manufacture of artificial teeth.

For ceramics, feldspar is classified as potash spar or soda spar and graded in either category as No. 1 Ceramic or No. 2 Ceramic according to purity. To qualify as No. 1 Ceramic, feldspar should contain less than 0.06 per cent iron or other colouring oxides and under 5 per cent quartz. For No. 2 Ceramic, the iron content must be low but more latitude is permitted in respect of quartz. Colour is of no importance in either grade.

For cleansers, the material should be grit-free and approach a good white colour. Either potash or soda spar is acceptable.

Dental spar is potash spar of high purity, selected by the trade according to its firing characteristics. Up to 0.10 per cent iron oxides may be tolerated but there must be a complete absence of tourmaline, biotite, and any other dark mineral that will leave specks in the product.

Markets, Prices and Tariffs

International Minerals and Chemical Corporation (Canada) Limited, 512 Victoria Bldg., Ottawa, is the principal purchaser of crude feldspar of all grades in Canada. Bon Ami Limited, 13719 Notre Dame St. E., Montreal, purchases white spar for cleanser use.

Buyers of dental-grade spar include Myerson Tooth Corporation, Cambridge, Massachusetts; Dentists' Supply Company, 220 W. 42nd. St., New York, N.Y.; and Universal Dental Company, Brown at 48th St., Philadelphia, Pa.

The declared unit value of feldspar (95 per cent of which was ground, the remainder crude) exported in 1955 was $26.73 per short ton.

United States year-end prices, per ton, bulk, f.o.b. point of shipment N.C., as quoted in E & M J Metal and Mineral Markets Bulletin, were: 200 mesh, $18.50; 325 mesh, $22.50; No. 18 grade, $12.50; semi-granular, $11.75.

The duty on crude feldspar entering United States is 12 1/2 cents per long ton and on ground feldspar 7 1/2 per cent ad valorem.

The Canadian tariff is as follows:

Crude - Free
Ground -
British preferential - Free
Most favoured nation - 15% ad valorem
General - 30% ad valorem

Note: Import duties are subject to revision at any time and should be verified at the time shipment is being considered.

FLUORSPAR

By G. F. Carr

Production (shipments) of fluorspar in Canada in 1955 reached a new high of 128,114 tons valued at $2,708,437, compared with the previous high of 118,969 tons valued at $2,987,026 in 1954. Over 99 per cent of the output came from Newfoundland and the remainder from Ontario. Exports, all to the United States, reached an all-time high of 38,958 tons, an increase of 12 per cent over that of 1954, the previous record year. Imports totalled 21,774 tons, as compared with 16,240 tons in 1954 and 20,161 tons in 1953, and came mainly from Mexico, Spain, the Union of South Africa, and the United States.

Producers

There was no production at the Kilpatrick mine of Huntingdon Fluorspar Mines Limited in Ontario during 1955. Shipments were confined to ore produced in the previous year. In Newfoundland, as before, there were two producing companies -- St. Lawrence Corporation of Newfoundland Limited and Newfoundland Fluorspar Limited.

St. Lawrence Corporation operated four properties, with the Iron Springs mine supplying 39.6 per cent of the 112,730 tons hoisted; output from the others was, respectively: from Number 2- 25.5 per cent, from Number 3- 22.7 per cent, and from Lord and Lady Gulch - 12.2 per cent. From this 112,730 tons, the company recovered 62,684 tons of heavy-media concentrate (sub-metallurgical grade), 58,443 tons of which was shipped to Wilmington, Delaware, U.S.A., where it received beneficiation in a flotation mill operated by an affiliated company, St. Lawrence Fluorspar Incorporated; no other shipments were made.

Newfoundland Fluorspar Limited, a subsidiary of Aluminum Company of Canada Limited, operates the Director mine, one and one-half miles west of St. Lawrence. Ore hoisted during the year amounted to 123,055 tons, from which was produced 78,091 tons of heavy-media concentrate (sub-metallurgical grade). Shipments were 71,049 tons to Arvida, Quebec.

Fluorspar - Production, Trade and Consumption

	1955 Short Tons	1955 $	1954 Short Tons	1954 $
Production (shipments)				
Newfoundland	127,384	2,678,641	118,065	2,946,896
Ontario	730	29,796	904	40,130
Total..................	128,114	2,708,437	118,969	2,987,026
Imports				
Mexico................	9,690	233,703	10,798	222,110
Spain	5,815	111,053	-	-
Union of South Afrcia ...	3,155	69,007	-	-
United States...........	2,825	92,350	3,115	100,618
United Kingdom	289	11,889	2,327	60,207
Total..................	21,774	518,002	16,240	382,935
Exports*				
United States	38,958	1,495,181	34,756	1,458,529
Consumption				
Heavy chemicals and white-metal alloys	68,628		63,766	
Steel furnaces	18,610		16,002	
Glass	592		757	
Enamelling and glazing..	97		85	
Total..................	87,927		80,610	

* From "United States Imports of Merchandise for Consumption".

Fluorspar Reserves in Newfoundland

While no accurate estimate of Newfoundland's reserves of fluorspar has been made, they are known to be very large, and may be classed as among the most important in the world. Fluorite mineralization in the St. Lawrence area is known to extend for as much as three miles longitudinally, and, at depths up to 890 feet, no significant changes in grade or width are noted. The higher-grade veins average four to five feet in width and have a fluorite content of 95 per cent or more, with a silica content of one to four per cent, while the lower-grade veins run from 15 to 20 feet in width, and have a fluorite content of about 75 per cent, with silica ranging from 10 to 15 per cent. Some forty veins have been located to date, many of which have been untouched, and none of which have been completely traced longitudinally or vertically.

Other Occurrences

Deposits of fluorspar occur in Ross township, Renfrew county, Ontario; Huddersfield township, Pontiac county, Quebec; in the Lake Ainslie district, Cape Breton Island, Nova Scotia; and near Grand Forks, British Columbia.

An occurrence of fluorite in association with witherite, barite, and quartz was located in 1953 at Lower Liard River Crossing in northern British Columbia. The occurrence is reported to be extensive, and is being explored by Conwest Exploration Company Limited.

Uses and Specifications

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

In United States, the largest consumer is the steel industry, which also consumes substantial quantities of hydrofluoric acid and sodium fluoride. The next largest use is in the manufacture of hydrofluoric acid.

Standard fluxing gravel, or lump grade, for metallurgical use is usually sold on a specification of a minimum of 85 per cent CaF_2, and maximum of 5 per cent silica and 0.3 per cent sulphur. Fines should not exceed 15 per cent.

Glass and enamel grades call for not less than 95 per cent CaF_2, with maxima of 2 1/2 to 3 per cent SiO_2 and 0.12 per cent Fe_2O_3. The material must be in mesh sizes ranging from coarse to extra fine.

Acid-grade spar has the most rigid specifications, namely a minimum of 97 per cent CaF_2 and not over one per cent silica. Like the ceramic grade, it is used mainly in powder form.

Prices

Canadian prices of ceramic grade fluorspar as quoted by Aluminum Company of Canada f.o.b. Arvida, Quebec, and published in the December 29, 1955, issue of The Northern Miner were as follows:

Ceramic grade, coarse, in 100-lb bags: minimum carload or truckload, $61.50; L.C.L. to one ton $70.70; less than one ton, $76.85. In bulk: minimum carload or truckload, $57.75.

Ceramic grade, fine, in 100-lb bags: minimum carload or truckload, $63.50; L.C.L. to one ton, $73.00; less than one ton, $79.35. In bulk: minimum carload or truckload, $59.75.

Specifications: 95 per cent CaF_2 minimum with maximum 2.5 per cent $CaCO_3$, 2 per cent SiO_2 and 0.1 per cent Fe_2O_3.

United States year-end prices, as quoted in E & M J Metal and Mineral Markets Bulletin, were as follows:

Metallurgical grade, effective units CaF_2 content, per short ton, f.o.b. shipping point Illinois and Kentucky: 72 1/2 per cent, $33.00; 70 per cent, $32.00; 60 per cent plus, $28.00; and pellets, 60 per cent, nominal. "Effective units" are computed at the actual CaF_2 content less 2 1/2 times the percentage of contained silica.

Acid-grade concentrates, per short ton, bulk, carload lots, f.o.b. Rosiclare, Illinois, $47.50.

Ceramic grade, 93-94 per cent CaF_2, calcite and silica variable, Fe_2O_3-0.14 per cent, $41.00 per short ton, in bulk, f.o.b. Rosiclare. In 100-lb bags, $4.00 extra.

European fluorspar c.i.f. U.S. ports, duty paid, per short ton: Metallurgical, 70 per cent effective CaF_2, $32.00 to $34.00; acid grade, $50.00 to $52.50, nominal.

Mexican fluorspar, f.o.b. border, metallurgical, 72 1/2 per cent effective CaF_2 content, all rail, duty paid, $25.75 per short ton; barge, Brownsville, Texas, $27.50 to $27.75.

Tariffs

The duty on fluorspar entering United States is $1.875 per short ton if it contains more than 97 per cent CaF_2, and $7.50 per short ton if it contains 97 per cent or less. Fluorspar enters Canada duty free.

GRANITE

By G. F. Carr

Production of granite in 1955 amounted to 5,618,940 tons valued at $9,666,592 as compared with the all-time high of 12,834,727 tons valued at $13,041,999 in 1954, and the previous high of 2,490,086 tons valued at $7,327,022 in 1952. The unusually high output of 1954 was due primarily to the large tonnage of granitic rocks used in the construction of the causeway linking Cape Breton Island with the Nova Scotia mainland. Quebec was the leading producer in 1955, contributing about 61 per cent of the total output. The other producing provinces were: British Columbia (22 per cent), Ontario (8 per cent), Nova Scotia (5 per cent), followed by New Brunswick, Manitoba and Newfoundland, in that order.

Exports of granite and marble (unwrought) in 1955, all to the United States, amounted to 6,019 tons valued at $92,796, representing a 26 per cent increase in tonnage and a 16 per cent increase in value over those of the previous year - the largest quantity exported since 1916, when shipments were

15,967 tons valued at $7,989. Imports, mainly from the United States, Sweden, Western Germany, and Finland, amounted to $661,788, as compared with the all-time high of $716,152 in 1954.

Production of Canadian granites for building purposes is fairly well established, and the many splendid granite buildings already erected across Canada bear witness to the excellent quality of material available. The granites quarried in many parts of Canada compare favourably with those produced elsewhere, and no difficulty should be encountered by an architect or contractor in obtaining suitable material of almost any colour desired. Canada also produces a wide variety of monumental stone - the equal of many of the imported stones - and this branch of the industry is increasing steadily in spite of competition from the better-known, lower-priced imports. To acquaint architects, building contractors, monument dealers, and the public at large with the merits of the various types of granites available in Canada, the Mines Branch has recently issued a 191-page report "The Granite Industry of Canada". The report is obtainable from The Queen's Printer, Ottawa, at $3.50 a copy.

In the stone industry, the term 'granite' covers all compact igneous rocks, as well as metamorphic rocks of igneous origin, adaptable to commercial use; thus, anorthosites, syenites, diorites, andesites, gneisses, and other related rocks are known to the trade under the general name 'granite'. 'Black granite' is merely a trade name employed to distinguish the darker-coloured commercial stones of igneous origin. These rocks are rarely true granites in the mineralogical sense. Stones so designated are not necessarily black, but may be of varying shades of dark grey or dark green.

Occurrences and Producing Areas

Newfoundland

Granite deposits suitable for dimension stone are widespread in Newfoundland, but they have been utilized only on a small scale for local buildings, bridge abutments, and paving. Quarrying has been confined mainly to the Petites (Rose Blanche) area of the southwest coast, the south side of Conception Bay, and to several points along the railroad. There has been little production, if any, in recent years and at present the industry is at a standstill.

Nova Scotia

Although granite quarrying has been carried on in Nova Scotia for many years, no extensive development has yet taken place, probably because of limited local markets and lack of variety and quality of the granite types. The high output in 1954 was a temporary effect of the construction of the causeway linking Cape Breton Island with the mainland. The granites of the province are mainly grey in colour and medium to coarse in texture. Black diorite is also available. Grey granite is produced in the Nictaux and Shelburne areas, and black from the Shelburne area.

New Brunswick

Extensive masses of granite occur in several areas of New Brunswick, the greater part suitable for one form or another of construction. In a number of places the stone is of monumental grade. These granites are greatly diversified, not only in texture which varies from the finest grain to extremely coarse, but also in colour, various shades of grey, green, black, and dark red to the lightest pink being available. Each type of stone has its special characteristics, and there is scarcely a use for granite that cannot be

Granite - Production and Trade

	1955		1954	
	Short Tons	$	Short Tons	$
Production by type				
Monumental and building granite				
Rough	12,093	339,065	22,601	387,478
Dressed	22,880	2,679,416	29,327	3,069,822
Total	41,973	3,018,481	51,928	3,457,300
Rubble and riprap, roofing granules, concrete aggregate, road metal, etc.	5,576,967	6,648,111	12,782,799	9,584,699
Total	5,618,940	9,666,592	12,834,727	13,041,999
Production by provinces				
Newfoundland	628	4,710	1,896	14,220
Nova Scotia	243,523	574,001	9,652,140	6,157,946
New Brunswick	281,203	459,107	11,803	58,176
Quebec	3,403,649	5,800,835	2,389,431	5,182,356
Ontario	444,140	1,013,510	276,944	675,444
Manitoba	860	4,057	9,500	9,500
British Columbia	1,244,937	1,810,372	493,013	944,357
Total	5,618,940	9,666,592	12,834,727	13,041,999
Exports, granite and marble (unwrought)				
United States	6,019	92,796	4,761	79,511
Imports, granite				
Rough				
United States		119,181		101,101
Sweden		78,522		87,925
Finland		23,399		19,514
Other countries		16,611		14,269
Total		237,713		222,809
Sawn				
United States		46,710		59,765
Finland		14,450		6,253
Sweden		10,479		13,611
Other countries		12,501		10,728
Total		84,140		90,357
Manufactures				
West Germany		135,762		151,607
Finland		96,967		111,313
Sweden		66,721		90,397
United States		35,896		39,801
Other countries		4,589		9,868
Total		339,935		402,986

satisfactorily met by one or other of the granite districts of this province. Despite this the industry has remained comparatively small for many years. At present, operations are confined to the Hampstead (Spoon Island) district, where a pinkish-tinted grey granite is being quarried on a small scale, mainly for monumental use; to the Bathurst district, where a reddish-grey granite is quarried intermittently for the local building trade; and to the Antinouri Lake district, where a pink granite is being quarried for building purposes.

Quebec

For many years Quebec has been the leading producer of granite in Canada. Its displacement from that position in 1954 by Nova Scotia was due only to the temporary increase in Nova Scotia's output for the causeway construction.

Most of the production comes from the Eastern Townships south of the St. Lawrence River where a highly developed industry is based on the production of a light grey granite. North of the river, the resources of granite are more varied but the industry is less developed. At present there are at least ten important granite-producing areas in the province.

The Precambrian Shield occupies most of the province north of the St. Lawrence. In the deposits already opened, these Precambrian rocks provide a wide variety of colour, composition, and texture, and it is believed that many good deposits remain to be found. Thus, there are the blacks, pinks, browns, and reds of the Lake St. John region; the reds, greens, and greys of the Rivière-a-Pierre district; the pinks of Guenette; the banded gneisses of St. Raymond; the blacks and pinks of Rouyn; and the reds and greens of the Grenville area.

South of the St. Lawrence, the granites are considerably more recent in age than those of the Precambrian Shield and they occur as a large number of comparatively small isolated deposits. The stones have little variety in colour and all may be considered as grey granites, although they may have differences in composition and texture. Production comes from the Stanstead, Stanhope, Scotstown, St. Gerard, St. Samuel, and St. Sebastien areas. At Mount Johnson, a dark, mottled, grey granite of medium texture is being produced.

Ontario

Although Ontario contains large granite areas with numerous outcrops, these have not been exploited to any great extent. Activity is confined to production of a medium-grained black granite in the River Valley area, a medium-grained red granite in the Vermillion Bay area, and a coarse-grained red granite in the Lyndhurst area.

Manitoba and Saskatchewan

Granites, granite-gneisses and allied rocks of Precambrian age occupy a large part of eastern and norther Manitoba, northern Saskatchewan, and the extreme northeastern corner of Alberta. Very little of the region, however, is served by rail and road communication, and the only activity of consequence in recent years has been in the West Hawk Lake area, 100 miles east of Winnipeg, where small amounts of grey and black granite are quarried intermittently.

British Columbia

British Columbia has large areas of igneous rocks, many of which are traversed by the principal roads and railroads, or are along the Pacific Coast and thus close to water transportation. The predominant type being quarried consists of grey granites of varying shades, but in a few localities stone of other colour has been or is being worked in a small way. At Nelson Island, a high-quality light-grey granite is being produced, and at Haddington Island another highly desirable building stone, an andesite, is being quarried. Granite quarrying in the interior of British Columbia is small and intermittent and confined to areas near Nelson and Sirdar.

Uses and Specifications

Granite is quarried chiefly for the building and monumental trades. Most other uses are secondary, as they utilize the waste material left after extraction of building and monumental stone. Such uses include concrete aggregate, road metal, breakwaters, poultry grit, stucco dash, and rubble retaining walls. However, in some cases granite quarries are opened for the sole purpose of supplying concrete aggregate or road metal.

For building purposes the stone must have an even texture, be of uniform composition, and have a pleasing and lasting colour. For use in polished form in base courses and trim, the granite should be of the same quality as monumental stone but when other finishes are employed the specifications need not be quite so rigid. Iron is at all times an objectionable constituent, as it will sooner or later cause disfiguring stains. For massive structures, a coarse-textured stone may be used with pleasing effect, although fine-textured stones are also in demand.

The specifications for monumental granite are more rigid and exacting, and only stone of the highest quality is used for this purpose. The stone must be free from flaws such as cracks, knots, hair lines, iron spots and any other imperfections that would mar its beauty. The texture and composition must be uniform, and the colour must be pleasing. The stone must be capable of taking and retaining a high polish, and there must be a good contrast between the different finishes such as polished and hammered surfaces. It is probably true to say that a good monumental stone will always make a good building stone whereas a good building stone will not necessarily make a good monumental stone.

A special use for granite is in the manufacture of granite press rolls for pulp and paper machines. Granite for this purpose should be fine-grained, hard, of uniform close texture, of high tensile strength, and free from soft spots and sulphides that might be acted upon by any residual chemicals remaining in the paper stock. Mica is undesirable as, besides being soft, it seems to have an affinity for the paper. Colour is unimportant, but the stone should be capable of taking a high polish.

GRAPHITE

By G. F. Carr

There was no production of graphite in 1955. Production ceased in 1954 with the closing of the Black Donald mine, near Calabogie, Ontario, for many years the sole Canadian producer. Exports, to the United States and Australia, amounted to 7 tons valued at $761, as compared with 2,156.3 tons valued at $199,612 in 1954.

Artificial graphite is produced by Electro Metallurgical Company of Canada Limited, Welland, Ontario.

Total value of graphite imports (all kinds) for 1955 was $829,056, a 9 per cent increase over that of the previous year. Unmanufactured graphite came principally from United States, Mexico and Norway; ground and manufactured from United States, Western Germany, and United Kingdom; and crucibles, from United States and United Kingdom.

During the year McKenzie Red Lake Gold Mines formed a subsidiary company Gleneagle Graphite Mines Limited to develop its graphite property near Maynooth station on the C.N.R., some 18 miles north of Bancroft, Ontario. The deposit is being explored by diamond drilling and stripping.

Another promising graphite deposit, undergoing current investigation by diamond drilling, is that of Dun Raven Mines Limited. The deposit is situated in Thorne and Clarendon townships, Pontiac county, Quebec, about 10 miles north of Shawville and 50 miles from Hull.

Up to the present, Canada's graphite production has consisted mostly of small flake and amorphous grades derived from widely separated deposits in the area of the Gatineau and Lievre Rivers north of Ottawa, and in adjacent portions of Ontario. Graphitic shales and schists are common in the Maritime Provinces and in British Columbia.

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

Uses and Specifications

Natural graphite is used mainly in the form of crucibles, foundry facings, and other refractories, in the iron and steel industry (the largest user), and in the paint industry as a pigment and anti-corrosive element in protective coatings. Graphite is used widely as a lubricant particularly under high-temperature and corrosive conditions, as a conductive filler for dry batteries, 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. Graphite has been used recently as a moderator in atomic piles.

Artificial graphite, which is made from petroleum coke or anthracite by electric-furnace treatment, is used in the manufacture of electrodes, brushes, and other special shapes. In powdered form it competes with natural amorphous graphite in paints, polishes, foundry facings, boiler compounds, etc., and particularly where high purity is desirable, as in dry batteries.

Graphite - Production and Trade

	1955		1954	
	Short Tons	$	Short Tons	$
Shipments by types				
Amorphous foundry grades	-	-	2,202	197,278
Dust grades	-	-	118	20,454
High-grade lubricating & pencil grades	-	-	143	36,802
Total	-	-	2,463	254,534
Exports, crude and refined				
United States	6	501	2,156	199,535
Australia	1	260	0.3	77
Total	7	761	2,156.3	199,612
Imports				
Unmanufactured				
United States		29,413		28,975
Mexico		21,030		15,969
Norway		13,697		8,899
Madagascar		658		275
Other countries		-		267
Total		64,798		54,385
Ground and manufactured				
United States		518,497		518,586
Western Germany		20,360		6,590
United Kingdom		17,642		20,242
Other countries		4,895		3,406
Total		561,394		548,824
Crucibles				
United States		101,524		56,939
United Kingdom		101,340		99,577
Total		202,864		156,516
Total Imports		829,056		759,725

	1955	1954
	Short Tons	Short Tons
Consumption		
Polishes and dressings	11	11
Paints	55	52
Brass and copper products	20	24
Electrical apparatus	685	356
Heavy chemicals	344	248
Boiler, tank and plate works	4	4
Steel ingots and castings	808	537
Farm implements	5	1
Railway rolling stock	39	210
Machinery	89	59
Iron castings	402	253
Cooking and heating	15	19
Ferroalloys	250e	300e
Asbestos products	14	7
Explosives	1	21
Miscellaneous products	397	224
Total	23,139	2,326

e - estimated

Carbon content, mesh size, and type (flake, crystalline, or amorphous) 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 recipes developed and protected by the manufacturers.

No universal code of specifications is recognized, but those for No. 1 crucible flake usually required 85% or 90% carbon, through 20-mesh on 60- or 90-mesh. For lubricants, the requirement is usually a minimum of 95% carbon. In general, the demand is for material containing at least 70% 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 St., New York, N.Y.; and George F. Pettinos Inc., 1206 Locust St., Philadelphia 7, Pa.

Prices

No regular market quotations for graphite in Canada were published during the year.

Prices prevailing in the United States, as published in E & M J Metal and Mineral Markets Bulletin, were unchanged from the previous year as follows: United States - f.o.b. shipping point, per pound: crystalline flake - 13¢

to 26 1/2¢; amorphous, up to 85% C, - 9¢; Madagascar c.i.f. New York, standard grades 85 to 87% C, - $235 per ton, special mesh - $260 per ton; amorphous, Mexican, f.o.b. point of shipment (Mexico), per metric ton - $9 to $16 depending on grade.

Tariffs

Canada	British Preferential	Most Favoured Nation	General
Graphite, not ground or otherwise manufactured.....	free	5%	10%
Graphite flakes	5%	5%	25%
Graphite, ground and manufactured..............	15%	20%	25%
Graphite foundry facings	15%	22 1/2%	25%
Graphite crucibles	free	15%	15%
Graphite bearings for use in automobiles and motor vehicles, etc:			
Of a class not made in Canada	free	free	30%
Of a class made in Canada .	free	17 1/2%	30%

United States

Amorphous - 5% ad val.
Crystalline chip, dust or lump - 7 1/2% ad val.
Crystalline flake, valued per lb:
Under 2 3/4¢ - 0.4125¢ per lb
2 3/4¢ or more but not over 5 1/2¢ - 15% ad val.
Over 5 1/2¢ per lb - 0.825¢ per lb.

GYPSUM AND ANHYDRITE

By R. K. Collings

Crude gypsum production amounted to 4,667,901 short tons, an increase of 18 per cent over 1954. This increase was due, in part, to the establishment of a new gypsum-quarrying operation near Milford Station, Nova Scotia, which commenced production in June 1955.

Exports of gypsum and gypsum products were 3,039,289 short tons in 1955 - approximately 65 per cent of the output. Practically all of this was in the form of crude gypsum for markets in the United States.

Imports of gypsum and finished gypsum products were 42,040 short tons. Approximately 60 per cent of this was in the form of manufactured plaster and plaster products, the remainder was crude gypsum imported by consumers in western Canada.

Occurrences of Gypsum

Gypsum deposits of economic size and quality occur in all provinces, with the exception of Prince Edward Island and Saskatchewan.

The largest deposits known in Canada occur in the Maritime Provinces. These deposits are flat-lying and are generally covered with from 0 to 15 feet of overburden. They are quite pure and measure up to 50 feet or more in thickness. The Nova Scotian deposits are widespread in occurrence being found at many places in the northern half of the province and on Cape Breton Island. The chief gypsum deposits of New Brunswick occur in the southeastern section of the province in the vicinity of Hillsborough. The Newfoundland deposits are confined to the Bay St. George area in the southwestern section of the island.

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 are quite thick, measuring 50 feet or more in places.

Gypsum is found in a number of localities in Ontario, chief of which are the Moose and Grand River areas. The deposits in the Moose River area in northeastern Ontario measure 15 to 20 feet or more in thickness and are covered with 10 to 30 feet of overburden. In the Grand River area in southern Ontario, gypsum occurs as narrow underground seams at depths of 0 to 200 feet.

Large gypsum deposits occur in two of the three Prairie Provinces. In Manitoba, the main occurrences are located 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. White massive seams totalling 115 feet in thickness have been found near Dominion City in southern Manitoba at a depth of over 300 feet. In Alberta, the chief occurrences are found in the northern part of the province in the McMurray and Peace River districts. At McMurray, 130 feet of gypsum occurs at a depth of 500 feet while shallow, 10- to 15-foot seams are found along the banks of the Peace River north of the town of Peace River.

In British Columbia, the chief gypsum deposits occur near Kamloops and Cranbrook, in the southern section of the province. Many occurrences have been noted in the vicinity of Kamloops, chief of which is the Falkland deposit. Here, massive, white to grey beds are found in mountain-side deposits. In the Cranbrook area, gypsum has been found at many locations including Mayook, Wardner, and Canal Flats.

Production and Trade of Gypsum

	1955 Short Tons	1955 $	1954 Short Tons	1954 $
Production, crude gypsum				
Nova Scotia	3,838,847	6,061,922	3,168,134	5,235,581
Ontario	366,416	808,424	357,432	822,094
Manitoba	176,005	291,708	162,037	273,180
British Columbia	150,078	383,934	147,310	421,734
New Brunswick	90,096	315,336	88,856	217,697
Newfoundland	46,459	175,829	26,653	124,385
Total	4,667,901	8,037,153	3,950,422	7,094,671
Exports				
Crude Gypsum				
United States	3,039,192	4,930,626	2,830,945	4,204,603
Plaster of paris, wall plaster				
United States	85	3,083	157	6,221
Other countries	12	258	14	367
Total	3,039,289	4,933,967	2,831,116	4,211,191
Imports				
Crude Gypsum				
United States	10,174	71,206	4,795	45,857
Mexico	5,890	51,309	-	-
United Kingdom	40	1,341	163	5,370
Plaster of paris, wall plaster				
United States	25,676	591,543	19,108	416,889
United Kingdom	260	3,989	72	1,182
Sweden	-	-	2	303
Total	42,040	719,388	24,140	469,601

Producers of Gypsum

Nova Scotia

Nova Scotia, the chief producer, accounted for 83 per cent of the total Canadian production in 1955. Most of the crude gypsum quarried in the province is exported to the United States. Small percentages are used in the manufacture of plaster at Windsor, Nova Scotia, and for the manufacture of plaster and wallboard at plants located in Montreal, Quebec.

Gypsum is quarried at Wentworth, near Windsor, for export by the Canadian Gypsum Company Limited, a subsidiary of the United States Gypsum

Company of Chicago, Illinois. The Canadian Gypsum Company is the largest producer in Canada.

National Gypsum (Canada) Limited, a subsidiary of the National Gypsum Company of Buffalo, New York, is the second largest producer. This company operates quarries at Walton in Hants county, and at Milford Station, about 30 miles north of Halifax. Crude gypsum from these quarries is exported to the United States.

Little Narrows Gypsum Company Limited, with head offices in Toronto, operates a gypsum quarry at Little Narrows on Cape Breton Island. Gypsum from this quarry is shipped to the United States and to Montreal where it is used in the manufacture of plaster and plaster products.

Windsor Plaster Company Limited of Windsor operates the only calcining mill in the province. Gypsum from quarries at nearby Brooklyn is calcined at the Windsor plant and shipped to various consumers in Nova Scotia and eastern Quebec and Ontario.

Ontario

Gypsum is mined at Hagersville and Caledonia in the southern section of the province. In 1955, Ontario produced about 7 per cent of the total Canadian output.

Canadian Gypsum Company Limited operates the mine at Hagersville. Gypsum from this mine is used in the manufacture of plaster and wallboard at Hagersville.

Gypsum, Lime and Alabastine, Canada, Limited, with head offices in Toronto, operates a mine at Caledonia. Rock from this mine is used at Caledonia in the manufacture of plaster and wallboard.

Manitoba

Gypsum is mined from an underground deposit at Amaranth by Western Gypsum Products Limited, a subsidiary of British Plaster Board (Holdings) Limited of London, England. Gypsum from this deposit is shipped by rail to Winnipeg, Manitoba, and Calgary, Alberta, where it is used in the manufacture of plaster and wallboard in company-owned plants.

Gypsum is quarried at Gypsumville, Manitoba, by Gypsum, Lime and Alabastine, Canada, Limited for use in the manufacture of plaster and wallboard at its Winnipeg plant.

British Columbia

Two gypsum firms are presently operating in British Columbia. Gypsum, Lime and Alabastine, Canada, Limited quarries gypsum at Falkland for use in its plaster and wallboard plant at Port Mann, British Columbia, and its plaster plant at Calgary, Alberta. Columbia Gypsum Company Limited, with head offices in Vancouver, operates a quarry at Windermere. Crude gypsum from this quarry is used in the manufacture of cement at plants in Bamberton, British Columbia, and Exshaw, Alberta. Gypsum from this quarry is also shipped to Spokane, Washington, where it is processed in a company-owned plant and sold as agricultural gypsum or, if calcined, as plaster of paris.

New Brunswick

Gypsum is quarried at Hillsborough by Canadian Gypsum Company, Limited for use in the manufacture of plaster and wallboard at a company-owned plant in Hillsborough.

Newfoundland

Gypsum wallboard and plaster is produced by Bellrock Gypsum Products Limited of Glasgow, Scotland, at a government-owned plant located in Humbermouth on Newfoundland's western coast. Crude gypsum for this operation is obtained from a quarry, also government-owned, at Flat Bay Station, 62 miles by rail southwest of Humbermouth. Atlantic Gypsum Limited, which formerly operated the gypsum plant and quarry, was purchased by Bellrock Gypsum Products Limited in 1955.

Other Gypsum 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.

Alberta

Gypsum, Lime and Alabastine, Canada, Limited produces plaster at its plant in Calgary, using raw gypsum obtained from company quarries at Falkland, British Columbia.

British Plaster Board (Holdings) Limited, through its subsidiary Western Gypsum Products, Limited, manufacturers plaster and wallboard at a plant in Calgary. Raw gypsum for this plant is obtained from the company's mine at Amaranth, Manitoba.

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 used extensively in the building construction industry.

Crude, uncalcined gypsum is used as a retardant in portland cement, as a filler in paint and paper, and as a soil conditioner and fertilizer.

Gypsum and anhydrite are potential sources of sulphur compounds. In Europe gypsum or anhydrite is calcined at 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. To date, gypsum and anhydrite are considered to be uneconomical sources of sulphur and sulphur dioxide in Canada. However, the discovery of better methods of utilizing gypsum and anhydrite for this purpose may eventually open the way to new Canadian uses for these minerals.

Prices

The nominal price of crude gypsum in 1955 was $3.00 to $5.00 per ton f.o.b. quarry or mine. However, large contracts with seaboard quarries were at prices much below these figures.

ANHYDRITE

Production of anhydrite in Canada is limited to quarries where its removal is essential to the continued production of gypsum. Anhydrite is used to a limited extent as a soil conditioner and is a potential source of sulphur compounds.

IRON OXIDE PIGMENTS

By T. H. Janes

Iron-oxide pigments are divided into two groups -- natural iron oxide pigments, commonly known as mineral-earth pigments, and chemically manufactured iron oxide pigments, known as pure or synthetic. Natural iron oxide pigments are generally prepared for market by washing, drying, grinding, blending, and calcining. Synthetic iron oxide pigments are made by one of two processes -- by the calcination of copperas or by the controlled oxidation of precipitated ferrous hydroxide. In Canada, the Sherwin-Williams Co. of Canada, Limited, is the sole producer of natural iron oxide pigments and Northern Pigment Company Limited, New Toronto, is the only producer of synthetic iron oxide pigments.

In addition to the mineral pigment market for natural iron oxide there is a second market for the bog iron ores from the Three Rivers area of Quebec in the manufactured gas industry. Here, crude air-dried iron oxide is used as a purifying agent to remove hydrogen sulphide and other unwanted gases from the stream before storage and distribution.

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The production of natural iron oxides from the area north and east of Three Rivers amounted to 7,702 tons valued at $162,512 in 1955 compared to 5,798 tons valued at $183,507 in 1954. Statistics show a considerable rise in the output of crude air-dried oxide used for cleaning gas and a decline in that of calcined oxide for pigment purposes. The production of synthetic mineral pigment is not presented in statistics.

Exports of mineral pigments, mainly to the United States, increased from 3,111 tons valued at $421,535 in 1954 to a new high of 3,623 tons valued at $448,363 in 1955. Imports of mineral pigments in 1955, according to Dominion Bureau of Statistics, totalled 986 tons valued at $66,007 compared to 1,052 tons valued at $61,418 in 1954.

Production in Canada

Sherwin-Williams operates two bogs to supply feed for its calcining plant at Red Mill, Quebec, about seven miles east of Three Rivers. The bogs near the mill, in Champlain county, were first operated as a source of paint pigment in 1888, when The Canada Paint Company built a small plant at Red Mill for treatment of the bog iron oxide ores; operations have been continuous since that time. The ore is removed from surface stockpiles at the mill, calcined at high temperatures (1200°F to 1400°F), and ground in burr mills in closed circuit with an air-classifier and ball mill for the oversize. The material, about 99.5 per cent minus 300 mesh, is packed for shipment in 400-pound barrels and 100-pound paper bags. Calcined iron oxide exported to the United States is not ground.

The only producer in 1955 of crude air-dried bog iron ore for purifying manufactured gas was Charles D. Girardin of Yamachiche, who operated a deposit in Champlain county about two miles west of St. Louis. Bog iron ore contains up to 70 per cent water by weight, but after air-drying the product carries from 15 to 25 per cent only. Specifications for bog ore for gas purification are not strict with respect to size of material, iron content, or silica, but clay content must be held to a minimum so that the material does not pack and clog in the purifying chambers.

Northern Pigment Company Limited, New Toronto, makes synthetic iron oxides from scrap iron by the ferrite process. The product from the chemical and oxidation reaction is a yellow colloidal hydrous iron oxide ($Fe_2O_3 . H_2O$) which is washed, dried, and ground for marketing as yellow oxide; or calcined in an oil-fired rotary kiln for shades from buff to deep red. A black pigment is also made by the company.

Formation of Bog Iron Ore Deposits

Bog iron ores are found in swamps, small lakes, and even in sluggish watercourses in layers of varying thickness mixed with peat, decaying vegetation, silica grains, and clay, and very rarely contain as much as 50 per cent iron on the dry basis. The term 'ochre', as opposed to bog iron ore or limonite, is commonly used to designate those forms of iron oxide and hydroxide, Iron Oxides - Production, Trade and Consumption

	1955		1954	
	Short Tons	$	Short Tons	$
Production (sales)				
Natural (crude and calcined)..	7,702	162,512	5,798	183,507
Imports, ochres, siennas, umbers				
United States	880	60,837	947	55,664
United Kingdom	86	4,182	105	5,754
France.....................	20	988	-	-
Total	986	66,007	1,052	61,418
Exports, natural and synthetic iron oxides				
United States	3,439	418,384	2,741	360,004
France.....................	100	16,702	143	22,328
Belgium	36	5,462	18	2,669
Mexico	8	1,343	69	9,601
Other countries	40	6,472	140	26,933
Total	3,623	448,363	3,111	421,535
Consumption, specified industries				
Coke and gas industry	6,835	70,675	9,167	100,240
Paint industry				
Calcined and synthetic iron oxide......................	2,298	407,762	2,190	389,588
Ochres, siennas, and umbers	221	55,745	212	52,691

generally mixed with clay, sand, and organic matter, that are used for the manufacture of polishing (jeweller's) rouge, as pigments for colouring concrete, roofing granules, floor tile, linoleum, oilcloth, plastics, and similar articles, and in making paint.

The principal mineral in these ores is limonite ($2Fe_2O_3.3H_2O$). Iron carbonate is frequently present and the amount of water in bog iron ores varies widely. Deposits are irregularly distributed in flat, low-lying ground where iron hydroxide has been precipitated from solution by chemical action and by certain organisms usually present in stagnant or sluggish water. The iron is taken into solution from the iron-bearing constituents of primary igneous rocks and from iron pyrites and magnetite by surface waters passing over the high ground surrounding the deposition basin.

Bog Iron Ore Occurrences in Canada

Quebec

In addition to the many bogs within a fifteen-mile radius to the north of Three Rivers, several other locations of iron oxide bogs in the province are on record. On the south shore of the St. Lawrence, across from Three Rivers, there are reported extensive deposits, but the beds are relatively thin and do not offer much promise. Other occurrences have been noted in Portneuf, Montmorency, Labelle, and Drummond counties, of which the most promising appears to be that in Labelle county.

Ontario

Small, shallow deposits have been reported on the east bank of the Abitibi river in Kennedy township, about eight miles east of Cochrane in northern Ontario. Quite small deposits have also been noted in Monmouth township, Haliburton county.

Western Canada

Deposits of ochre occur near Grand Rapids and Cedar Lake in Manitoba; at Loon Lake, 32 miles from St. Walburg on the C.N.R. in Saskatchewan; and at several locations in British Columbia. The Alta Lake deposit, formerly operated for the B.C. Electric Company, was mined out in 1949 and the Lomong deposit near the Pend d'Oreille river in south central British Columbia has not been operated for several years. Bog iron ore that might be suitable for the cleaning of manufactured gas occurs in the Peace River district but has not been mined.

Uses

Crude air-dried iron oxide is used to remove hydrogen sulphide from manufactured coal gas. It is a low-priced commodity and sells for about $4.50 a ton at the source.

Iron-oxide pigments are used as colouring agents in paints, linoleum, floor tile, oilcloth, wood stains and fillers, cement, stucco, mortar, and brick. They are used as colouring agents and fillers in imitation leather, shade cloth, shingle stain, paper, and cardboard. Finely ground, grit-free iron oxides are used in the manufacture of jeweller s rouge for polishing plate glass, optical glass, and metal. Siennas and umbers are used primarily in wood stains and fillers. An expanding market for red oxide pigments is in concrete for brick manufacture. The manufacture of artificially coloured roofing granules is absorbing increasing amounts of mineral-earth pigments.

Prices

The price of ochre, according to the E & M J Bulletin of December 1955, was quoted at $26.50 to $30.00 per ton, f.o.b. Georgia mines, packed in 100-lb paper bags; and f.o.b. Virginia mines at $24.50 to $25.50 per ton, for dark yellow ground to 300-mesh, in bags, and containing a minimum of 60 per cent ferric oxide.

The Oil, Paint and Drug Reporter lists the price of iron oxides per pound, in carload lots, in the United States at May 1, 1955 as follows: red - 11¢, black - 13 1/4¢, brown - 14¢, yellow - 10 3/4¢.

Quotations on iron-oxide pigments in Canada, per lb, f.o.b. Toronto, at the end of 1955, were reported to be: Pure Reds - 11¢, Pure Yellows - 9 3/4¢, 93% to 95% Reds - 8 1/2¢, Simulated Naturals - 4 1/4¢ to 6 1/4¢, and Brown 65% - 7 1/4¢.

Crude air-dried iron oxide for purifying manufactured gas sells from $4.50 to $5.00 a short ton at the producing bog.

LIME

By H. M. Woodrooffe

1955 was a peak year for Canadian lime production; 1,313,118 tons of hydrated and quicklime valued at $15,801,904 were produced compared with 1,214,839 tons at $14,742,149 in 1954.

The high level of industrial activity and building construction experienced by Canada during recent years is reflected in an increased demand for lime. Of the ten provinces, six are currently producing lime, and all but Prince Edward Island have deposits suitable for its manufacture. Dolomitic and calcium limes are produced in Ontario, Manitoba, and New Brunswick, while the output in British Columbia, Alberta, and Quebec is of the high-calcium variety. At the present time there are approximately 40 plants burning lime in nearly 150 kilns. These range in size from small shaft units to large-capacity rotary kilns; 20 of the latter are in operation at the present time.

Certain industrial plants burn lime for their own use as intermediate stages in a manufacturing process; examples are the production of cyanamide and calcium carbide, and the refining of sugar.

Although limestone deposits are plentiful in Canada, few are suitable for the economic production of a lime sufficiently high in calcium, low in impurity, and of white colour, for chemical uses.

Since it is a relatively low-priced commodity, lime is not generally an item of international trade. However local economic conditions favour export to the United States of Canadian lime on the West Coast and imports from that country on the East Coast.

Producers

New Brunswick

At the present time the only production of lime in the Maritime Provinces is from two plants in New Brunswick. One, Bathurst Power and Paper Ltd., burns lime at Bathurst for its own use in the manufacture of paper. Snowflake Lime Limited at Saint John is the other active producer.

Quebec

Shawinigan Chemicals Limited operates a lime plant at Shawinigan Falls burning a high-calcium stone quarried at Bedford, Missisquoi county. The lime is used principally by the company in the manufacture of calcium carbide.

Standard Lime Company Limited has in operation two plants at Joliette and at St. Marc des Carrières, Portneuf county.

Dominion Lime Limited burns a high-calcium stone at Lime Ridge in Wolfe county for the production of both quick and hydrated lime.

Aluminum Company of Canada Limited produces both quicklime and hydrated lime near Wakefield, during the recovery of magnesia from brucitic limestone.

There are five small producers in the province.

Ontario

Gypsum, Lime and Alabastine, Canada, Limited, produces quicklime and hydrated lime -- both dolomitic and high calcium. Its kilns are located near Beachville, Hespler, and Milton. The company is installing a rotary kiln at its Beachville plant.

North American Cyanamid Limited operates lime-burning kilns at Niagara Falls, Ontario, using stone quarried by the company at Beachville. The lime is used in the processing of cyanamide.

Brunner-Mond Canada Limited burns high-calcium limestone at Amherstberg for use in alkali manufacture.

Chemical Lime Limited, at Beachville, burns lime mainly for the iron and steel industry.

Six smaller plants produce lime in Ontario.

Manitoba

A dolomitic limestone is burned at Inwood by Building Products and Coal Company Limited.

Lime - Production, Trade and Consumption

	Short Tons	$	Short Tons	$
Production by type				
Quicklime	995,639	12,221,541	894,109	11,262,114
Hydrated lime	335,479	3,589,363	320,730	3,480,035
Total	1,331,118	15,190,328	1,214,839	14,742,149
Production by provinces				
New Brunswick	18,861	385,979	22,533	439,161
Quebec	461,805	4,448,525	445,892	4,371,797
Ontario	698,245	8,420,382	610,591	7,680,739
Manitoba	57,510	886,901	52,178	821,903
Alberta	38,335	553,526	32,599	493,303
British Columbia	56,362	1,115,591	51,046	935,246
Total	1,331,118	15,810,904	1,214,839	14,742,149
Imports, quicklime				
United States	24,697	278,766	26,131	282,768
United Kingdom	311	4,410	395	6,184
Total	25,008	283,176	26,526	288,952
Exports				
United States	29,031	537,647	30,814	550,983
Other countries	5	149	4	135
Total	29,036	537,796	30,818	551,118
Producers' shipments				
Building trades				
Finishing lime	89,769	1,760,307	91,336	1,755,371
Mason's lime	108,095	1,678,044	97,033	1,515,975
Industrial uses				
Non-ferrous smelters	171,220	852,994	163,154	886,127
Iron and steel plants	99,950	1,146,498	58,634	659,504
Cyanide and flotation mills	24,138	336,383	26,420	393,290
Pulp and paper mills	249,309	3,134,588	237,905	2,933,273
Glass works	19,058	219,110	14,735	142,764
Sugar refineries	28,940	361,076	27,434	339,105
Tanneries	6,011	74,637	5,750	74,857
Sand-lime brick	16,033	190,518	15,445	179,549
Insecticides, fungicides	141	966	482	5,239
Other industries	503,591	5,835,326	449,344	5,527,041
Agricultural	5,420	84,074	10,923	157,067
Other uses	9,433	136,383	16,244	172,987
Total	1,331,118	15,810,904	1,214,839	14,742,149

Winnipeg Supply and Fuel Company Limited produces a dolomitic lime at Stonewall and a high-calcium lime at Moosehorn.

The Manitoba Sugar Company Limited operates kilns at its Fort Garry plant.

Alberta

Lime is manufactured from high-calcium limestone by Loder's Lime Company Limited at Kananaskis and by Summit Lime Works Limited near Crowsnest, British Columbia.

Three refineries of Canadian Sugar Factories Limited burn lime for their own use.

British Columbia

The limestone properties and lime plants of Pacific Lime Company Limited at Blubber Bay, Texada Island, and Granville Island were acquired during the year by Gypsum, Lime and Alabastine, Canada Limited. High-calcium, quick and hydrated lime are produced by the company.

Crown Zellerbach, Canada, Ltd. burns lime at Ocean Falls for its own use in the manufacture of paper.

Uses and Marketing

Lime is a common raw material with wide industrial application. It is a plentiful and low-cost causticizing agent and base for acidity control. It is also important in the production of calcium compounds.

High-calcium lime is used in large quantities by the chemical and metallurgical industries. It is a basic raw material in the manufacture of calcium carbide and calcium cyanamide, and in the production of soda-ash, ethylene glycol, bleaches, citric acid, pharmaceuticals, and fine chemicals. In the manufacture of steel it is used for the removal of sulphur. Non-ferrous metallurgical applications include additions of lime during flotation of several minerals and for acidity control in the recovery of precious metals from their ores by the cyanidation process. It is used to some extent in the preparation of alumina from bauxite by the Bayer process.

It is of importance to the pulp and paper industry both as a causticizer in the sulphate and soda processes and in preparing calcium bisulphite dissolving liquor. It is used in the manufacture of glass, in tanning of leather, and in treatment of municipal waters. In the latter case it is useful in overcoming temporary hardness and turbidity. It is also used to neutralize acidic industrial and municipal wastes to reduce stream pollution.

The use of lime as plaster, stucco, and mortar by the building industry is well known. It is also a raw material in the production of lime-sand building bricks, cold-water paints, and some forms of insulation.

Agricultural uses of lime include its direct addition to soil to adjust acidity and to overcome calcium deficiency. It is also used in the preparation of some insecticides.

In Canada, lime is marketed both as the calcium oxide and the calcium hydrate, usually referred to as quicklime and hydrated lime respectively.

The former type is shipped in bulk in lump form or as crushed lime in bulk or containers; a small part is pulverized and shipped in bags. Hydrated lime, the dry slake form is sold as a fine powder (95 per cent passing 325-mesh), in containers, usually multi-wall bags.

Prices

Market prices for lime in the Montreal area during 1955 for hydrated lime in carload lots were in the range $15.00-$19.00 per ton.

LIMESTONE, GENERAL

By H. M. Woodrooffe

Canadian production of limestone in 1955 was 28 per cent greater than the previous year and established a new peak; 24,107,571 tons valued at $32,322,313 were quarried compared with 18,829,748 tons at $25,144,026 the previous year. Quarry output for the manufacture of portland cement and lime is not included in these figures.

Apart from a small production of dimension stone for building, Canadian limestone is marketed in crushed form in several sizes for a variety of uses. It is the most widely quarried of all native rocks and is used in large quantities as concrete aggregate, road building material, and railway ballast. The availability of deposits and ease of quarrying are the principal factors responsible for its wide use. Limestone is also an important raw material in several industrial processes. Although there are active quarries in all provinces, except Prince Edward Island and Saskatchewan, the indsutry is largely concentrated in southern Ontario and Quebec, which together account for 88 per cent of current production.

Limestone occurs in this country in two forms; in bedded formations, which yield most of the production, and in massive metamorphosed deposits. Its chemical composition varies from high-calcium through magnesian to dolomite. Deposits of siliceous and argillaceous varieties occur, as well as brucitic limestone and magnesitic dolomite. Deposits of the last two varieties are currently worked. High-calcium limestone, sufficiently pure to provide industry with an important raw material for use in certain chemical and metallurgical processes, is available in only a few areas.

Limestone - Production and Consumption

	1955		1954	
	Short Tons	$	Short Tons	$
Production by provinces				
Newfoundland	333,354	590,945	357,454	605,254
Nova Scotia	102,648	209,981	92,607	205,852
New Brunswick	423,619	609,226	116,132	299,038
Quebec	8,975,721	12,623,593	7,320,968	10,443,665
Ontario	12,233,730	14,765,784	9,816,205	11,346,494
Manitoba	227,297	1,112,276	198,056	693,552
Alberta	23,577	91,831	21,360	98,354
British Columbia	1,787,625	2,318,677	906,966	1,451,817
Total	24,107,571	32,322,313	18,829,748	25,144,026
Production by uses				
Structural*	89,525	2,796,244	89,555	2,764,426
Metallurgical	1,893,266	2,202,833	1,231,505	1,563,230
Glass making	17,662	43,840	15,968	27,992
Sugar refining	8,905	11,093	10,583	13,421
Pulp and paper.......	439,730	1,344,352	452,036	1,348,783
Other chemical uses..	63,371	65,910	29,676	25,444
Pulverized, agricultural and fertilizer...........	424,028	1,027,161	362,110	930,015
Pulverized, other	140,499	656,768	126,875	448,290
Rubble and riprap	410,457	402,322	296,509	321,589
Concrete aggregate...	8,203,448	9,834,144	6,358,862	7,387,487
Road metal	11,548,279	12,953,661	8,947,856	9,280,139
Rail ballast..........	753,412	756,524	569,128	597,428
Other uses	114,989	227,461	339,085	435,782
Total	24,107,571	32,322,313	18,829,748	25,144,026
Limestone used in manufacture of cement..............	6,033,619		5,436,225	
Limestone used in manufacture of lime ..	2,274,211		2,163,427	
Limestone, miscellaneous	24,107,571		18,829,748	
Total	32,415,401		26,429,400	

* Includes building, monumental, and ornamental stone, flagstone and curbstone.

Because of its abundance and low cost there is virtually no international trade in limestone. However, on the Pacific coast where geographic and economic conditions are favourable, it is exported to the United States for use in the manufacture of pulp and paper and as metallurgical flux.

Uses

Large quantities of limestone are crushed and marketed for road metal and for aggregate in concrete. During 1954, 81 per cent of all stone quarried was used in this manner.

Limestone is widely used by the metallurgical industry as a slag-making constituent in smelting processes. In the reduction of iron ore in the blast furnace, limestone is added to flux the siliceous impurities. It is the general practice to use a stone high in calcium and low in silica.

Limestone also finds application in the pulp and paper industry in the preparation of calcium bisulphite dissolving liquor. High-calcium varieties with little soluble impurity are preferred for this use. It is also used in the manufacture of glass and in sugar refining and is marketed in ground form for use as a mineral filler in several industrial processes.

Ground limestone generally referred to as "agstone" is added to agricultural soil to overcome calcium deficiency and correct acidity in the land. Canadian sales of agricultural limestone during 1954 amounted to $930,015.

High-purity dolomite quarried near Haley, Ontario, is used in the thermal ferrosilicon process as a source of magnesium metal. The latter is also made by a different process from magnesia obtained from brucitic limestone quarried near Wakefield, Quebec.

Dolomite is quarried and dead-burned at Dundas, Ontario, by Steetly of Canada Limited for use as a refractory material in basic open-hearth steel furnaces.

Magnesitic dolomite is mined at Kilmar, Quebec, and used in the manufacture of basic refractories. These are also made from magnesia recovered from brucitic limestone quarried near Wakefield, Quebec.

Limestone is the raw material used in the production of lime and is an important raw material in the manufacture of portland cement.

Geographical location, quality, and use all effect the price of limestone. As a commercial stone used as concrete aggregate, the price at the quarry is as low as $1.50 per ton, in some areas.

LIMESTONE, STRUCTURAL

By H. M. Woodrooffe

Production of structural limestone in Canada during 1955 increased slightly over the previous year; 88,202 tons valued at $2,785,523 were produced compared with 87,922 tons valued at $2,745,482. There was a marked increase in production from Manitoba, offsetting decreases in Ontario and Quebec.

In present day construction, structural or, as it is sometimes referred to, "dimension" limestone finds application principally in larger buildings. It is used for exterior facing, window sills, lintels, entrances, etc. Mill blocks of limestone are quarried and prepared in slabs and other shapes cut to accurate dimensions to enable the stone to be set in place without further dressing. When used for facing, the slabs may be as large as 4 feet by 2 feet and vary from 4 to 8 inches in thickness. For such sections the stone must be heavily bedded, free from cracks, fissures, and other flaws, and easily worked. Durability is necessary to resist the climatic conditions experienced during the Canadian winter season. Texture and colour must be pleasing.

Stone for larger buildings is quarried in rough blocks that may weigh as much as 10 tons and which are sawn into slabs in dressing sheds, either at the quarry or elsewhere. These slabs are cut and shaped to the exact dimensions required by the builder. Few occurrences of limestone in Canada are suitable for this use. There is a small production of hand-trimmed stone to provide facing, sills, etc., for use in residential and small-building construction.

In Quebec, the principal structural limestone quarries are located at St. Marc des Carrieres, Portneuf county. Three firms are operating, quarrying a stone of pleasing grey colour which finds a market in Ontario and Quebec. Dressing plants are located at each quarry. In the Montreal area, several small quarries are producing hand-trimmed stone for residential construction.

A heavily bedded section of the Lockport formation is quarried near Queenston, Ontario, for the production of mill blocks. This stone is in silver grey, and variegated buff and grey colours and is widely used in Eastern Canada in the construction of large public buildings.

There are three quarries operating near Tyndall, Manitoba, thirty miles northeast of Winnipeg. The stone is unique, possessing a distinctive mottling in buff and grey and is used both in exterior and interior work. It is sometimes polished to a pleasing finish for use as an interior decorative stone.

In addition to domestically quarried stone, Indiana limestone is imported in the form of rough blocks that are finished in Canadian dressing plants. Small imports are also received from the United Kingdom and Italy.

Structural Limestone - Production and Trade

	1955 Short Tons	1955 $	1954 Short Tons	1954 $
Production				
Rough	46,234	416,854	43,903	351,266
Dressed	41,968	2,368,569	44,019	2,394,216
Total	88,202	2,785,523	87,922	2,745,482
Production, by provinces				
Newfoundland	63	272	470	1,848
New Brunswick	575	1,725	150	300
Quebec	24,804	1,361,932	28,134	1,690,135
Ontario	51,267	637,347	53,766	623,641
Manitoba	11,493	784,247	5,402	429,558
Total	88,202	2,785,523	87,922	2,745,482
Imports, building stone				
United States	34,602	634,745	34,605	653,751
United Kingdom	45	1,956	125	6,666
Italy	24	2,482	-	-
Total	34,671	639,183	34,730	660,417
Exports, building stone, unwrought				
United States	279	9,420	228	8,492

Prices

The price of structural limestone in quarry blocks depends upon size, grade, texture, and colour of stone, and on quarry location. Domestic stone is marketed as low as $1.20 per cubic foot and imported stone varies between $1.00 and $1.75 per cubic foot at the quarry site.

MAGNESITE AND BRUCITE

By H. M. Woodrooffe

Canadian production of calcined brucite granules and magnesitic dolomite during 1955 amounted to $2,151,820, a 12.6 % increase from the previous year.

At the present time the only mineral deposits being worked as a source of magnesia are situated in Quebec province north of the Ottawa River at Kilmar, Argenteuil county, and at Farm Point near Wakefield, 22 miles north of Ottawa.

At Kilmar, Canadian Refractories Limited mines an underground deposit of magnesitic dolomite, an intimate mixture of magnesite and dolomite. Impurities are controlled by beneficiation and the milled product is calcined in a rotary kiln to a dead-burned clinker. From the latter a number of basic refractory products are manufactured. At Marelon, 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.

At Farm Point, The Aluminum Company of Canada Limited quarries a brucitic limestone. In this rock, granules of brucite, a hydroxide of magnesium, occur in the matric of calcite. The rock is crushed, sized, calcined, and separated into marketable forms of magnesia and lime. Part of the magnesia is used by the company at Arvida in the production of magnesium metal. The remainder is used in the manufacture of high-magnesia refractories, as a soil additive, and in other industrial applications. Both quick and hydrated lime are recovered in the process.

Other occurrences of brucitic limestone are known in Canada in the vicinity of Wakefield and Bryson, Quebec, Rutherglen, Ontario, and on West Redonda Island, British Columbia.

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 consequently are not worked. The more important of these occurrences are at Marysville, near Cranbrook, British Columbia, and are owned by The Consolidated Mining and Smelting Company of Canada, Limited.

Hydromagnesite occurrences near Atlin and Clinton, British Columbia, have been worked intermittently.

Uses

Magnesia is a raw material for the production of magnesium metal and of basic refractories. It is also used in the preparation of oxysulphate and oxychloride cements. The latter is a durable cement used principally as a floor covering, and is obtained by the reaction of active magnesia with a solution of magnesium chloride. Magnesia is also used in the pulp and paper industry 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. It is also used in processes for recovering uranium from its ores. Other uses for magnesia are in the preparation of a number of magnesium chemicals and compounds for use in the pharmaceutical trade, in industry, in soil additives, and to control acidity. An example of the last is its use in neutralizing sulphuric acid solutions where it forms a compound more soluble than that obtained with lime.

Magnesite and Brucite - Production and Trade

	1955 Short Tons	1955 $	1954 Short Tons	1954 $
Production				
Magnesitic dolomite and brucite		2,151,820		1,909,163
Imports				
Dead-burned and caustic calcined magnesite				
Yugoslavia	7,514	356,049	2,500	131,859
United States	6,349	488,478	3,545	263,021
Other countries	74	9,625	71	11,020
Total	13,937	854,152	6,116	405,900
Magnesite fire-brick				
United States		528,284		390,692
United Kingdom		16,412		6,881
West Germany		9,375		-
Total		554,071		397,573
Magnesia alba and levis				
United States	5,187	224,416	5,869	275,193
United Kingdom	90	42,586	162	64,698
Other countries	-	-	67	2,681
Total	5,277	267,002	6,098	342,572
Magnesia pipe covering				
United States		53,846		104,399
United Kingdom		38,551		35,157
Total		92,397		139,556
Magnesium carbonate and magnesium oxide				
United States	5,035	465,984	5,628	479,125
United Kingdom	462	67,878	400	55,835
Total	5,497	533,862	6,028	534,960
Exports				
Basic refractory materials, dead-burned				
Brazil	1,880	112,437	1,969	118,127
United States	1,105	67,676	4,694	361,984
Other countries	270	15,658	1,224	57,431
Total	3,255	195,771	7,887	537,542

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LITHIUM MINERALS

By V. A. Haw

Lithium developments during the year resulted in new levels of interest both in Canada and abroad. These were highlighted in Canada by the initial production of lithium concentrates from the mill of Quebec Lithium Corporation in northwestern Quebec; in the United States by the construction of a new plant in Texas to produce lithium chemicals, as well as greatly expanded production facilities at other locations; and, generally, by the association of lithium with the production of nuclear energy.

Quebec Lithium Corporation began producing spodumene (lithium aluminum silicate) concentrates late in the year from its new mine and plant in Lacorne township about 25 miles north of Val d'Or. Canada has thus become for the first time an important supplier of raw material to the lithium industry. The spodumene deposits of this property are considered to be the largest known in the world. The widespread interest in lithium and its potential uses sparked mining and exploration companies to intensify their efforts in search for, and development of, lithium deposits. The result has been the discovery of several occurrences in areas not previously known to contain lithium minerals, and vastly increased resources of lithium in the form of spodumene deposits.

Production and Trade

Quebec Lithium Corporation has made public the terms of a contract with Lithium Corporation of America to supply lithium concentrates. Two hundred thousand tons of concentrate with a minimum content of 4 1/2 per cent lithia is to be delivered at the rate of 165 tons per day. Price per unit of lithia (20 lb) is given as $11.00. The mill at the mine has been designed for a feed capacity of 1,000 tons per day; however, to the end of the year the rate was maintained at 500 tons during the breaking-in period.

In addition to the output of Quebec Lithium, a few small shipments of amblygonite (lithium aluminum phosphate) were made from the Northwest Territories to the United States, but further shipments seem unlikely in the foreseeable future.

Consumption of lithium products in Canada is not large. Estimated imports from the United States in the form of lithium carbonate and lithium hydroxide amount to $30,000 annually. Lithium carbonate and lithium hydroxide account for essentially all the consumption of lithium products in Canada.

Occurrences of Lithium Minerals in Canada

Quebec

Exploration drilling on the property of Quebec Lithium Corporation in the north portion of Lacorne township has indicated one of the largest spodumene deposits in the world. The main dyke has been traced for about two miles and, together with closely associated groups of parallel dykes, constitutes an orebody with reported indicated reserves of 15 million tons down to the 500-ft level. Mineralogy of the ore is relatively simple, consisting of spodumene, feldspar, quartz, and minor accessory minerals including magnetite, muscovite, and tantalite-columbite. Average lithia content has been calculated to be 1.2 to 1.3 per cent.

Underground development at the property consists of a shaft to a depth of 560 feet with three levels established. Stoping by blast-hole and shrinkage methods is under way on the first and second levels. The spodumene-bearing rock from the stopes is fed to a primary crusher located on the third level before being hoisted to the surface. Concentration of the spodumene is accomplished by froth flotation.

Other lithium-bearing dykes in the same general area are located in Lacorne, Figuery, and Landrienne townships. In most of the occurrences spodumene is the only lithium mineral present, although lepidolite has been reported occurring in some of the smaller dykes and lithiophilite has also been recognized as a minor accessory 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

New discoveries of spodumene-bearing dykes made in Ontario during the year increased potential reserves of lithia-bearing pegmatite by several million tons. The original discovery is located in the District of Thunder Bay at Georgia Lake, 10 miles east of McKirdy on the Long Lac-Port Arthur branch of the Canadian National Railways. Numerous other finds were made in the area, especially to the northwest toward MacDiarmid. Individual dykes upwards of ten feet wide have been traced for hundreds of feet. Mineralization in all occurrences in this area is similar; coarse green spodumene crystals occur with quartz and feldspar and minor muscovite. The spodumene has been described as being uniformly distributed in the dykes. Three different companies have reported reserves in excess of one million tons each with lithia contents ranging from 1.06 to 1.43 per cent.

In addition to the above, spodumene dykes were examined in the Root Lake area, 50 miles to the north of Sioux Lookout, and in the Falcon Lake area 14 miles to the north of the Canadian Pacific Railway half-way between Nakina and Armstrong. Work on these occurrences only started near the end of the year and as yet little is known of them except they are reported to contain very substantial tonnages of spodumene pegmatite.

Manitoba

In southeastern Manitoba numerous lithia-bearing dykes occur in the Winnipeg River - Cat Lake area. As in deposits elsewhere in Canada the principal mineral of interest is spodumene. However, in one dyke near Lamprey Falls on the Winnipeg River the lithium mica, lepidolite, is a prominent constituent, and east of Bernic Lake amblygonite occurs in a dyke in sufficient quantity to yield several tons by hand picking. In neither case has it been suggested that there is enough present to be economically important.

Companies have been active in the area and in properties east of Bernic Lake and northwest of Cat Lake tonnages of spodumene reserves in excess of eight million tons have been indicated by diamond drilling. Plans have been announced by two companies to sink shafts.

Spodumene-bearing pegmatite dykes also occur near East Braintree, 84 miles east of Winnipeg, and in the Herb Lake area of northern Manitoba. The Herb Lake property has recently been drilled and indicated tonnages in excess of five million tons containing 1.20 per cent lithia have been reported.

Northwest Territories

In the area lying to the northeast of Yellowknife for about 50 miles,and eastward along the north shore of Great Slave Lake as far as Hearne Channel, pegmatite dykes containing rare-element minerals are common. All the lithium minerals of commercial interest, as well as beryl and columbite-tantalite, have been reported as occurring in many of these dykes. Members of the Geological Survey of Canada who examined the area have particularly mentioned occurrences in the areas of Buckham Lake, Sproule Lake, and to the north of Hearne Channel, as having a high content of spodumene. Appreciable quantities of amblygonite have also been observed, in addition to minor occurrences of lithiophilite, lepidolite, and petalite.

World Survey of Resources and Production

There are four principal companies producing lithium chemicals, metals, and alloys in the United States. Raw material for this production is partly imported from Canada, Southwest Africa, Southern Rhodesia, Brazil, and Mozambique, and partly 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 dilithium phosphate, obtained as a by-product of other salt constituents. Present production of the latter in terms of lithium carbonate is estimated to be close to two million pounds, about one-fifth of American requirements for 1955.

Lithium mineral production in Africa consists mainly of lepidolite (lithium potassium aluminum silicate), petalite (lithium aluminum silicate), and amblygonite. Very large reserves of lepidolite and petalite are known to exist in Southern Rhodesia and Southwest Africa and the great bulk of production consists of these two minerals, although amblygonite is produced on a realtively small scale. A new six-and-a-half-million dollar chemical processing plant recently constructed in Texas uses imported lepidolite from Southern Rhodesia as raw material. These African sources supply lithium concentrate requirements of the United Kingdom and European countries also. Other countries too numerous to mention are also known to contain lithium mineral occurrences which have not yet been developed. Very large deposits of spodumene have been reported as occurring in the Belgian Congo.

Canada is exporting her entire output of spodumene concentrates to Lithium Corporation of America, Bessemer City, North Carolina, for conversion to lithium chemicals. Other plants producing lithium chemicals from concentrates are; Foote Mineral Company at Sunbright Virginia; American Potash and Chemical Corporation at Trona California (from the Searles Lake salt brine); American Lithium Chemicals Company, San Antonio Texas; Lithium Corporation of America, Minneapolis, Minnesota (in addition to their Bessemer City Plant); and the Maywood Chemical Works, Maywood, New Jersey. The entire capacity of these plants is estimated at between 20 and 25 million pounds of lithium carbonate equivalent. The United States accounts for well over 50 per cent of consumption of lithium concentrates. Present American requirements in terms of lithium carbonate are estimated at about 10 million pounds by commodity specialists in the United States. This would indicate a large excess of production capacity over consumption under present conditions.

Uses and Specifications

Lithium compounds find their most important application in the ceramic industry and for the manufacture of lubricating greases. Practically all lithium concentrates are converted chemically to lithium carbonate or hydroxide, which are the usual basic compounds used in industry. For chemical processing, the only specification available is for the spodumene that Quebec Lithium Corporation is exporting. A figure of 4 1/2 per cent lithia is required as a minimum in the concentrate. However, practically all products of lithium compounds either own outright or participate in the financing of mining properties from which they obtain concentrates, hence standard specifications have not been established and requirements are a matter of individual negotiation.

Although ceramics and greases account for most of the consumption of lithium compounds these have now become invaluable in many other fields of industry. The following table, reproduced from the Engineering and Mining Journal, September 1955, gives the estimated uses of lithium compounds.

	1953*	1955*
Pharmaceuticals	180	200
Storage batteries	260	550
Air conditioning and refrigeration	360	450
Lubricating grease........................	2500	3500
Welding and brazing flux	450	750
Ceramics................................	2000	3500
Defence and misc.	....**	....**

* In thousands of pounds of carbonate; E & M J estimates.
** Not available.

Lithium greases, only evolved in 1943, came to play an important role in lubrication wherever operational extremes of temperature were experienced. Such greases maintain their lubricating qualities between -60°F and +320° F, and, as well, have excellent water insolubility characteristics. In wartime, lithium greases were invaluable for aircraft engines. Since the war, their industrial use has grown rapidly because their unique combination of properties enables production of multi-purpose greases, simplifying both manufacture and application.

In modern ceramics, lithium's function is 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 ultra-violet 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; lithium chloride and bromide in air conditioning units, and in refrigeration systems; lithium fluoride as a flux in the welding and brazing of aluminum and for such other miscellaneous uses as the production of single-crystal optical units (lithium fluoride); the control of reactions leading to the formation of alkyd resins for use in paints, and the manufacture of dry-cell batteries which will function at extremely low temperatures where normal cells are inoperative.

The use of lithium as a metal has so far limited applications. Its principal use appears to be as a scavenger of impurities in refining non-ferrous metals, and as a grain-refining agent. Only very small amounts are added for this purpose. Lithium alloys of magnesium, aluminum,copper, lead, and zinc are under development and have promise.

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 isotope Li^6 with neutrons. The association of lithium with solid fuels is apparently in the form of lithium hydride. This chemical compound furnishes a readily available source of hydrogen, which is a high-energy fuel.

Prices and Tariffs

Lithium concentrates are not traded on the open market and so prices published in trade journals are purely nominal. The one exception is the price of spodumene concentrate as established in the contract between Quebec Lithium Corporation and Lithium Corporation of America of $11.00 per unit of lithia (Li_2O).

Nominally quoted prices for lithium concentrates

Spodumene	-	$11.00/unit Li_2O
Lepidolite	-	"
Petalite	-	"
Amblygonite	-	$75.00/short ton

Prices of lithium chemicals from the "Chemical and Engineering News Quarterly Report on Current Prices" are:

	Per lb*
	$
Lithium metal, lump, 98%	11.00 - 14.00
" chloride	1.45
" bromide	1.80
" carbonate	0.85
" hydroxide monohydrate	0.80
" stearate	0.50
" fluoride	2.17 1/2 - 2.40

* For quantities normally involved in commercial transactions.

There is no tariff on mineral concentrates coming into the United States. A duty is imposed on the metal and alloys of 25 per cent ad valorem, and on chemicals 12 1/2 per cent.

The only known restriction on trade in lithium products is a United States regulation whereby permits are necessary to ship lithium metal, alloys, ores, and chemicals out of the country, except to Canada.

MARBLE

By H. M. Woodrooffe

There was an increase in the quantity of marble produced in Canada during 1955, although value of production decreased. Output of 63,335 tons valued at $633,531 compared with 57,748 tons at $633,702 in 1954. Quarry production is largely in crushed form for use in terrazzo flooring and as stucco dash, artificial stone, poultry grit, and whiting substitute. Crushed marble high in calcium carbonate and low in impurities is used to prepare dissolving liquor in the pulp and paper industry.

During 1955, at three locations in Quebec, rough blocks were quarried to be dressed for use as ornamental stone in building construction. In dressing marble, the stone is sawn into slabs, matched, shaped and polished. Canadian production of such marble is only a small part of the country's requirements and the domestic market is mainly supplied by imports from Italy and the United States in the form of mill blocks or sawn slabs which are finished in Canadian marble-dressing plants.

Canadian Marble Quarries

Quebec

Missisquoi Stone and Marble Company Limited quarries a clouded grey marble at Phillipsburg near Lake Champlain. This is the largest marble quarry in Canada and its products include mill blocks, sawn slabs, and finished marble. In addition, quarry and mill waste are crushed and sized for use as terrazzo chips and poultry grit. A recent innovation at the quarry is the continuous wire-sawing method of cutting quarry blocks from the marble beds.

Near North Stukely, in Shefford county, the Orford Marble Company Limited works an occurrence of serpentine marble in red, green and grey. Both mill blocks and terrazzo chips are produced. This marble has been used in recent years as an interior decorative stone in several public buildings.

Near St. Denis de Brompton, Richmond county, the Green Marble Quarry Company opened deposits of green marble in 1954 for the production of mill blocks. The stone polishes well, and two distinct marbles, one of which is a breccia, are being offered to the market.

At Portage du Fort, Pontiac county, Canadian Dolomite Company Limited quarries a white crystalline variety of dolomite which is crushed and sized for the production of terrazzo chips, stucco dash, artificial stone aggregates, and similar products. South Stukely Marble and Terrazzo Company and Delbo Incorporated, North Stukely, both in Shefford county, produce white marble for similar purposes.

Production of Marble, 1955 and 1954

	1955		1954	
	Short Tons	$	Short Tons	$
Quebec	29,565	373,718	25,559	310,455
Ontario	33,699	258,813	32,189	323,247
New Brunswick	71	1,000	-	-
Total	63,335	633,531	57,748	633,702

Imports of Marble, 1955*

	Italy	United States	Other	Total 1955	Total 1954
	$	$	$	$	$
Rough marble	60,852	48,346	12,910	122,108	179,265
Sawn marble	224,696	115,433	26,731	366,860	254,821
Marble for tombstones	-	44,440	-	44,440	38,913
Marble manufacturers	49,369	11,060	9,298	69,727	49,169
Ornamental marble for churches	121,932	-	1,281	123,213	135,912
Total	456,849	219,279	50,220	726,348	658,080

* Imports of mosaic flooring material, part of which is marble, were valued at $359,059 in 1955 compared to $305,700 in 1954.

Ontario

Silvertone Black Marble Quarries Limited, St. Albert Station, south-east of Ottawa, produces a black marble in the form of terrazzo chips. Marble from this location has been quarried as mill blocks for use as an ornamental building stone.

Terrazzo chips in red, pink, buff, green, black and white are produced by Stocklosar Marble Quarries from deposits in the vicinity of Madoc, Hastings county, and by Pulverized Marble Products Limited, whose plant is located at Kaladar in Lennox and Addington county. The latter company also quarries a crystalline dolomite at Kaladar for the production of plaster aggregate and other uses.

Bolenders Limited, north of Haliburton at Eagle Lake, produces poultry grit and stucco dash from a crystalline limestone.

Other Occurrences in Canada

There are a number of undeveloped occurrences of highly coloured marbles in Manitoba along the Hudson Bay and the Flin Flon branches of the Canadian National Railways and at Fisher Branch, 100 miles north of Winnipeg. Other deposits exist in British Columbia.

Prices

The price of marble varies widely and is affected by use, quality, colour, and figure.

MICA

By T. H. Janes

Production and value (primary sales) of mica of all classes in 1955 dropped to 1,640,708 pounds valued at $77,541 from the 1,706,770 pounds at $85,139 in 1954 and the 2,265,128 pounds at $161,128 in 1953. Value of imports was $588,663 in 1955 with manufactured products accounting for $482,853. In 1954 the value of mica imports was $453,205.

Production of mica in Canada consists mainly of phlogopite from the general Ottawa region. A small amount of mica, derived from schist, is produced in Vancouver. No muscovite has been shipped since late in 1953 when North Bay Mica Company Limited ceased operating the Purdy mine near Eau Claire, Ontario. The Croft Mining Company, which operated muscovite deposits in Croft and Chapman townships, Ontario, has been inactive since 1953.

Producers

Quebec

Production in 1955, consisting entirely of phlogopite, came from many small, scattered deposits in the Gatineau-Lievre Rivers area north of Hull. Open-cut mining operations have been conducted in Templeton, Wakefield, Buckingham, Wentworth, Blake, Portland, and Amherst townships during the past few years. Most of the production in 1954 and 1955 came from Templeton, Wakefield, and Wentworth counties, with E. Wallingford Limited, Perkins, and Blackburn Bros., Cantley, being the major contributors.

Ontario

Phlogopite production in Ontario comes from the Stanleyville area, North Burgess township, about 15 miles south of Perth, and from Bedford township in an area north and east of Kingston. Operations have been conducted, in recent years, by J.C. Donnelly and Peter Farrel, Stanleyville, and Oliver Marks, Sydenham.

British Columbia

Geo. W. Richmond Company Limited and Fairey and Company Limited, both of Vancouver, continued to grind mica schist mined near Albreda for the

Mica - Production, Trade and Consumption

	1955 Pounds	1955 $	1954 Pounds	1954 $
Production (primary sales)				
Trimmed	24,317	26,019	18,939	17,811
Splittings	-	-	1,901	3,551
Sold for mechanical splittings	8,000	2,080	40,150	8,841
Rough, mine-run or rifted	25,275	2,272	11,416	1,495
Ground or powdered	943,158	42,857	937,076	44,057
Scrap and unclassified	639,958	4,313	697,288	9,384
Total	1,640,708	77,541	1,706,770	85,139
Imports				
Unmanufactured*				
India	103,300	54,111		
United States	80,300	42,234		
Brazil	15,300	9,465		
Total	198,900	105,810		
Manufactured				
United States		462,424		395,122
United Kingdom		17,937		14,417
Brazil		2,492		-
India		-		43,666
Total		482,853		453,205
Exports, unmanufactured				
Rough				
United States	2,000	195	60,200	12,647
Trimmed				
Japan	45,500	34,858	16,800	18,884
United States	1,000	5,320	600	2,699
United Kingdom	400	1,140	-	-
Total	46,900	41,318	17,400	21,583
Scrap				
United States	272,200	2,836	453,600	6,241
Netherlands	20,400	612	-	-
Belgium	20,400	612	-	-
Total	313,000	4,060	453,600	6,241
Ground				
United States	900	45	200,000	12,000
France	-	-	40,000	1,319
Total	900	45	240,000	13,319
Total exports of unmanufactured mica	362,800	45,618	771,200	53,790

* Imports of unmanufactured mica are reported separately for the first time in 1955. For 1954 these imports are included under manufactured mica.

	1955		1954	
	Pounds	$	Pounds	$
Exports, manufactured				
Jamaica		42		-
United States		-		2,335
Brazil		-		512
Total		42		2,847
Consumption				
Paints	1,721,152		1,802,747	
Electrical apparatus	492,589		473,352	
Rubber goods	484,985		322,247	
Roofing	480,000		674,000	
Paper goods	38,000		56,000	
Non-metallic mineral products	127,376		85,000	
Miscellaneous	12,802		16,502	
Total	3,356,904		3,429,848	

local roofing trade. It is used to dust the backs of asphalt roofing shingles and siding to prevent sticking.

Uses and Properties

Mica is used in three principal forms, namely, natural sheet, splittings, and ground mica.

Natural Sheet

Sheet mica is used principally 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 radios, television and sound-recording equipment; as the dielectric in capacitors; and as a glaze for 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 the micas and is used extensively for insulation at high frequencies and high voltages and for capacitors. Because of its high mechanical strength and transparency, it is favoured for glazing also.

Phlogopite (magnesium or amber mica) varies considerably as regards dielectric strength, hardness, structural strength, and other properties but its electrical properties are such that it is used widely as an insulator in a variety of electrical installations at normal industrial and domestic frequencies and voltages. Its high thermal resistance makes it suitable for use under high-temperature conditions, as in heaters, toasters, flat irons, etc., and its softness, as compared to muscovite, makes it particularly suitable for flush commutators in which the copper and mica segments are required to wear at the same rate.

Biotite (iron or black mica) has comparatively low dielectric strength and is somewhat brittle. However, it finds limited application as insulation in low-powered fixtures and appliances.

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. Splittings are used similarly in the manufacture of mica tape, cloth, and paper, and are cut or moulded into washers, tubes and many other forms.

Built-up mica sheet is used, within the limits of its dielectric characteristics, in place of natural sheet, particularly in cases where large size would make the use of natural sheet uneconomical.

Ground Mica

Mica may be ground wet or dry according to use.

Dry ground mica is usually lower-grade, off-colour material, mainly muscovite and phlogopite but to some extent biotite, and is used principally in the roofing trade as a backing for asphalt tile and tar paper. It is also used for moulded high-frequency insulation in which the mica is bonded with ceramic binders to form a compound which may be pressed into any desired shape. Other uses are in protective coatings and to a limited extent in grease lubricants.

Wet ground mica is prepared mainly from good-quality muscovite scrap chiefly for the paint, rubber, and wallpaper trades. White products are preferred. In paint, wet ground mica serves as a pigment and extender; in rubber, as a dusting agent and lubricant on tire walls, and as a filler in hard rubber. In wallpaper it is used to produce decorative effects. Wet ground biotite also is used as a lubricant in rubber tire manufacture.

A new form of mica insulation is now being prepared in 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 United States conform generally to those adopted by the American Society for Testing Materials (Designation 351-49T). Grade sizes are shown in the following table:

A.S.T.M. grade sizes	Area of max. rectangle Sq. inches	Minimum dimension of one side Inches
OOEE Special	100 and over	4
OEE Special	80 to 100	4
EE Special	60 to 80	4
E Special	48 to 60	4
A-1 (Special)	36 to 48	4
No. 1	24 to 36	3
No. 2	15 to 24	2
No. 3	10 to 15	2
No. 4	6 to 10	1 1/2
No. 5	3 to 6	1
No. 5 1/2	2 1/4 to 3	7/8
No. 6	1 to 2 1/4	3/4

O = Over E = Extra

A.S.T.M. specifications for the quality-grading of block muscovite provide for six grades as follows: clear, clear and slightly stained, fair stained, good stained, stained, heavy stained, and black stained and spotted. In all grades except the last (black stained and spotted) the mica must be free from mineral inclusions and in all but the last two, free from mineral inclusions and cracks.

Natural Phlogopite Sheet

In Canada, size gradings for phlogopite sheet conform generally to those applying to muscovite but are expressed in terms of linear dimensions (in inches), the following grades being in common use: 1 x 1 and 1x2, 2 x 3, 2 x 4, 3 x 5, 4 x 6, 5 x 8, and larger.

No formal quality grading which 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" are commonly used in reference to quality.

Ground Mica

There are no specifications for ground mica common to the industry. A.S.T.M. (Designation D607-42), however, specifies the requirements for mica pigment.

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 United States and Canada at minus 160-mesh for rubber and minus 200-mesh for paint and wallpaper. In general, wet-ground muscovite must be white or nearly so.

Since covering power is one of the dominant properties of finely divided mica, 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. (D607-42) specifies 10 pounds per cubic foot for mica pigment.

Markets

Mica purchasers in Canada and United States, classified according to their requirements, include the following:

Canada

All grades

Walter C. Cross, 209 Eddy St., Hull, P.Q.
Blackburn Bros., Limited, 85 Sparks St., Ottawa, Ont.

Block

Mica Company of Canada Limited, 4 Lois St., Hull, P.Q.
Geo. P. Dowe, Co., Limited, P.O. Box 505, Richmond Hill, Ont.

Scrap

Geo. W. Richmond, 4190 Blenheim St., Vancouver, B.C.
Fairey and Company, 661 Taylor St., Vancouver, B.C.

United States

Muscovite & Phlogopite - all grades

Minerals & Insulation Co., 53 Central Avenue, Rochelle Park, N.Y.
American Mica Insulation Co., 410 Frelinghuysen Ave., Newark 5, N.J.
Ashville Mica Company, Newport Mews, Va.

Muscovite & Phlogopite Block

Hal Delphin & Co., 880 Bergen Ave., Jersey City 6, N.J.
Industrial Mica Corporation, 223 South Van Brunt St., Eaglewood, N.J.
Blanchard Mica Inc., 2315 Broadway, New York 24, N.Y.

Muscovite Block

Ford Radio & Mica Corp., 536-540 63rd St., Brooklyn, N.Y.
Gillespie-Rogers-Pyatt Co., Inc., 75 West St., New York, N.Y.
Reliance Mica Co., 341-351 39th St., Brooklyn 32, N.Y.
Farnham Manufacturing Co., Ashville, N.C.
Manchard Trading Corp., 2315 Broadway, New York 24, N.Y.
Spruce Pine Mica Company, Spruce Pine, N.C.
Micacraft Products Inc., 710 McCarter Highway, Newark 5, N.Y.

Phlogopite Splittings

The Macallen Company, Macallen St., Boston 27, Mass.
New England Mica Company, Waltham 54, Mass.
Continental Diamond Fibre Co., Valparsiso, Ind.

Muscovite Scrap

Hayden Mica Company, Wilmington, Mass.
F.D. Pitts Company, 85 Chestnut Hill Road, Newton 67, Mass.

Phlogopite Scrap

U.S. Mica Company, Jordan and Van Dyke Streets, East Rutherford, N.J.
Electronic Mechanics Inc., 101 Clifton Blvd., Clifton, N.J.

Prices

Prices offered for trimmed sheet phlogopite by Ottawa region dealers in 1955 were approximately as follows:

Size inches	Per Pound $
1 x 1 and 1 x 2	0.40 - .60
1 x 3	0.75
2 x 3	1.00
2 x 4	1.40
3 x 5	2.00
4 x 6	2.50
5 x 8	3.00

Clean scrap phlogopite sold up to about $25 per ton delivered at plant. Scrap muscovite sells for about $25 to $30 per ton f.o.b. shipping point, when available.

E & M J Metal and Mineral Markets of December 15, 1955, quoted prices on mica sheet as follows:

North Carolina, clear sheet -

Size inches	Per Pound $
1 1/2 x 2	0.70 to 1.60
2 x 2	1.10 to 1.60
2 x 3	1.60 to 2.00
3 x 3	1.80 to 2.30
3 x 4	2.00 to 2.60
3 x 5	2.60 to 3.00
4 x 6	2.75 to 4.00
6 x 8	4.00 to 8.00

NEPHELINE SYENITE

By T. H. Janes

Shipments of nepheline syenite in Canada in 1955 reached a new high of 146,068 short tons valued at $2,099,512 from the previous high of 123,669 tons valued at $1,770,528 in 1954. This increase of about 18 per cent is a continuation of the steady growth that has been characteristic of the industry in Canada, the sole supplier of nepheline syenite to industry outside the Russian orbit.

Nepheline syenite was originally used almost entirely in the manufacture of glass when it was first introduced commercially about 1940. Since its introduction many other applications have been developed in the ceramic industry, resulting in a steadily increasing demand. With a constant and uniform supply of nepheline syenite assured for many years from extensive deposits north of Peterborough, Ontario, a continuing growth in demand and, consequently, production, is anticipated.

Shipments in 1955 were confined to American Nepheline Limited, Lakefield, Ontario, from deposits on Blue Mountain, Peterborough county. Late in 1954, the Canadian Pacific Railway completed a 16-mile spur line connecting Nephton, location of the company's mine, mill, and townsite, with the main line at Havelock. This eliminated the trucking formerly required between Nephton and Lakefield, the previous shipping point.

By the end of 1955, International Minerals and Chemical Coporation (Canada) Limited had nearly completed a 300-ton mill to treat nepheline syenite from its extensive deposit on the northeasterly end of Blue Mountain. The company is a subsidiary of International Minerals and Chemical Corporation, Chicago, Illinois, which has extensive mining and processing operations in the United States. The Canadian subsidiary operated formerly under the name of Canadian Flint and Spar Company, Limited.

Other Occurrences and Production

In addition to the commercially important deposits of nepheline syenite that occur in Methuen township, Peterborough county, central Ontario, other deposits of nepheline syenite occur in Ontario near Bancroft, Hastings county; Gooderham, Haliburton county, in the French River area, Georgian Bay district; and at Port Coldwell, Thunder Bay district. In Quebec, nepheline syenite occurs in the Labelle-Annonciation and other areas and in British Columbia in the Ice River district near Field.

Russia is the only other country producing nepheline syenite but production data are lacking. In Russia, large tonnages of nepheline syenite are mined for the recovery of apatite with nephelite as a co-product. Material of glass-grade quality, unsuitable for pottery grade, is recovered. Canada is the sole source of high-grade ceramic material.

Occurrences of nepheline syenite have been reported in California, New Jersey, Arkansas, and other localities in the United States. Deposits also occur in India andFinland but no production has been reported. It would appear that the material does not occur in sufficient tonnage, or the iron content is too high and difficult to reduce in order to make it acceptable for ceramic purposes.

Specifications

Nepheline syenite is a quartz-free crystalline rock consisting principally of nephelite (a silicate of alumina, potash, and soda), albite, and microcline 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 under 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 minus 28-mesh material, and, for pottery grade, all through 200-mesh or finer. High-intensity magnetic separation reduces the iron-oxide content from about 1.50 per cent in the feed to under 0.08 per cent in the finished product. Dry milling methods are used throughout the processing.

Nepheline Syenite - Production, Trade and Consumption

	1955 Short Tons	1955 $	1954 Short Tons	1954 $
Production, crude (Crude ore mined)..	194,205		159,885	
Shipments				
Ground				
Glass grade	99,651		86,098	
Pottery grade......	33,551		27,365	
Miscellaneous	10,694		8,639	
Total	143,896		122,102	
Crude.............	2,172		1,567	
Total shipments....	146,068	2,099,512	123,669	1,770,529
Exports, crude and processed materials				
United States.......	114,297	1,682,372	79,967	1,197,031
Netherlands	1,832	32,960	1,658	29,841
United Kingdom	848	14,669	824	14,776
Puerto Rico	720	12,480	800	14,000
Other countries	578	10,636	703	13,450
Total	118,275	1,753,117	83,952	1,269,098
Consumption				
Glass & glass wool .	25,765		13,007	
Pottery and miscellaneous clay products	1,520		2,063	
Total	27,285		15,670	

Uses

Nepheline syenite finds wide use in the ceramic industry where it replaces feldspar as a source of alumina and the alkalis in making glass, pottery, floor and wall tile, refractory cements, whiteware and porcelain products, enamels, and varied ceramic products. The lower fusibility and greater fluxing action of nepheline syenite as compared with that of the traditional vitrifying agents enables a manufacturer to either fire the ware at lower temperature or use a reduced amount of vitrifying agent and still attain the desired properties. In glass batches, the low iron content (0.06 to 0.08 per cent Fe_2O_3) of nepheline syenite, combined with its high alumina and alkali content, make it a desirable means of introducing alumina, especially where low iron is important. About two thirds of Canadian shipments are used in glass manufacture.

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Finely ground material is suggested for use as a pigment extender for paint, as a filler for plastics and rubber, and as an inert carrier for insecticides and fungicides.

Miscellaneous industrial applications of nepheline syenite include its role as a fired bond in abrasive grinding wheels and as a bond for refractory cements. B-grade (lower grade) material is used as a vitrifying agent in some types of structural or heavy clay products, and to a limited extent in cleansers and scouring compounds.

Prices

Recent prices have been as follows:

Bulk, carload lots, f.o.b. shipping point (Nephton or Lakefield), per short ton -

Glass grade, minus	28-mesh	-	$14.50
Pottery grade, "	200-mesh	-	18.50
" " "	270-mesh	-	19.00
B-grade, "	100-mesh	-	10.00

Add $3.00 per ton in bags

A-400 (all minus 325-mesh) bulk	-	24.00
Bagged	-	28.00

PHOSPHATE

By T. H. Janes

Production of phosphate in Canada has been negligible since the large, sedimentary deposits of Florida were developed about the turn of the century. Peak production in Canada, from the Gatineau-Lievre Rivers district in Quebec and from the Perth area of Ontario, was reached in 1890 when an output of over 30,000 tons was recorded. There has been no substantial production of phosphate since the mid 1890's.

In 1955, Multi-Minerals Limited continued exploration from surface of its large magnetite-apatite property near Nemegos, Ontario, about 155 miles west of Sudbury.

Most phosphate rock is used in the manufacture of fertilizers. Imports, mainly from the United States, amounted to 588,209 tons valued at $4,512,833 in 1955 compared to the all-time high of 644,860 tons valued at $4,577,633 in 1954. Requirements for Eastern Canada come mainly from the 'pebble phosphate fields' of Florida and those for Western Canada from sedimentary formations that cross the states of Utah, Wyoming, Idaho, and Montana. The

Consolidated Mining and Smelting Company of Canada Limited obtains phosphate rock for its large fertilizer operations in Western Canada from owned and leased properties near Helena, Montana.

Occurrences in Canada

Production of phosphate in Canada has consisted of the mineral apatite, frequently found associated with the phlogopite mica deposits of the general Ottawa region, in Ontario and Quebec. It was mined on a fairly substantial scale prior to 1895 but production since then has rarely reached 1,000 tons in any year. The total production of apatite in Canada is recordec at 350,000 tons, of which Quebec supplied 90 per cent and Ontario 10.

In Quebec, most of the production has come from deposits in the Lievre River area, Papineau county, and from Templeton and adjacent townships to the west of that area. In Ontario, most of the output came from Bedford township in the Rideau Lakes area. Rock phosphate occurs along the Rocky Mountain Divide, particularly in the vicinity of Crowsnest, British Columbia, where a few thousand tons were mined about 1930.

World Production

More than 90 per cent of world production of phosphate comes from rock phosphate of secondary origin, probably derived from the primary apatite. Enormous reserves of 'secondary' apatites, called 'phosphorites' exist in many parts of the world. These calcium phosphates have been formed in the alteration of sediments by solutions containing phosphoric acid. Such solutions have come from the weathering and leaching of igneous rocks containing apatite, bone deposits of prehistoric animals and marine life, or guano deposits. Phosphorites are mostly alterations of phosphatic limestones that took place slowly over many years. Whether it is apatite or phosphorite that is being produced, it is known in the trade as "phosphate rock".

Total world production of phosphate rock is approaching 30 million metric tons a year of which about one-half is supplied by the United States. Other major producing countries include French Morocco, Tunisia, Algeria and Egypt in Africa, Christmas Island in the Indian Ocean (Asia), Nauru, Ocean, and Makatea Islands in Oceania, and Russia. Many other countries contribute to the world output.

Uses

About 80 per cent of the phosphate rock imported into Canada is used in making commercial fertilizers, chiefly superphosphate. Ordinary superphosphate is made by treating the rock phosphate with sulphuric acid to provide the phosphorus in a more soluble form and thus it becomes "available" to plant life. Triple superphosphate, containing 45 to 48 per cent available P_2O_5 most of which is water soluble, was first made in the early 1900's and is growing in importance. In the United States, phosphate fertilizers of the slag type are produced, in limited quantity, by blast furnace and electric furnace

Imports and Consumption of Phosphate Rock and its Derivatives

	1955 Short Tons	1955 $	1954 Short Tons	1954 $
Imports				
Phosphate rock				
United States	577,026	4,232,914	625,756	4,192,358
Netherlands Antilles....	11,155	275,811	11,200	273,840
Other countries	28	4,108	7,904	111,435
Total	588,209	4,512,833	644,860	4,577,633
Fertilizers*				
Triple superphosphate				
United States	35,324	1,606,817		
Superphosphate N.O.P.				
United States	175,944	3,263,012		
Phosphate fertilizer N.O.P.				
United States	1,850	90,224		
Other countries	804	69,379		
Total	2,654	159,603		
Total, fertilizers				
United States	213,118	4,960,053	198,853	4,249,270
Other countries	804	69,379	6,530	189,940
Total	213,922	5,029,432	205,383	4,439,210
Phosphoric Acid				
United States	222	45,302	350	57,111
United Kingdom	-	-	760 lbs.	290
Total	222	45,302	350	57,401
Consumption				
Phosphate rock				
Fertilizers	465,129		506,241	
Heavy chemicals	97,716		100,642	
Steel	128		1,081	
Stock and poultry feeds..	21,919		19,582	
Miscellaneous..........	434		515	
Total..................	585,326		628,061	

* Breakdown of superphosphate and phosphate fertilizers not available prior to 1955.

methods. Finely ground phosphate rock is used in minor amounts for direct application to the soil.

Phosphate rock is the chief source of elemental phosphorus, compounds of which are widely used 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.

Ferro-phosphorus 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

Because of its open texture, sedimentary phosphate rock is preferred for acid treatment to compact, crystalline apatite. The tricalcium phosphate content should approach 80 per cent.

For furnace treatment apatite should contain a minimum of 70 per cent tri-calcium phosphate. Size specifications call for a minimum of 80 per cent on 10-mesh.

Apatite for furnace treatment is purchased by Electric Reduction Company, Limited, Buckingham, Quebec.

Prices

According to E & M J Metal and Mineral Markets of December 15, 1955, the prices per long ton of Florida pebble phosphate, f.o.b. mines, were as follows:

Grades %	Price $
77/76 B.P.L.*	7.00
75/74 B.P.L.	6.00
72/70 B.P.L.	5.00
70/68 B.P.L.	4.35
68/66 B.P.L.	3.95

* B.P.L. signifies bone phosphate of lime, $Ca_3(PO_4)_2$

Price quotations for Tennessee brown-rock phosphate, elemental phosphorus, and some phosphate compounds are published in the Oil, Paint and Drug Reporter. Prices for Western States phosphate rock are not quoted in the trade journals.

Domestic apatite lump from the Ottawa region, when available, sells for about $16.00 a short ton delivered at the consuming plant.

There is no import duty on phosphate rock entering Canada.

ROOFING GRANULES

By T. H. Janes

Total consumption of roofing granules in 1955 by manufacturers of asphalt roofing and siding reached an all-time high of 147,877 tons valued at $4,087,668, according to figures supplied to the Mines Branch by the industry. This was 10 per cent above the 1954 consumption.

Imports, all from the United States, also reached a new high of 120,757 tons compared to 104,865 tons in 1954. Of the total imports, 104,391 tons were artificially coloured granules made from igneous rocks (97 per cent) and slate (3 per cent). More than half the remaining imports were granules made from black slag, the balance being made from slate and greenstone. The average price, c.i.f. consuming plant, of all granules in 1955 was $27.65 per short ton compared to $26.61 the previous year.

Roofing Granule Plants in Canada

Ontario

Building Products Limited, by far the largest producer of roofing granules in Canada, operates a grey-black basalt quarry near Havelock and a pink syenite quarry northwest of Madoc from which a full range of coloured granules is made in the newly built colouring plant near the basalt quarry. Rock from the syenite quarry is trucked 12 miles to the granule plant for crushing, sizing and colouring. Aggregate for concrete and asphalt road construction is produced at the Havelock quarry with the undersize from this operation being used for making roofing granules. The sodium silicate colouring process is used to make a complete line of artificially coloured roofing granules for use in the company's roofing and siding plants at Montreal and Hamilton and for sale to other manufacturers.

British Columbia

Geo. W. Richmond supplies natural granules from a crushing and screening plant in Vancouver to West Coast roofing manufacturers. Sources of material are a dark grey slate at McNab Creek, Howe Sound, and a green siliceous rock at Bridal Falls near Chilliwack.

Roofing and Siding Plants in Canada

In 1955 granule-coated roofing and siding was manufacture by 9 companies in 16 plants across Canada, as follows:

Company	Location of Plant
Bishop Asphalt Papers Limited	Portneuf Station, Quebec, and London, Ontario

Roofing Granules - Consumption and Trade*

	1955		1954	
	Short Tons	$	Short Tons	$
Consumption, by kind				
Natural	24,173	430,013	28,737	484,523
Artificially coloured....	123,704	3,657,655	105,180	3,079,055
Total.................	147,877	4,087,668	133,917	3,563,578
Consumption, by colour				
Black and grey-black**..	37,751	731,952	38,833	743,952
Green.................	43,700	1,248,033	39,523	1,107,479
Red	20,821	534,319	19,000	476,647
Blue	15,285	564,137	13,643	489,326
White ***	16,332	610,702	12,190	468,808
Grey..................	8,923	240,456	6,891	167,838
Buff	2,087	72,358	2,255	66,629
Brown	2,978	85,711	1,582	42,899
Total.................	147,877	4,087,668	133,917	3,563,578
Imports				
United States				
Natural...............	16,366	299,642	15,841	285,665
Artificially coloured....	104,391	3,174,512	89,024	2,650,469
Total	120,757	3,474,154	104,865	2,936,134

* Compiled from figures supplied to the Mines Branch, partly estimated.
** Includes natural granules used as undercoat granules.
*** Includes minor tonnages of cream and coral granules.

Company	Location of Plant
The Brantford Roofing Company Limited	Brantford, Ontario
Brantford Roofing (Maritimes) Limited	Coldbrook, New Brunswick
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 & Paper Company, Limited	Victoria, British Columbia, and Lloydminister, Alberta
Canada Roof Products Limited	Vancouver British Columbia

Company	Location of Plant
The Barrett Company, Limited	Montreal, Quebec, and Vancouver, British Columbia
Canadian Johns-Manville Company, Limited	Asbestos, Quebec.

Specifications and Colouring

Specifications for rock types suitable for making roofing granules are very rigid and few rocks possess all the qualities required. The rock should break well with a not too sharp fracture andyield, on crushing, a high percentage in the granule size range (-10 +35-mesh for coarse, and minor amounts of -28 +48-mesh for fines). Granules should be blocky rather than splintery. No stone source should be considered unless it contains many years' supply of rock having uniform characteristics chemically, physically, and mineralogically, and unless it lies within economic hauling distance of roofing plants.

Any stone source for roofing granules should contain a minimum of acid-reactive materials such as carbonates, sulphides, sulphates, or high-alkali materials. Pyrites by themselves in small quantities do no harm, but pyrites in conjunction with carbonates inevitably lead to poor weathering. Rocks should be hard and tough enough to withstand breakage and dusting through handling with mechanical equipment. The stone should be fine-grained with low porosity so that it withstands weathering effects from freezing and thawing and so that a minimum of pigment is required to cover the granules.

A granule should have 'tooth', or adhesive properties in relation to asphalt and the ability to 'wet' well with that material. For instance, granules made from quartz, feldspar, and some rhyolites do not have this latter property because, on crushing, they fracture with a glassy smooth surface. There is no rule by which to determine the ability of a granule to take colour but, in general, for a full range of colours a light-shade base granule is preferred to a dark-shade one because less pigment is required to hide the colour of the base granule.

Opacity of rock granules appears to be a very important property by which to determine the acceptability of a base-rock material. If the ultra-violet light of the sun's rays passes through the granules, the resultant deterioration of the asphalt underneath causes a loss of adhesion, with ultimate loss of the granules from the roofing. Some manufacturers and consumers of granules claim that the infra-red (heat) rays of the sun have a more direct influence on the durability of roofings than ultra-violet rays. The type of asphalt used and the filler used in the asphalt are also believed to have a bearing on the loss of granules from shingles. Major producers of roofing granules maintain test stations in warm, humid climates where panels of roofing and siding can be exposed to accelerated weathering over a period of years. The results of this test are taken as the final criterion on the durability of the roofing and quality of the granule. Quick laboratory tests of the quality of a granule and the stability of the colour coat that check with actual weathering conditions have been devised.

Processes for colouring granules are covered by many patents. The two most widely used processes are the sodium silicate process, in which the granules are thoroughly coated with sodium silicate, clay, the required pigment, and a little titanium dioxide, and heated to the required temperature in a rotary kiln, and the phosphoric acid process, in which the granules are mixed thoroughly with zinc oxide, clay, liquid phosphoric acid, and the required pigment, and then heated.

The colour of granules is usually heightened by oiling after colouring with a paraffin-base oil but this effect tends to wear off in use. Oiling also improves the adhesiveness of the granules. A good granule shingle has a life expectancy of twenty years or more.

United States Production

The Bureau of Mines, United States Department of the Interior, reported that the production of roofing granules in 1953, the latest year for which figures are available, was 1,618,831 short tons valued at $27,819,624. The average value for all types of granules in 1953 was $17.19 a ton with natural granules averaging $9.47 and artificially coloured granules averaging $19.21 a short ton, f.o.b. producers' plants. Of the total production, artificially coloured granules accounted for 1,282,325 tons and natural granules 336,506 tons.

Canadian Prices

Prices paid for roofing granules, c.i.f. consumers' plants, depend upon the type of granule, the colour, distance from producing plant, and whether the colour is natural or artificial. Imported natural granules in 1955 averaged $18.31 per short ton compared with $18.03 per short ton in 1954, c.i.f. Canadian roofing plants. These figures include black granules made from slag but not artificially coloured. The average price of all artificially coloured granules per short ton in 1955, with 1954 figures in brackets, by colour were: red $25.66 ($25.08); green $28.64 ($27.97); black $22.21 ($24.93); blue $36.91 ($35.94); white $37.38 ($38.45); grey $26.95 ($24.64); buff $34.67 ($29.49); brown $28.10 ($27.12). The average value of all types of granules per short ton c.i.f. consumers' plants was $27.65 in 1955 compared with $26.61 in 1954.

SALT

By R. K. Collings

Canada produced 1,244,761 short tons of salt in 1955, an increase of approximately 28 per cent over 1954. Imports at 365,255 short tons decreased very slightly; exports, on the other hand, increased from 1,199 short tons in

1954 to 146,472 short tons in 1955, this constituting the most significant development in the Canadian salt industry in 1955. This great increase was a direct result of the establishment of Canada's second rock salt mine at Ojibway in southern Ontario. Since initial production began in the last half of the year only, a further increase during 1956 may be expected. Imports of coarse salt are expected to decrease as consumers in Ontario and Quebec, presently importing this salt, utilize a Canadian source of supply.

All of Canada's salt production is obtained from underground deposits of salt or brine. A large part of the total production is used as brine by the chemical industry in the manufacture of chlorine, hydrochloric acid, caustic soda, and related chemicals. The remainder is marketed as granular salt produced by the evaporation of brine or as rock salt. Forty-four per cent of the 1955 total was consumed as brine, 34 1/2 per cent as evaporated salt, and 21 1/2 per cent as coarse salt produced from rock salt.

Malagash Salt Company Limited, a subsidiary of The Canadian Salt Company Limited, continued shaft-sinking at Pugwash, Nova Scotia, during the year. The shaft will be 500 feet deep, and is to be used for mining salt beds located at an average depth of 400 feet. Shaft-sinking operations are scheduled for completion late in July, 1956.

Producers

Ontario

Ontario accounted for 80 per cent of the total Canadian production of salt in 1955. The salt comes from beds located 800 to 1,500 feet below the surface in the southwestern section of the province.

Fine salt, obtained by vacuum-pan evaporation of brine from local wells, was produced by The Canadian Salt Company Limited at Sandwich and by Sifto Salt Limited, a subsidiary of Dominion Tar & Chemical Company, Limited, with plants at Goderich and Sarnia.

Coarse salt, obtained by open-pan evaporation of brine, was produced in limited quantities by Warwick Pure Salt Company at Warwick and by Sifto Salt Limited at its Goderich plant.

The production of coarse salt by the mining, crushing, and screening of an underground deposit of rock salt was commenced in August 1955 at Ojibway, near Windsor, Ontario, by The Canadian Rock Salt Company Limited, a subsidiary of The Canadian Salt Company Limited.

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.

Salt - Production, Trade and Consumption

	1955 Short Tons	1955 $	1954 Short Tons	1954 $
Production by types				
Fine vacuum salt......	430,327	7,223,928	414,799	6,871,812
Coarse grainer salt...	1,142	21,300	1,750	32,495
Mined rock salt	267,984	1,874,472	81,006	672,363
Salt, chemical *.......	545,308	1,002,599	472,332	763,493
Total................	1,244,761	10,122,299	969,887	8,340,163
Production by provinces				
Ontario	998,789	5,845,340	733,066	4,440,418
Nova Scotia..........	144,862	1,808,302	150,589	1,838,559
Saskatchewan	40,748	976,298	37,227	899,849
Alberta	41,408	1,014,745	31,196	722,183
Manitoba	18,954	477,614	17,809	439,154
Total	1,244,761	10,122,299	969,887	8,340,163
Exports				
United States.........	146,159	988,489	949	14,445
Bermuda	132	5,839	138	5,915
Other countries	181	6,173	112	5,575
Total	146,472	1,000,501	1,199	25,935
Imports				
United States.........	311,118	1,484,893	306,893	1,692,709
Spain	30,119	204,530	23,179	145,902
Bahamas	10,888	59,132	22,449	89,489
Jamaica	5,702	28,569	6,148	20,891
United Kingdom	4,084	94,972	6,942	153,187
Other countries	3,344	11,754	4,800	49,250
Total	365,255	1,883,850	370,411	2,151,428
Apparent consumption..	1,463,544	11,005,648	1,339,099	10,465,656

* Mainly in brine and used by the producers in the manufacture of chemicals.

Nova Scotia

Fine salt is produced by Sifto Salt Limited at a plant near Amherst. Brine for this operation is obtained from wells that are 1,100 to 1,800 feet in depth.

Malagash Salt Company Limited, a subsidiary of The Canadian Salt Company Limited, operates a rock salt mine at Malagash. The salt is crushed and screened to give a coarse salt for use in ice and dust control on highways and for ice removal from railways. 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 Ltd. 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

Slat beds have been found at depth on the west coast of Cape Breton Island; under Hillsborough Bay, Prince Edward Island; and in the area to the south of Moncton, New Brunswick.

Beds of salt varying from a few feet to 400 feet or more in thickness underlie large areas of all three Prairie Provinces. The beds occur in a huge southwesterly-dipping basin that extends from north-eastern Alberta, southeasterly through central Saskatchewan and thence into the southwestern portion of Manitoba. The depth of these beds below the surface varies from less than 400 feet in northern Alberta to 6,000 feet or more in southern Saskatchewan.

Uses

Brine is used extensively in the chemical industry for the manufacture of chlorine, hydrochloric acid, caustic soda, and related chemicals. Fine salt, produced by vacuum-pan evaporation of brine, is also used in the chemical industry and for dairy, household, and food purposes.

The coarser grades of salt are used in the curing of fish, for ice and dust control on highways, for dairy uses, 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 salt is generally rather impure and finds its greatest use in the control of ice and dust conditions on highways and the removal of ice on railways.

SAND AND GRAVEL

By R. A Simpson

Canadian production of sand and gravel rose sharply in 1955 to 127,524,474 tons, an all-time record. This is an increase of 14.9 per cent or 16,563,440 tons above the previous record set in 1954. Of the increase, more than two-thirds or 11.7 million tons came from Quebec and Ontario; New Brunswick accounted for about 2.2 million tons of the increase and Newfoundland and British Columbia for about 1 million tons each. In terms of value, sand and gravel ranked ninth in mineral production and second, following asbestos, among industrial minerals.

Although occurrences of gravels and sands are widespread, deposits of suitable material are scarce in parts of Canada, notably in Saskatchewan and near-by parts of Alberta and Manitoba. Sand for concrete construction is in short supply in the more densely populated areas, and the industry is turning to manufactured sand to help satisfy the demand. Crushing or grinding equipment such as hammer mills, short-head cone crushers, and rod mills are used after the nomal stone crushing stages to reduce the stone to sand size. Screening or other classification, often a wet process, is then carried out to bring the product within grading specifications.

Suitable manufactured concrete sand has been produced from granite, sandstone, limestone and gravel. Almost any kind of stone that is essentailly free from deleterious constituents such as clay, shale, or hydrous silica may be used to make manufactured sand, but it is important that the shape of the particle be predominantly cubicle. Elongated or slab-shaped particles do not allow the sand to pack closely, and excessive amounts of cement are required to fill the voids. Also, sands having poorly shaped particles produce a "harsh" concrete mix that is difficult to "work".

Manufactured sand is used to make concrete for both plant-manufactured products and concrete construction. It is not used to make mortar or plaster since very plastic mixes are required for these phases of construction.

Sand and gravel producers are widespread, and for the most part production is used within short haulage distances of the pits. Small operations are constantly being brought into production or being closed down, depending usually upon road building programs in the area. Large permanent operators maintain production for about 8 months of the year and stockpile enough sand and gravel to satisfy the reduced demand during the winter months. Principal producers of sand and gravel are distributed among the provinces as follows:

Provinces	No. of Principal Producers*
Newfoundland	2
Nova Scotia	4

Sand and Gravel - Production, Trade and Consumption

	1955		1954	
	Short Tons	$	Short Tons	$
Production, by provinces				
Newfoundland	3,142,226	1,660,984	2,105,522	1,096,883
Nova Scotia	1,156,710	1,148,245	1,330,979	1,297,693
New Brunswick	5,731,835	2,942,830	3,528,318	1,832,299
Quebec	36,722,008	15,346,416	30,052,887	12,985,931
Ontario	51,488,067	29,945,730	46,433,191	26,577,612
Manitoba	5,272,676	1,571,103	4,831,716	2,084,367
Saskatchewan	5,039,682	2,320,260	5,211,429	2,055,766
Alberta	7,819,933	5,894,341	7,313,380	4,867,410
British Columbia	11,151,337	6,945,144	10,153,612	6,189,710
Total	127,524,474	67,775,053	110,961,034	58,987,671
Production, by type				
Sand				
Moulding sand	15,838	43,468	18,331	48,544
Building "	12,341,052	9,879,011	8,961,378	6,950,734
Core "	295	981	584	1,667
Other sand	427,000	219,050	374,120	134,728
Total sand	12,784,185	10,142,510	9,354,413	7,135,673
Sand and gravel				
Railway ballast	5,129,714	1,711,776	6,083,110	2,433,413
Concrete, road building, etc.	83,941,517	40,245,390	73,899,831	35,652,959
Mine filling	5,249,860	1,467,341	4,405,652	1,345,235
Crushed gravel	20,419,198	14,208,036	17,218,028	12,420,391
Total sand and gravel	114,740,289	57,622,543	101,606,621	51,851,998
Total, all types	127,524,474	67,775,053	101,961,034	58,987,671
Exports				
United States	336,304	383,445	305,831	324,633
Imports of sand and gravel				
United States	258,858	273,720	282,225	281,790
Sweden	550	1,100	-	-
United Kingdom	-	-	1,624	5,293
Total	259,408	274,820	283,849	287,083
Apparent Consumption	127,447,578	67,666,428	110,939,052	58,950,121

Provinces	No. of Principal Producers *
New Brunswick	3
Quebec	60
Ontario	252
Manitoba	15
Saskatchewan	35
Alberta	9
British Columbia	50

* Does not include production by railway companies for ballast or production by countries and townships in Ontario for road use.

Gravels

Gravels vary in composition and in size of component particles and these factors determine suitability for various uses. Where coarse deposits are being worked, crushing and screening plants are usually installed for the production of those graded sizes which demand the highest prices.

Gradations of particles making up the various sizes of aggregates are of prime importance. Large users of aggregates may set their own grading specifications but most conform closely to those set by such organizations as the Canadian Engineering Standard Association. Grading limits for different designated sizes of aggregate set by this association are given in the table that follows.

Large quantities of pit-run and crusher-run gravel are used for basic highway construction and for secondary road construction and maintenance. These materials contain considerable amounts of fine material which allow the road to be compacted into a hard, durable mass. For top courses of highways where bituminous pavements and portland cement concretes are used, the relative amounts of fine and coarse material are of prime importance. Consequently screened, graded, coarse and fine aggregates are combined to give the desirable proportions of each. For road construction the gravel usually comes from pits in the vicinity of the work in progress. Movable crushing and screening plants are employed to produce the required amounts and then moved to the next site.

Gravel is also used for ballast for railway lines, but in recent years, especially on main lines, there has been a tendency to replace gravel with crushed stone.

Sand

The amount of sand consumed follows the trend of building activity, as most of it is used for concrete, cement and lime mortar, or wall plaster. For these purposes the sand must be free from dust, loam, organic matter, clay or shale, and contain but little silt. Grading is of prime importance and grading limits may be set by large consumers. However, most consumers

Grading of Coarse Aggregate for Commonly Designated Sizes

Percentage Passing (by weight)

Sieves, Square Openings	Designated Stone Sizes							
	3 1/2 to 2"	2 to 1"	1 1/2 to 3/4"	2" to 4-mesh	1 1/2" to 4-mesh	1" to 4-mesh	3/4" to 4-mesh	1/2" to 4-mesh
4"	100							
3"	90-100							
2 1/2"	-	100		100				
2"	0-15	90-100	100	95-100	100			
1 1/2"		35-70	90-100	-	95-100	100		
1"		0-15	20-55	35-70	-	90-100	100	
3/4"			0-15	-	35-70	-	90-100	100
1/2"				10-30	-	25-60	-	90-100
3/8"				-	10-30	-	20-55	40-75
4-mesh				0-5	0-5	0-10	0-10	0-15
8-mesh							0-5	0-5

conform to those set by the Canadian Engineering Standards Association or the American Association for Testing Materials.

These grading specifications are given below.

Sieve Size	Percentage Passing Each Sieve (by weight)	
	Concrete Sand	Masonry Sand
3/8"	100	100
No. 4	95 to 100	100
No. 8	80 to 100	95 to 100
No. 16	50 to 85	60 to 100
No. 30	25 to 60	35 to 70
No. 50	10 to 30	15 to 35
No. 100	2 to 10	2 to 15

SILICA MINERALS

By R. K. Collings

The production of silica minerals in Canada in 1955 was 1,869,913 short tons, an increase of 8.9 per cent over the 1954 production. The value of production increased 29 1/2 per cent to $2,039,575. This increase in value was due to increased production of higher priced silica in Canada in 1955.

The Canadian output of quartz, quartzite, and silica sand is used in the manufacture of silicon and ferrosilicon alloys, as a fluxing material in the metallurgical industries, and for other purposes such as the manufacture of silica brick, as an ingredient in portland cement, for foundry use, etc. Part of the Canadian output of lump silica is exported to the United States where it is used in the manufacture of silicon and ferrosilicon alloys. In 1955 Canada exported 87,622 short tons of quartzite; this represented about 4 1/2 per cent of the total production of silica for the year.

The silica requirements of the glass, chemical and other industries using high-purity silica continued to be supplied, for the most part, by imports from the United States, Belgium, and other countries. However, small quantities of good quality silica sand are presently being manufactured from a Canadian deposit of quartzite by a Montreal firm. A number of other firms are investigating the possibility of producing high-quality silica sand from Canadian deposits of sandstone.

Canadian Silica Corporation Limited of Toronto, Ontario, continued the construction of a silica milling plant at St. Canut, Quebec, during the year.

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Production of various grades of silica sand and flour from the St. Canut sandstone deposit is scheduled for early 1956.

Peace River Glass Company Limited completed the construction of a glass fibre plant at Fort Saskatchewan, Alberta, and production of glass fibre began in September 1955. Glass rods for use in this operation are presently being imported; however, this company is planning to construct a glass melting plant which, when completed, will furnish the glass requirements of the fibre plant. The glass melting plant, scheduled for completion early in 1957, will be supplied with sand from the Peace River silica deposits.

The Winnipeg Selkirk Sand Company, Limited was incorporated in July 1955 to quarry sand from the silica deposit on Black Island in Lake Winnipeg. Sand from this deposit is to be transported by barge to Selkirk, Manitoba, where it will be washed, sized and sold for glass, foundry, and oil-well fracturing.

Producers

Nova Scotia

Dominion Steel and Coal Corporation, Limited, quarries quartzite from a deposit at Chegoggin Point, Yarmouth county. Rock from this deposit is shipped to Sydney, where it is used in the manufacture of silica brick.

Quebec

St. Lawrence Alloys and Metals Limited quarries sandstone at Melocheville, Beauharnois county, for use in the manufacture of ferrosilicon at a plant in Lachine. Glass sand, sand for use in the abrasives industry, and other high-quality silica products are presently being produced at Lachine.

Radius Exploration Limited of Montreal operates a sandstone deposit near Ste. Clothilde, Chateauguay county, Quebec. Sized sand from this deposit is shipped to Delson, Quebec, where it is used in the manufacture of lightweight concrete.

Ontario

Lorrain quartzite is quarried by the Electro Metallurgical Company of Canada, Limited, at Killarney, 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 production from Sheguiandah is shipped to Canadian Silica's grinding plant at Whitby, Ontario, where it is used to produce silica flour.

Algoma Steel Corporation Limited quarries quartzite from a deposit at Bellevue, north of Sault Ste. Marie, for use in the manufacture of silica brick for furnace linings.

Silica Minerals - Production and Trade

	1955 Short Tons	1955 $	1954 Short Tons	1954 $
Production				
Quartz and silica sand*..	1,869,913	2,039,575	1,716,151	1,574,893
	Thousands of brick		Thousands of brick	
Silica brick	4,763	602,625	3,578	465,157
	Short Tons		Short Tons	
Imports, silica sand				
United States	711,432	2,113,042	633,610	1,854,174
Belgium	23,828	32,453	21,687	28,176
United Kingdom.........	198	593	124	668
Other countries.........	-	-	441	980
Total	735,458	2,146,088	655,862	1,883,998
Exports, quartzite				
United States	87,622	265,374	162,374	547,821

* Includes both crude and crushed quartz, crushed sandstone and quartzite, and natural silica sands.

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 quartzites exist in all provinces, but most of these deposits are either too impure or too far from existing markets to warrant their development.

Uses

Quartz, quartzite, and, in some cases, sandstone and sand, are used as fluxes in smelting base-metal ores low in silica. Lump quartz, quartzite, and well-cemented sandstone are used in the manufacture of silicon and ferrosilicon.

Quartz and quartzite, crushed to pass an 8-mesh screen, are used in the manufacture of silica brick for furnace linings.

Sand, either naturally occurring or produced by crushing quartz, quartzite, or sandstone, is used in the manufacture of glass, for the production of silicon carbide, for sand-blasting purposes, for poultry grits, for the manufacture of silicates, etc.

Naturally occurring sand, or sand produced by reduction of sandstone to grain size, is used extensively in the foundry industry for moulding purposes.

Silica sand is used in the hydraulic fracturing of oil-bearing formations. This consists of pumping a viscous fluid containing suspended sand into the oil-bearing strata under pressure sufficient to cause fracturing and parting of the formation. When the pressure is released, the sand remains as a propping agent to hold the fracture open and thus provides a permeable passage for the flow of oil. The amount of sand used varies greatly but is generally from 5,000 to 15,000 pounds per treatment.

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 a filler in rubber and asbestos-cement products, as an extender for paint, and as an abrasive ingredient in soaps and scouring powders.

Quartz crystals free of flaws, and possessing the necessary piezo-electric properties, are used in radio-frequency control apparatus.

Specifications

Typical specifications for the most important uses of silica are given below:

1. Silica Sands

For Glass-making. The silica content of sand used in the manufacture of glass should be 99% or more. The iron content, for most types of glass, should be less than 0.04% and that for other impurities, such as alumina, lime, magnesia, and alkalies, should be low. Uniformity of grain size is very important; glass sand should be between 20- and 100-mesh in size with a minimum of coarse or fines.

For Silicon Carbide. Silica sand for use in silicon carbide manufacture should have a silica content of 99%. The iron and alumina contents should each be less than 0.10%. Lime, magnesia and phosphorus are objectionable. A coarse-grained sand is preferred for silicon carbide manufacture; however finer sands are sometimes used. All sand should be + 100-mesh while the bulk of the sand should be + 35-mesh in size.

For Hydraulic Fracturing. Sand used in the hydraulic fracturing of oil-bearing formations must be clean and dry and have a high compressive strength. The grain size of sand used for the purpose must be closely controlled; all sand should be between 20- and 35-mesh. The grains should be well rounded to permit easy placement and to provide for maximum permeability.

For Foundry Use. Silica sands for foundry use vary greatly in screen size and chemical composition. The purity and size of sand used depends upon the type of casting to be produced and the foundry practice followed. 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.

For Sodium Silicate. Sand for use in the manufacture of sodium silicate should have a silica content of 99%. The alumina content should be less than 1%, the combined lime and magnesia content less than 0.5%, and that of the iron less than 0.1%. All sand should be between 20- and 100-mesh in size.

For Sand Blasting. A coarse, closely-sized sand is generally preferred for use in sand blasting. Grain size is usually between 8- and 48-mesh. The physical properties, such as shape of grains, friability, and hardness, are very important and have a marked bearing on the effectiveness of any sand used for this purpose.

2. Lump Silica

For Ferrosilicon. The quartz, quartzite or well-cemented sandstone used in the manufacture of ferrosilicon should have a silica content of 98%. The iron and alumina contents should each be less than 1% and those for the total iron and alumina less than 1 1/2%. Lime and magnesia should each be less than 0.2%. The silica used in the manufacture of ferrosilicon is generally all -6 inches, + 1 inch in size.

As a Flux. The composition and amount of silica used as a flux in metallurgical operations is dependent upon the composition of the ore being fluxed.

For Silica Brick. The silica content of quartz or quartzite used in the manufacture of silica brick should be 97%. The iron and alumina contents should each be less than 1% and that of other impurities such as lime and magnesia should be low.

3. Silica Flour

For Ceramics. The silica content of flour used for ceramic purposes should be 98%. The iron and alumina contents should each be under 0.10%. The silica is generally all -325-mesh in size.

As a Filler. The silica content of flour used for this purpose should be quite high but varies depending upon industrial requirements. A white colour is quite important and all silica should be -150-mesh in size.

Price

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, cost from $7 to $9 per ton.

SODIUM SULPHATES

By G. F. Carr

Production of natural sodium sulphate in Canada in 1955 amounted to 178,888 tons valued at $2,799,715, representing 13 per cent increase in tonnage and 17 per cent increase in value over that of the previous year. The 1955 value of production is an all-time high, although 1951 was the peak year as regards the amount produced. As in previous years, the entire output came from Saskatchewan. Imports, amounting to 29,927 tons valued at $574,440 in 1955, were slightly lower than in 1954, but exports rose 15 per cent to an all-time high of 75,833 tons valued at $1,274,183.

Sodium Sulphate - Production, Imports and Exports

	1955 Short Tons	1955 $	1954 Short Tons	1954 $
Production(shipments)	178,888	2,799,715	158,417	2,385,573
Imports				
United States	18,871	345,708	19,112	308,986
United Kingdom	11,056	228,732	11,123	173,666
Total	29,927	574,440	30,235	482,652
Exports *				
United States	75,833	1,274,183	66,049	1,039,284
Consumption				
Pulp and paper......	137,555		134,533	
Glass, including glasswool	2,722		2,276	
Medicinals	37		20	
Soaps	1,555		1,264	
Total accounted for..	141,889		138,090	

* From "United States Imports of Merchandise for Consumption".

Large reserves of sodium sulphate occur in beds and in the form of highly concentrated brines in many lakes in Saskatchewan, Alberta, and British Columbia.

Domestic Producers

There were four producers of natural sodium sulphate in 1955. They were: Ormiston Mining and Smelting Company Limited, at Ormiston; Midwest Chemicals Limited, at Palo; Sybouts Sodium Sulphate Company Limited, at Gladmar; and Saskatchewan Minerals, Sodium Sulphate Division, with plants at Chaplin and Bishopric.

While production methods vary somewhat, the general trend is towards the production of a higher-grade product by means of the crystallizing pond. In some lakes, the sodium sulphate occurs as an actual bed in a dried-up lake or under a saturated brine; in others, as a brine with little or no actual crystal beds. In late summer, the brine in all lakes is usually almost saturated and is pumped from the lake into an enclosed pond. After being subjected to more evaporation and the effects of cooler weather, the sodium sulphate crystallizes out and the excess brine is returned to the main lake. The crystal, or Glauber's salt, is collected and stockpiled. It is then fed to a dehydrating plant to remove the water of crystallization, which amounts to over 50 per cent of the weight of the crystal. A dehydrating plant usually consists of a simple rotary kiln and a crushing and screening plant. The finished salt, commonly known as "salt cake", is shipped in bulk. The product from this crystallizing pond method is usually purer than that produced from the mining of the salt beds with their other salts and silt.

Uses and Prices

The largest single use of sodium sulphate is in the sulphate process for making kraft pulp. Kraft pulp is used chiefly in the manufacture of brown wrapping paper and corrugated board boxes in which a high degree of strength is required.

Sodium sulphate is used in some of the synthetic detergent powders as a diluent and to improve the detergent action. It is also used in the manufacture of heavy chemicals, among which are sodium carbonate, sodium silicate, sodium sulphide, and sodium hydroxide.

Other minor uses of sodium sulphate are in the glass, dye, and textile industries. Small amounts are used for medicinal purposes, and for tanning.

The price of sodium sulphate varies considerably, depending upon the duration and size of contract and the purity of the salt cake supplied.

SULPHUR AND PYRITES

By T. H. Janes

Production of sulphur in Canada in 1955 from all sources reached an all-time high of 654,419 short tons compared to 551,071 tons in 1954. The suphlur content of by-product pyrites shipped increased from 311,159 tons in 1954 to 403,986 tons in 1955. The increase in total sulphur production and pyrites shipped can be attributed mainly to the first complete year's operation of the Noranda sulphur-sulphur dioxide-iron ore plant at Port Robinson, Ontario. An increase in elemental sulphur recovery from natural gas in Alberta to 25,976 tons was recorded.

The world sulphur supply continued to improve during 1955 despite steadily increasing demands. Developments in Canadian sulphur production during the year are outlined later in the review. The development of salt dome deposits on the Isthmus of Tehuantepec, Mexico, continued and production increased from about 150,000 long tons in 1954 to nearly 500,000 tons in 1955. Further domes are being developed and it is expected that Mexico will become a major supplier. In the United States, production of sulphur from salt domes and from natural gas continued to climb. One new dome came into production and a second was being developed.

Consumption Pattern of Sulphur in Canada

The pulp and paper industry remains the largest consumer of sulphur in Canada. In 1954, of an apparent total consumption of 672,590 short tons, this industry used approximately 334,000. Of this, 268,607 was elemental sulphur, the remainder being obtained by roasting pyrite or in the from of liquid sulphur dioxide (SO_2) from Canadian Industries Limited's plant at Copper Cliff, Ontario.

In 1954, about 332,000 tons of sulphur or its equivalent was used in making sulphuric acid. Of this amount, approximately 200,000 tons was used in making fertilizers with most of this sulphur being derived from stack gases. The remaining 132,000 tons of sulphur used in acid manufacture was contained in stack gases (20,000 tons), pyrites (50,000 tons), and as elemental sulphur, domestic and imported. This acid was in turn used in a wide variety of manufacturing processes.

The rubber, insecticide, and match industries consume approximately 7,000 tons of sulphur a year.

Sulphuric Acid

The production and consumption of sulphuric acid in Canada tend to remain in fairly close balance, as shown in the table below.

North American Cyanamid used sulphur dioxide gas from Noranda's Port Robinson plant to make acid for the manufacture of fertilizers at its Welland works.

Inland Chemicals (Canada) Limited, at its acid plant adjoining the Sherritt Gordon refinery at Fort Saskatchewan, Alberta, started operations in the fall of the year. Rated capacity of the plant is 100 tons of acid a day, of which Sherritt Gordon has contracted for a large portion for the manufacture of ammonium sulphate fertilizer. Capacity operation of the Sherritt Gordon plant will require about 25 tons of sulphur a day, which will be supplied by Shell Oil Company's plant for extracting sulphur from hydrogen sulphide in the natural gas of the Jumping Pound field, west of Calgary, Alberta.

The sulphuric acid used in processing uranium ores by Gunnar Mines Limited and Eldorado Mining and Refining Limited at Uranium City, Saskatchewan, and by Eldorado at Great Bear Lake, Northwest Territories, is all made at the plants from sulphur extracted from Alberta natural gas.

Two new sulphuric acid plants under construction at the end of 1955 will be in operation in 1956. Noranda Mines Limited is building a 500-ton acid plant at Cutler, Ontario, near Blind River, similar to the one operated at Port Robinson. Feed for the plant will be pyrite flotation concentrates from the Company's operations in the Noranda area of Quebec. The acid will be used for processing uranium ores in the Blind River area. Northwest Nitro Chemicals Ltd. is building a new $25,000,000 plant at Medicine Hat, Alberta, to make

Sulphur - Production and Trade

	1955 Short Tons	1955 $	1954 Short Tons	1954 $
Production (sulphur content)				
By-product pyrites shipped *	403,986	3,740,383	311,159	2,663,499
Smelter gases	224,457	2,244,570	221,247	2,212,470
Total	628,443	5,984,953	532,406	4,875,969
Sulphur from natural gas (shipments)...............	25,976		18,665	
Total, all sulphur	654,419		551,071	
Imports				
All from United States	373,373	9,386,983	310,127	7,816,301
Exports **				
Sulphur content of by-product pyrites				
United States		1,293,373	140,122	955,207
United Kingdom		458,202	25,922	388,300
Netherlands		210,000	2,940	30,000
France..................		40,000	2,500	30,000
Other countries		-	17,124	163,064
Total		2,001,575	188,608	1,566,571

* Includes also sulphur content of sulphur dioxide gas obtained from roasting zinc concentrates.

** Starting in 1955 only dollar values are shown in the official export statistics of pyrites.

ammonia, sulphuric acid, and fertilizers, using sulphur in liquid form delivered by insulated tank cars from Canadian Gulf Oil's Lethbridge plant, described below.

During the year Nichols Chemical Company Limited completed the second expansion since 1950 of its acid plant at Valleyfield, Quebec. Capacity at this plant has been doubled in that time. The Company operates two other sulphuric acid plants - at Sulphide, Ontario, and Barnet, British Columbia. Feed for all three is obtained from domestic by-product pyrite producers.

In British Columbia, The Consolidated Mining and Smelting Company of Canada Limited (Cominco) makes acid at Trail and Kimberley. The Trail plant uses SO_2 from the lead-zinc smelter stack gases and the Kimberley gas from the roasting of by-product pyrrhotite recovered in treating lead-zinc ores. Cominco uses the acid to make phosphatic fertilizers.

Canadian Industries Limited makes acid in two Ontario plants. At Copper Cliff, the company extracts SO_2 from the stack gases of International Nickel Company's nearby smelter to manufacture the acid. At Hamilton, imported brimstone is used to make sulphuric acid, some of which is used by C.I.L. for fertilizer manufacture; the remainder is sold.

Aluminum Company of Canada Limited makes sulphuric acid at Arvida, Quebec, from sulphur dioxide gas resulting from the roasting of zinc concentrates from Barvue Mines Limited; some imported sulphur also is used. The acid is used in the company operations.

Production, Imports, Exports, and Apparent Consumption of Sulphuric Acid in Canada, 1951 to 1955

(short tons of 100% acid)

Year	Production	Imports	Exports	Apparent Consumption
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	922,673	110	21,930	900,853
1955	952,910	151	29,578	923,483

Consumption of Sulphuric Acid by Industries in Canada, 1953 and 1954

(short tons of 100% acid)

	1955	1954
Fertilizers	577,100	603,200
Heavy Chemicals	139,700	123,400
Non-ferrous smelters and refiners	24,500	19,300
Coke and gas	37,900	31,000
Petroleum refining	6,500	5,400
Leather tanning	2,300	1,900
Iron and steel	35,300	25,800
Electrical apparatus	8,100	6,000
Plastics	15,000	13,700
Soaps and washing compounds	11,300	10,600
Sugar refining	300	300
Pulp and paper	5,700	9,300
Vegetable oils	100	100
Adhesives	200	500
Miscellaneous	70,800	72,000
Total	937,800	922,500

Liquid Sulphur Dioxide

Canadian Industries Limited makes liquid sulphur dioxide from smelter gases resulting from the oxygen flash smelting of copper concentrates by International Nickel Company at its Copper Cliff works. Rated capacity of the plant, which adjoins the smelter, is 90,000 tons of liquid sulphur dioxide a year, which is used by pulp and paper mills within economic rail haulage distance of the plant.

Pyrites in Canada

Pyrites shipments (sales) in Canada in 1955 contained 403,986 short tons of sulphur compared to 311,159 tons in 1954. Figures for both years include the small tonnage of zinc concentrates shipped to Arvida for roasting.

Practically all pyrite is obtained as a flotation by-product of the treatment of base-metal ores and is a relatively low-price commodity. Pyrite output of the major producers is generally sold by negotiation between producers and consumer for future delivery over a period of time. Small shipments to occasional purchasers command higher prices, perhaps up to 25 cents per long ton unit (22.4 lb) or more. Most pyrite, however, on a tonnage basis over a period of time will command from perhaps 7 to 12 cents per long ton unit f.o.b. mine.

The value of pyrite exported in 1955 was $2,001,575 compared to $1,566,571 in 1954. The quantity exported is not available for publication but, as in 1954, by far the major portion was sold to acid manufacturers in the United States. The remainder found markets in the United Kingdom, Netherlands, and France.

Noranda Mines Limited, the largest producer in Canada, ships pyrite recovered in the milling of copper-zinc ore at the Horne Mine, Noranda, Quebec, to acid manufacturers in the United States and Canada. In 1955 initial production of pyrite from the Noranda-controlled West Macdonald mine was shipped to the company's plant at Port Robinson, Ontario. The ore from West Macdonald, carrying about 80 per cent pyrite and low zinc values, is milled at the nearby Waite Amulet mill. At Port Robinson, Noranda produces iron sinter, sulphur, and sulphur dioxide gas. Plant capacity is rated at 300 tons of pyrite daily, from which 72,000 tons of iron sinter, 36,000 tons of sulphur as sulphur dioxide gas, and 18,000 tons of elemental sulphur a year could be produced. The SO_2 is used by North American Cyanamid, in its nearby plant, to make acid for fertilizer manufacture. Noranda, as outlined earlier, is building an acid plant near Blind River, Ontario, that will use pyrite as feed and will be similar to the one at Port Robinson.

Noranda has large reserves of pyrite in the No. 5 orebody in its Horne mine at Noranda. Reserves are estimated at 100 million tons grading 50 per cent pyrite and carrying low copper values.

Other producers of by-product pyrite from the treatment of base metal ores included Weedon Pyrite and Copper Corporation Limited, Waite Amulet

Mines Limited, Normetal Mining Corporation Limited, Quemont Mining Corporation, Ltd., and East Sullivan Mines Limited in Quebec; Britannia Mining and Smelting Company Limited at Britannia Beach, British Columbia; and Buchans Mining Company Limited at Buchans, Newfoundland.

Seven pulp and paper mills in Canada burn pyrite for all or part of their sulphur requirements. Four of these are in Quebec and one each in Newfoundland, Ontario, and British Columbia. Two companies use liquid sulphur dioxide from C.I.L. at Copper Cliff for process requirements.

It is unlikely that a pyrite deposit in Canada will be operated in the foreseeable future for pyrite alone. It is a relatively low-priced commodity and its mining and concentration to a minimum 48 per cent S would not be economic.

Elemental Sulphur Recovery

The recovery of sulphur, in elemental form, from sour natural gases is a development of significant consequence in North America since the end of World War II only. From an average yearly recovery of about 25,000 long tons of sulphur during the 1943 to 1947 period in the United States, production of sulphur from natural gas had risen to about 300,000 long tons in 1954, as a result of the greatly increased use of natural gas. The gas must be cleaned of hydrogen sulphide (H_2S) and other impurities before it is used. The amount of H_2S in natural gas varies with the field, but one million cubic feet of H_2S gas contains approximately 44.6 tons of sulphur, of which 80 to 90 per cent is recovered.

Western Canada, particularly Alberta and the Peace River district of British Columbia, has tremendous reserves of natural gas. The H_2S content of the Pincher Creek, Jumping Pound, and Turner Valley fields of Alberta has been estimated at 8, 4, and 2 per cent respectively; other fields are reported to carry as high as 30 per cent.

Canada's first production of sulphur from natural gas took place in May 1951, when the plant of Shell Oil Company of Canada at Jumping Pound started operations. This plant cleaned daily about 25 million cubic feet of gas, from which about 15 tons of sulphur was produced. It was expanded in 1952 to a rate of about 30 tons of sulphur a day, and a further expansion of 50 long tons of sulphur a day came into production in January 1955.

The Royalite Oil Company opened a similar plant in 1952 to treat gas from the Turner Valley field and produces approximately 10,000 long tons of sulphur a year.

Present plans for the distribution of western natural gas by pipe line--notably to Eastern Canada--will probably mean a very large increase in consumption in the near future. Whether for domestic or industrial consumption, the sulphur content will have to be removed from the gas before it is used, and this will greatly increase production. It has been estimated that in another five years Canada's sulphur output may reach a total of over 1,200,000 tons, far in excess of the present consumption of about 600,000 tons annually.

Canadian Gulf Oil Company plans to recover 225 tons of sulphur a day from Pincher Creek natural gas in a $4 million plant the company is building near Lethbridge, Alberta. Completion of the plant is scheduled for September 1956.

Imperial Oil Limited is building a plant to treat 9 million cubic feet of gas per day from the Redwater field. Completion of this plant, which will recover about 20 tons of sulphur a day, is expected by November 1956.

Other Potential Sources of Sulphur in Canada

Extensive deposits of anhydrite and gypsum in Canada, particularly in Nova Scotia and New Brunswick, constitute a large potential source of sulphur and its compounds. Although these minerals are not at present an economic source of supply in Canada, plants for the recovery of sulphur as sulphuric acid and the production of portland cement from anhydrite are in operation in England, on the Continent, and in India.

A huge potential source of sulphur in Canada exists in the extensive deposits of bituminous sands along the Athabaska River in northern Alberta. The deposits are about 230 air miles north of Edmonton. Several processes for the extraction of the bitumen have been developed by the Alberta Government, the Mines Branch in Ottawa, and others. The amount of sulphur in the bitumen varies, but averages about 5 per cent. It has been estimated that a 20,000-barrel-per-day bitumen plant would result in the recovery of about 140 tons of sulphur.

World Supply Situation

Of an estimated 13,500,000 long tons of free world production of sulphur in 1955, United States sources supplied nearly 7,000,000 tons. About 5,700,000 tons of this was salt-dome sulphur, 400,000 tons from pyrites, 400,000 tons from natural gas, and the remainder from surface sulphur deposits, smelter gases, and other minor sources. Mexican production of salt-dome sulphur in 1955 has been estimated at 500,000 tons with shipments amounting to over 200,000 tons.

Research on reclaiming and recycling sulphuric acid refinery sludges has resulted, in the United States, in large savings in sulphur consumption. It has been estimated that 650,000 long tons of sulphuric acid was recycled (reused) in 1955, compared to 575,000 tons in 1954. Acid sludge reconstituted in 1955 was about 250,000 tons compared to 190,000 tons the previous year. Refinery sludges and steel-mill pickle liquor are wastes from which acid can be economically recovered.

In other parts of the free world many sulphur recovery and conservation measures have been effected since the extreme shortage of 1951-1952. With available sources of salt-dome sulphur increasing, with more extensive use of natural sulphates and pyrites for acid manufacture, and with increasing output from natural gas, it is doubtful if world supply will fall short of world demand in the foreseeable future.

Uses of Sulphur

Sulphur has long ranked as one of the basic industrial raw materials, and has become steadily more important in modern industry. There is an increasing tendency to measure a country's industrial growth in terms of sulphur consumption.

About 80 per cent of all sulphur is converted into sulphuric acid: sulphurous acid, elemental sulphur, and sulphur dioxide represent other major uses in the manufacture of such commodities as paper, foodstuffs, soaps and detergents, clothing, gasoline and lubricants, automobiles, aeroplanes, construction materials, paints and pigments, tires and tubes, and many others. Sulphur, in one or another of its forms, contributes in some measure to the manufacture of almost everything.

Prices

The Oil, Paint and Drug Reporter listed the following prices for Gulf Coast sulphur in the United States at the end of 1955:

In bulk, f.o.b. mines on contract basis, per long ton - $26.50.

In bulk to domestic and Canadian consumers, f.o.b. vessel Gulf Coast ports, per long ton - $28.00 and $29.50.

In bulk for export, f.o.b. vessel, Gulf Coast ports, per long ton - $31.00 and $33.00.

Pyrite is quoted in the same journal, f.o.b. domestic and Canadian mines, per long ton, at $3.00 and $5.00.

Including transportation charges, prices of Gulf sulphur at Canadian consuming plants would range from $35.00 to $45.00 per long ton depending on consumer's location. The price paid for Canadian by-product pyrite is subject to negotiation between buyer and seller and information on prices is not readily available. However, pyrite at the producer's plant is a relatively low-priced commodity and usually commands from $4.00 to $5.00 per long ton. Contracts usually call for 48 per cent minimum sulphur content and low moisture and metallic impurities content.

TALC AND SOAPSTONE; PYROPHYLLITE

By G.F. Carr

Production (sales) of talc and soapstone amounted to 27,160 tons valued at $338,967, slightly less in volume but more in value than in 1954. Output continued to come from the Eastern Townships of Quebec, and from Madoc, Ontario.

Talc and Soapstone - Production, Trade and Consumption

	1955 Short Tons	1955 $	1954 Short Tons	1954 $
Production (Sales)				
Ground	27,079	320,110	28,022	317,028
Sawn soapstone blocks and talc crayons	81	18,857	121	18,325
Total	27,160	338,967	28,143	335,353
Imports				
United States	10,312	330,219	11,365	349,455
Italy	1,059	47,343	991	46,852
France	11	465	13	728
India	-	-	23	950
Total	11,382	378,027	12,392	397,985
Exports				
United States	4,175	60,433	3,292	44,382
Cuba	95	1,702	25	437
Ecuador	67	886	222	2,885
Other countries	91	1,953	70	1,049
Total	4,428	64,974	3,609	48,753
Consumption				
Paints	7,872		7,240	
Roofing	9,414		7,772	
Pulp and paper	687		814	
Rubber	1,392		1,330	
Toilet preparations	540		455	
Electrical apparatus	311		598	
Clay products	3,302		2,345	
Soaps and cleaning preparations	64		106	
Insecticides and miscellaneous chemicals	5,503		9,704	
Polishes and dressings	8		13	
Misc. non-metallic mineral products	83		146	
Tanneries	7		2	
Asbestos	9		1	
Coal-tar distillation	783		2,195	
Medicinal preparation	408		372	
Total	30,383		33,073	

Exports, mainly to United States, amounted to 4,428 tons valued at $64,974, a 22-per-cent increase in volume over that of 1954 and a 51-per-cent increase over that of 1953. Imports, consisting mainly of special grades for the paint, ceramic, and cosmetic trades, principally from United States and Italy, amounted to 11,382 tons valued at $378,027, about 8 per cent less in volume than in 1954.

Talc and soapstone occur at several localities in Quebec and Ontario, in the Windermere mining division of British Columbia and adjacent portions of Alberta, on Vancouver Island, and in the southern reaches of the Fraser River watershed.

In general, talc from the Eastern Townships of Quebec is high in iron, often low in carbonates giving low loss on ignition, and somewhat off colour. It is used mainly for roofing, insecticides, and other less exacting applications.

Madoc talc, which is low in iron and relatively high in carbonates, is used for paints, ceramics and other applications where prime white colour is of first importance.

Producers

Quebec

Broughton Soapstone and Quarry Company Limited, Broughton Station, continued to produce ground talc, soapstone blocks, bricks and crayons.

Baker Talc Limited, 301-215 St. James St., W., Montreal, with mine and mill near Highwater continued production of ground talc.

Ontario

Canada Talc Industries Limited, Madoc, operating the Conley and Henderson mines, continued production of ground talc. The Henderson mine, a source of steatitic talc, has been rehabilitated in recent years after a period of idleness. The two mines are connected underground.

British Columbia

Geo. W. Richmond and Company, 4190 Blenheim St., Vancouver, continued production of ground talc for the roofing trade from imported materials.

Uses and Specifications

The roofing, insecticide, rubber, and paint industries account for the bulk of Canadian consumption. Lower-grade talc is used as a surfacing material and dusting agent for asphalt paper roofing, as a filler and dusting agent in rubber products, and as a polishing agent for wire nails, rice, peanuts, and other commodities. For paint use, colour, particle shape, packing index, and oil absorption are the principal factors. The ceramic trade demands prime white colour and the paper industry talc of high brightness, high retention in the pulp, low abrasivesness, and freedom from chemically active substances. For lubricants, talc must be soft, free from grit, and have high slip. Talc of high purity is demanded for the cosmetic and pharmaceutical trades. For preparations subject to heat treatment, such as asphaltic compounds, low ignition loss is of first importance.

Grinding specifications for cosmetic, ceramics, and filler grades vary from 95% - 98% minus 325-mesh; for roofing grades there are various specifications in the minus 80- plus 200-mesh range. Prices vary considerably owing to quality, colour, loss on ignition, and fineness of grind.

Miscellaneous uses for talc include cleaners, plaster, polishes, plastics, foundry facings, linoleum and oilcloth, oil-absorbent preparations, texiles.

Steatite, the massive, compact form of talc, is used in making ceramic electrical insulators.

Markets

Purchasers of crude talc for grinding purposes include Industrial Fillers Limited, Montreal, Quebec, and Geo. W. Richmond and Company, Vancouver, British Columbia.

Prices

According to E & MJ Metal and Mineral Markets of December 15, 1955, United States year-end prices were as follows:

Per short ton, carload lots, f.o.b. works, containers included:

Georgia
98% through 200-mesh grey - $10.50 to $11.00; white - $12.50 to $15.00.

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 per ton extra.

Virginia
200-mesh - $10.00 to $12.00; 325-mesh - $12.00 to $14.00; crude - $5.50.

Canadian prices quoted in The Northern Miner, December 29, 1955, were as follows:

Per short ton, in bags, f.o.b. Madoc, Ontario:

		$
Filler grade,	50-lb bags	- 11.50 - 15.00
Cosmetic	"	- 26.00 - 50.00
Ceramic	"	- 17.50 - 26.00
Roofing	70-lb bags	- 10.00 - 13.75

Tariffs

Canadian

	Crude or Ground	Micronized (under 20 microns)
British preferential	10%	free
Most favoured nation	15%	5%
General	25%	25%

United States

Talc, steatite or soapstone and French chalk	
Crude and unground	1/8¢ per lb
Cut, sawed or in blanks, crayons, cubes, discs or other forms	1/2¢ per lb
Ground, powdered, pulverized or washed (except toilet preparations) valued per ton:	
Not over $14.00	
Talc and steatite or soapstone	8 3/4% ad. val.
French chalk	17 1/2% ad. val.
Over $14.00	17 1/2% ad. val.

Note:

Tariffs are subject to change at any time and should be verified through a customs agency at time of shipment.

PYROPHLLITE

Pyrophyllite, a mineral similar to talc but with alumina in place of magnesia, may generally be used for the same purposes as talc. Pyrophyllite has been produced intermittently in Newfoundland from a large deposit near Manuels, Conception Bay. With the exception of a few sample shipments, there has been no production since 1947.

VERMICULITE

By T. H. Janes

Domestic requirements for raw vermiculite are filled by imports from the United States and the Union of South Africa. There has been no production of vermiculite in Canada to date.

Vermiculite - Trade and Consumption

	1955	1954
	$	$
Imports, crude		
United States........	284,152	275,041
Union of South Africa.	71,259	73,117
Total...............	355,411	348,158

	1954		1953	
	Short Tons	$	Short Tons	$
Consumption				
Ore used in miscellaneous non-metallic mineral industry.....	21,964	576,965	25,213	593,774
Products produced (particulars not available)...........		1,419,333		1,466,944

Description and Properties

Vermiculite is the term applied to a group of minerals composed of hydrated magnesium-aluminum silicates that show the characteristic basal cleavage of micas. The vermiculite minerals occur as soft, pliable, inelastic laminae commonly associated with intrusions of ultrabasic rocks, such as serpentines, peridotite, dunites, and pyroxenites. They often occur with phlogopite and biotite mica but possess exfoliating properties on heating in contrast to the micas that possess no 'expansion properties'. They are considered to have been formed by the hydrothermal alteration of mica or of the primary ultrabasic host rock. Vermiculite ranges in colour from black through brown and olive green to light buff and the golden yellow typical of South African material.

Field identification of vermiculite can be readily carried out by placing a thin flake of the suspected material in a match flame or against a lighted cigarette. If rapid, accordion-like expansion occurs the material is one of the vermiculite family -- if no expansion occurs the flake was mica. An expanding vermiculite will swell to 14 times its original volume or to as much as 26 times for some South African materials. Low-grade ores of vermiculite are considered to be material containing 35 per cent or less vermiculite. Montana deposits, being mined now, average perhaps 50 per cent with some zones grading up to 80 per cent vermiculite.

World Deposits and Occurrences

The United States, Union of South Africa, and Russia are the only countries presently producing raw vermiculite. Reserves in Montana and in the Palabora area of the Transvaal are large. Data are not available on the Russian deposits in the southern Urals but reserves are said to be extensive.

Large deposits occur in the State of Minas Gerais in Brazil, some of which have been worked. In addition to deposits being operated in Montana and South Carolina occurrences of vermiculite have been noted at several locations in the United States. Occurrences have also been noted in Australia and near Perth in Ontario, Canada.

Uses

The low bulk density, comparatively high refractoriness, low thermal conductivity, and chemical inertness make vermiculite satisfactory for many types of thermal and acoustic insulation.

Expanded vermiculite is used as loose insulation in buildings, as an aggregate in lightweight concrete, plastic, and asphaltic compounds. It is used in the manufacture of molded articles and compositions with numerous binders and as refractory insulation of several types. Its sound-proofing and fire-retardant properties, coupled with its low bulk density and chemical inertness, make expanded vermiculite useful in making fire-resistant wallboard and acoustic tile, and in building partitions, floors, and roofs where fire proofing and sound proofing are desirable. It is used as a rooting medium and soil conditioner and its uses as a diluent in dry chemicals, a pigment and extender in paint, an absorbent, and as a decorative filler in wallpaper, are expanding.

Specifications and Markets

Raw vermiculite is generally sold to the processor as a sized concentrate ready for exfoliation (expansion) by heating. Foreign impurities should not exceed 5 per cent and total unexpandable material 10 per cent.

Size classifications according to end uses are approximately as follows: acoustic tile- minus 1/2" plus 3-mesh; loose insulation - minus 3-mesh plus 14-mesh; plaster and concrete aggregate and agricultural uses - minus 6- or 8-mesh plus 65-mesh.

Bulk densities of finished vermiculite products range from 5 to 7 pounds per cubic foot for loose insulation to 8 pounds or more for finer grades.

In 1955, there were four companies expanding vermiculite at nine plants in Canada as follows:

Name of Company	Plant Locations
F. Hyde and Company, Limited	Montreal, Que. St. Thomas, Ont. Toronto, Ont.
Insulation Industries (Canada) Ltd.	Winnipeg, Man. Vancouver, B.C. Calgary, Alta.
Siscoe Vermiculite Mines Ltd.	Cornwall, Ont. Toronto, Ont.
Vermiculite Insulating Limited	Montreal, Que.

There are more than fifty plants expanding vermiculite in the United States.

Prices

According to E & M J Metal and Mineral Markets of December 15, 1955, prices of vermiculite (raw) were as follows:

Per short ton, f.o.b. mines, Montana	-	\$9.50 - \$18.00
South African, c.i.f. Atlantic ports	-	\$30.00 - \$32.00

WHITING

By H. M. Woodrooffe

Canadian production of whiting substitute during 1955 was about 5.3 per cent less than in the previous year. Output at 16,007 tons was valued at \$162,731 compared with 16,913 tons at \$181,112 in 1954. Included in the statistics is a quantity of finely-ground off-white limestone used as an industrial filler.

Whiting substitute as opposed to true whiting is a term applied to limestone, calcite and marble, white in colour and finely ground. In Canada this material is also referred to as domestic whiting or marble flour and is produced in Ontario, Quebec and British Columbia. Marl of good colour and free of organic matter is a potential source of whiting substitute, but there has been no production in Canada from this source for several years.

Whiting and Whiting Substitute - Production, Trade and Consumption

	1955 Short Tons	1955 $	1954 Short Tons	1954 $
Production				
Stone processed for whiting substitute				
Marble..................	11,764	141,169	11,767	141,204
Limestone..............	4,243	21,562	5,146	39,908
Total	16,007	162,731	16,913	181,112
Imports				
Whiting, gilder's whiting, and Paris white				
United States	5,785	224,303	5,268	187,584
United Kingdom	3,413	52,368	4,177	57,069
Other countries	2,707	21,208	1,379	9,158
Total	11,905	297,879	10,824	253,811
Chalk, prepared				
United States............		4,024		3,148
Miscellaneous--chalk, china, Cornwall or Cliff stone (ground or unground), and mica schist				
United States		2,430		2,151
Italy		226		200
United Kingdom		195		-
Total....................		2,851		2,351

	1954 Short Tons	1953 Short Tons
Consumption, ground chalk, whiting and whiting substitute		
Explosives	336	347
Medical and pharmaceuticals..........	28	28
Paints	11,755	11,632
Soaps	61	62
Toilet preparations	8	13
Electrical apparatus	462	464
Enamelling	106	149
Linoleum and oilcloth	6,013	5,968
Rubber goods	6,845	6,646
Tanneries	280	263
Non-ferrous smelters	50(e)	50(e)

(e) estimated

	1954 Short Tons	1953 Short Tons
Consumption (continued)		
Gypsum products.......	234	210
Polishes and dressings..	3	3
Adhesives	58	44
Asbestos products......	579	662
Miscellaneous chemicals	1,051	1,127
Other products.........	501	-
Total.................	28,370	27,668

Industrial Fillers Limited, Montreal, quarries a white marble near St. Armand, Bedford county, producing a whiting substitute in its Montreal plant. Beale Quarries Limited, Vananda, Texada Island, in British Columbia, prepares it from a white marble quarried there. Production in Ontario is restricted to an off-colour limestone which is ground, air-classified, and marketed for uses in which an off-white product is acceptable.

Although not produced in Canada, by-product whiting, a precipitated calcium carbonate, is obtained in some countries during the manufacture of caustic soda.

True whiting is prepared from chalk, a fine-grained, light-coloured stone composed of the calcareous residue of microscopic marine organisms. It is extremely white in colour and is finely ground and sized. True whiting is imported into Canada from Europe and the United States.

Uses

A number of industries use whiting in their manufacturing processes. It is used in the manufacture of both oil and cold-water paints; for the former it must be finely ground and free of certain impurities. It is also used in the manufacture of putty where low oil absorption is usually the characteristic desired. The rubber industry uses whiting as a filler, where it must be finely ground and contain only minor impurities. Whiting is also used in linoleum and oil cloth, in moulding plastics, polishes, cleaning compounds, and paper. The characteristics generally desired are proper particle size and shape, white colour, and an absence of grit.

The ceramic industry uses true whiting in glazing and the manufacture of whiteware.

Prices

In 1955 the price of whiting substitute per ton, bagged, ranged between $15.00 and $20.00 per ton f.o.b. plants.

COAL

By E. Swartzman

Although the Canadian coal industry still showed the effect of increasing competition from other fuels, it appeared that during 1955 it reached at least a tentative point of stability. Production at 14,818,880 tons was only 0.6 per cent below that of 1954 but still 22.6 per cent below the record of 19,139,112 tons in 1950. Nova Scotia contributed about 39 per cent of the total, Alberta 30, Saskatchewan over 15, British Columbia and Yukon 10, and New Brunswick 6. New Brunswick, Saskatchewan, British Columbia and Yukon showed, collectively, an increase of 10 per cent over 1954, whereas Nova Scotia's output decreased by about 1.9 per cent, and that of Alberta by somewhat over 8 per cent; bituminous coal accounted for approximately 71 per cent of the Alberta decrease.

Apparent consumption increased from 32,788,268 tons in 1954 to 33,383,371 tons in 1955, the increased requirements being met by the importation of additional bituminous coal from the United States. Imports made up about 58 per cent of coal consumed compared with 56 per cent in 1954. The increased requirements may be accounted for in part by a greater demand for fuel at the beginning of the 1955-56 heating season than at the beginning of the previous season, and in part by increased demand for coal brought about by industrial expansion - although this increase was not commensurate with the expansion owing to competition from liquid and gaseous fuels.

It is of interest to note that this year the average value of Canadian coal showed a decrease for the first time in several years from $6.48 per ton in 1954 to $6.31 in 1955, while imported coal continued to decrease from $5.70 per ton in 1954 to $5.46 per ton in 1955. This is probably partly due to the increased competition of other fuels, but it also reflects the influence of decreases in costs as a result of increased and improved mechanical mining and preparation.

The proportion of coal produced in Canada by strip mining continued to increase, over 36 per cent of the output in 1955 being produced in this manner, Nova Scotia being the only province where strip mining was not practised. In Saskatchewan practically the whole output was strip mined, in New Brunswick over 80 per cent, in Alberta over 47 per cent, and in British Columbia and Yukon over 20 per cent.

The output per man-day in strip mining varies from about 5 to 23 short tons, depending upon thickness and type of cover and thickness of coal seam in relation to that of the cover, but in all cases it is greater than for underground mining. Considering the average for all the provinces, the output in 1955 was about 13.3 tons per man-day for strip mining as against 2.7 for underground. In both cases there was an increase in output per man-day from 1954, strip mining showing an increase of over 6 per cent and underground mining almost 4 per cent. Underground mining has shown a steady increase in productivity per man-day during the last few years, which reflects the influence of increasing and improved mechanization.

Tables showing production, consumption and trade statistics are given at the end of this review.

Consumption of Briquettes

Briquettes available for consumption decreased from 951,837 tons in 1954 to 776,761 tons in 1955. About 80 per cent of the amount marketed in Canada was used by the railways, mainly as locomotive fuel. Owing to increased dieselization of the railways, the market for locomotive briquettes continued to decrease, with the result that a former large producer in the Mountain Park area had ceased making railway briquettes, its output being reduced to just under 11,000 tons of household briquettes. Saskatchewan output of briquettes, used almost entirely for household purposes, is made from carbonized lignite. The Alberta output is prepared from semi-anthracitic coal in the Cascade area, and medium volatile bituminous coals in the Crowsnest and Mountain Park area. In British Columbia medium volatile bituminous coals are briquetted in East Kootenay (Crowsnest) area.

Imports of briquettes from the United States in 1955 amounted to 124,216 tons, a decrease of 3,947 tons from 1954. These briquettes, used almost entirely for domestic purposes, are made from low-volatile bituminous coals and from anthracite, alone or mixed with bituminous coking 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 from the Inverness area. The New Brunswick output, consisting entirely of high volatile bituminous coking coal mined from one thin seam, came 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 and domestic purposes. In 1955 2,380,944 tons, approximately 36 per cent of the output, was shipped to central Canada for commercial and railway use, compared to 2,569,299 tons in 1954.

Saskatchewan

Only lignite is produced, chiefly from the Bienfait, and Roche Percee fields in the Souris area; approximately 52 per cent of the 2,293,816 tons produced in 1955 was shipped to Manitoba for domestic and industrial use, the rest being distributed within Saskatchewan for similar purposes.

Alberta

Almost all types of coal are 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. However, owing to the shrinking market, mining in the Mountain Park area all but terminated during the year. In the Lethbridge, Coalspur, Saunders and several other areas of the foothills, lower-rank bituminous non-coking coals are available, but production is presently confined mainly to the Lethbridge and Coalspur areas. In the latter area, one of the major producers ceased operation owing to the railway dieselization programme. The coals in these areas are distributed mainly for domestic and commercial use. The coal in the Drumheller, Edmonton, Brooks, Camrose, Castor, Carbon, Sheerness, Taber, Pembina and Ardley areas is classed as sub-bituminous and that in the Tofield, Redcliff and several other areas is on the border of sub-bituminous and lignite. These are mainly domestic and commercial coals, but increasing proportions are being used industrially, especially for thermal power production. The Cascade area was the only field that produced semi-anthractie.

Whereas in 1954 about 49 per cent of Alberta's output was bituminous coal, in 1955 this had dropped to 47 per cent the remainder being mainly sub-bituminous coal. Of the total production only about 8 per cent was shipped to central Canada mainly for commercial 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 areas. Small quantities of sub-bituminous coal have been produced in the Princeton field. In the Crowsnest area, the largest producing field, medium temperature (by-product) coke is manufactured chiefly for inudstrial consumption. The briquetting plant that started operating during 1953 produced well over 150,000 tons of railway briquettes in 1955. Mining on Vancouver Island was confined almost entirely to the Comox area.

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 product of the coal industry by the use of modern methods of beneficiation such as cleaning, drying, dust- and freeze-proofing, and briquetting.

During the year the first mechanical coal-cleaning plant for cleaning slack (2 x 0 in.) coal was established in the Minto area of New Brunswick. The success of this plant from a technical and coal marketing viewpoint will no doubt encourage other enterprising operators to seriously consider similar action. In Nova Scotia, plans went ahead for the establishment of a large central mechanical cleaning plant to process coals from the mines of the largest operator in the Sydney area. One of the smaller operating companies gave serious consideration to the possibility of introducing mechanical cleaning at one of its new mines where a continuous mechanical miner was recently introduced. In this regard, it should be noted that the "Dosco Miner", a continuous mechanical miner of the ripper type, was being increasingly introduced in the mines of the Sydney area, a move which practically necessitates the parallel introduction of mechanical coal cleaning.

A major problem continues to be the beneficiation of fines, both from the viewpoint of preparing a product with a uniform and satisfactory ash content and the production of a lump fuel that will find greater acceptance in the domestic and industrial markets. In this regard additional equipment has been installed at certain Western collieries for the cleaning and drying of fines.

During the year the Mines Branch, with a view to aiding the industry in various beneficiation problems, has co-operated with industrial organizations in conducting laboratory- and plant-scale tests both as to coal cleaning and the use of fine coal as a reductant in the smelting of minerals.

Competition

The data following indicate the extent to which oil and natural gas are continuing to replace coal.

Fuel Consumed by Railway Locomotives, 1943-1955

Year	Coal[a]	Fuel and Diesel Oil [a]	Estimated Heat Equivalent of Oil in Terms of Coal[b]	Estimated Heat Equivalent of Oil as a Percentage of Total Coal & Oil
	Thousands of Tons	Millions of Imp. Gal.	Thousands of Tons	%
1943	11,987	79.0	538.6	4.3
1944	11,993	80.9	551.6	4.4
1945	12,084	78.3	533.8	4.2
1946	11,632	82.2	560.4	4.6
1947	12,331	86.7	591.1	4.6
1948	12,422	96.3	656.6	5.0
1949	11,444	139.3	949.7	7.7
1950	10,452	217.9	1,485.6	12.4
1951	10,505	260.4	1,775.4	14.5
1952	9,798	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

(a) Railway Transport, Dominion Bureau of Statistics.
(b) Estimated in terms of coal at 13,000 B.t.u./lb, taking oil at 9.33 lb./gal. with a calorific value of 19,000 B.t.u./lb.

Preliminary surveys indicate a further decrease of approximately 14 per cent from 1954 in coal consumed by locomotives. An increase of approximately 17.8 per cent is recorded in the use of fuel and diesel oil by locomotives. Increased efficiency in the use of oil in diesels is apparently the main reason for the continued conversion to diesels with attendant reduction in the use of coal- or oil-burning steam locomotives. This is indicated clearly in the following table. Although the gross ton miles of total traffic (freight and passenger) increased by 39 per cent from 1946 to 1955, the total fuel consumed (coal and oil, the latter in terms of equivalent coal) decreased by 32.6 per cent in the same period. Oil consumption increased in this period from 4.6 per cent to 31.9 per cent of the total fuel used.

Relation of Fuel Consumed by Railway Locomotives to Gross Ton Miles of Traffic[(a)], 1946-1954

Year	Traffic in Millions of Gross Ton Miles[(b)]	Coal and Oil Consumed in Terms of Coal[(c)]	Fuel Consumed in Terms of Tons Coal per Million Gross Ton Miles Traffic	Oil Consumed As Percentage of Total Fuel
		Thousands of Tons		%
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

(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 B.t.u./lb, taking oil at 9.33 lb /gal. with a calorific value of 19,000 B.t.u./lb.

The use of oil for domestic and building heating and of natural and manufactured gas for domestic, commercial and industrial purposes continued to increase. Whereas the use of fuel oil has increased since 1947 by about 225 per cent, coal and coke consumption has decreased by about 37 per cent for the same period. During 1947, the oil consumed, estimated as the heat equivalent in terms of coal, amounted to 20.3 per cent of the total fuel used, in 1954 it amounted to almost 56 per cent.

Consumption of Fuels for Domestic and Building Heating, 1947-1955

Year	Fuel Oil and Distillate[(a)]		Natural Gas[(b)]	Manufactured Gas[(b)]	Coal & Coke[(c)]
	Gal. or	Bbl.	M cu ft	M cu ft	Short Tons
1947	569,569,808	16,273,423	28,198,903	20,525,540	13,117,157
1948	596,263,716	17,036,106	30,824,172	21,570,466	13,429,436
1949	655,686,161	18,733,890	32,164,544	23,864,281	12,473,258
1950	863,447,542	24,669,930	40,004,435	20,363,572	12,653,394
1951	1,042,546,139	29,787,032	43,048,025	24,072,327	11,436,717
1952	1,220,237,423	34,863,926	43,328,304	22,527,092	10,515,475
1953	1,350,478,654	38,585,104	46,390,654	21,418,959	8,941,428
1954	1,638,288,960	46,808,256	56,864,148	22,090,283	8,599,993
1955	1,850,157,540	52,861,644	68,591,360	15,742,947	8,283,432

(a) The Petroleum Products Industry, Dominion Bureau of Statistics.

(b) The Crude Petroleum & Natural Gas Industry, Dominion Bureau of Statistics. Take for manufactured and natural gas - household and commercial use.

(c) The Coal Mining Industry "Sales of Coal & Coke by Retail Fuel Dealers", Dominion Bureau of Statistics. Not available prior to 1947.

If the natural gas used in 1955 for domestic and commercial purposes were entirely replaced by coal, it would require an equivalent of 2.6 million tons of 13,000 B.t.u./lb coal. The delivery of Western gas to central Canada will, undoubtedly, further seriously affect the demand for coal, but it will replace mainly imported coal. Gas and oil are also strong competitors of coal in the production of power at central electric stations.

Production of Coal by Provinces and Territories*, 1954 and 1955

(short tons)

		Bituminous	Sub-Bituminous	Lignitic	Total
Nova Scotia	1955	5,731,026	-	-	5,731,026
	1954	5,842,896	-	-	5,842,896
New Brunswick	1955	877,838	-	-	877,838
	1954	781,271	-	-	781,271
Saskatchewan	1955	-	-	2,293,816	2,293,816
	1954	-	-	2,116,740	2,116,740
Alberta	1955	2,115,072**	2,340,207	-	4,455,279
	1954	2,402,826**	2,456,223	-	4,859,049
British Columbia and Yukon	1955	1,460,921	-	-	1,460,921
	1954	1,313,623	-	-	1,313,623
Total	1955	10,184,857	2,340,207	2,293,816	14,818,880
	1954	10,340,616	2,456,223	2,116,740	14,913,579
Value $	1955	78,191,725	11,078,583	4,309,163	93,579,471
	1954	81,233,732	11,404,832	3,961,702	96,600,266

* Coals classed according to A.S.T.M. Classification of coal by Rank - A.S.T.M. Designation D388-38.

** Includes a small amount of semi-anthracite from the Cascade area.

Production of Coal by Type of Mining, 1955

		Short Tons	Per Cent
Nova Scotia	- strip mines............	-	-
	- underground...........	5,731,026	100.0
New Brunswick	- strip mines............	703,754	80.2
	underground...........	174,084	19.8
Saskatchewan	- strip mines............	2,289,151	99.8
	underground...........	4,665	.2
Alberta	- strip mines............	2,106,004	47.3
	underground...........	2,349,275	52.7
British Columbia and Yukon	- strip mines............	295,253	20.2
	underground...........	1,165,668	79.8
Canada	- strip mines............	5,394,162	36.4
	underground...........	9,424,718	63.6

Average Output of Coal per Man-day for Canada, 1954 and 1955

	1955	1954
	Short Tons	
Strip mines..............................	13.309	12.512
Underground	2.718	2.618
All mines	3.826	3.581

Consumption of Canadian and Imported Coal, 1952-1955

	Canadian Coal (a)		Imported Coal (b)		
	Short Tons	% of Consumption	Short Tons	% of Consumption	Total Short Tons
1952	16,749,316	40.5	24,603,789	59.5	41,353,105
1953	15,240,105	40.0	22,900,392	60.0	38,140,497
1954	14,466,212	44.1	18,322,056	55.9	32,788,268
1955	14,060,039	42.1	19,323,332	57.9	33,383,371

(a) 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.

(b) Deductions have been made to take into account foreign coal re-exported from Canada and bituminous coal exwarehoused for ships' stores. Imports of briquettes are not included.

Imports of Coal for Consumption[a], 1954 and 1955
(short tons)

Country of Origin		Anthracite	Bituminous	Total
United States	1955	2,379,465	16,798,185[b]	19,177,650
	1954	2,487,842	15,695,283[c]	18,183,125
United Kingdom	1955	267,038	2,860	269,898
	1954	266,250	54	266,304
Union of South Africa	1955	-	-	-
	1954	790	-	790
Total	1955	2,646,503	16,801,045	19,447,548
	1954	2,754,882	15,695,337	18,450,219
Value $	1955	30,190,088	75,997,671	106,187,759
	1954	33,163,183	72,043,248	105,206,431

(a) From Trade of Canada: includes briquettes but does not include coal imported and subsequently sold for use on board ships.
(b) Includes 1,548 tons of lignite and 124,216 tons of briquettes.
(c) Includes 2,824 tons of lignite and 128,163 tons of briquettes.

Exports of Coal, 1954 and 1955

Destination	1955	1954
	Short Tons	
United States and Alaska	337,153	207,761
United Kingdom	233,770	-
West Germany	11,203	-
St. Pierre and Miquelon	10,656	11,585
Totals, tons	592,782	219,346
Value, $	4,870,598	1,716,435

COKE

By E. J. Burrough

Increased activity in the coke industry in general was shown by a rise in output and trade figures as compared with 1954. Production of coke from bituminous coal was 4,004,623 tons, 17 per cent greater than in 1954. Production of petroleum coke was 269,899 tons, 14 per cent above 1954, and followed an upward trend evident for several years. Imports at 760,614 tons were up 40 per cent, and exports at 171,748 tons were up 11 per cent. This increased activity was mainly owing to recovery from the temporary drop in steel production that took place in 1954.

Coal processed for the manufacture of coke was 5,386,033 tons, of which approximately 82 per cent was from the United States and the remainder from domestic sources.

Most of the coke produced in Canada is obtained from standard by-product coke ovens that process coal in large tonnages for use in processing steel and non-ferrous metals. A limited market for solid fuels in domestic heating also consumes prepared by-product coke. The production of retort coke, a by-product of the gas industry, continues to decline with the change in methods of production of manufactured gas for domestic use.

The principal use for petroleum coke in Canada is in the production of electrodes which are required in appreciable quantities in the aluminum industry. The Soderberg process for the manufacture of electrodes is the one generally used in this industry.

The production of pitch coke in Canada is confined to the disposal of surplus coal-tar pitch not required for other industrial uses such as the production of electrodes or briquettes.

Other than the standard by-product coke ovens which are used almost exclusively in the coking industry, there exist in Canada a Curran Knowles carbonization plant located at the Crows Nest Pass collieries in Michel, British Columbia; a distinctive coking stoker type of plant designed and operated by the Shawinigan Chemicals Company, Shawinigan Falls, 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 6 plants in Eastern Canada, namely; Dominion Steel and Coal Corporation at Sydney, Nova Scotia, with rated annual capacity of 1,001,900 tons of coal; Montreal Coke and 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 1,761,000 tons of coal; Hamilton By-Product Coke Ovens Limited at Hamilton, Ontario, with a rated

Coke - Production and Trade

	1955 Short Tons	1955 $	1954 Short Tons	1954 $
Production from bituminous coal				
Ontario	2,838,651	41,286,225	2,286,934	33,932,193
Nova Scotia, New Brunswick, Quebec and Newfoundland	869,495	13,390,416	856,887	13,302,036
Manitoba, Saskatchewan Alberta and British Columbia	296,478	3,564,714	280,397	3,303,659
Total	4,004,624	58,241,355	3,424,218	50,537,888
Production of pitch coke	3,029	74,109	7,621	146,312
Production of petroleum coke	269,899	2,374,090	236,887	2,139,222
Total	4,277,552	60,689,554	3,668,726	52,823,422
Bituminous coal used to make coke				
Imported	4,401,177	42,700,385	3,722,832	37,983,392
Canadian	984,856	9,199,021	881,443	7,981,347
Total	5,386,033	51,899,406	4,604,275	45,964,739
Imports, all types				
United States	760,503	11,406,689	542,082	8,715,152
United Kingdom	111	3,280	192	4,833
Others	-	-	231	13,798
Total	760,614	11,409,969	542,505	8,733,783
Exports, all types				
United States	147,271	1,556,967	135,144	1,394,280
United Kingdom	13,045	506,717	11,392	497,181
Other countries	11,432	400,897	7,674	316,086
Total	171,748	2,464,581	154,210	2,207,547

annual capacity of 415,000 tons of coal; Dominion Steel Foundries Limited, with an annual capacity of 300,000 tons; and Steel Company of Canada Limited at Hamilton, with a rated capacity of 1,470,000 tons of coal a year.

NATURAL GAS

By R. B. Toombs

Estimated gross production of natural gas, less field waste, in 1955 increased 25 per cent over 1954 to 150,772,312 M cu ft valued at $15,098,508. Alberta supplied 88 per cent of the output. Saskatchewan produced 6,706,743 M cu ft, more than double that of 1954. Ontario's output of 10,852,857 M cu ft was somewhat higher than in recent years. Production in New Brunswick and Northwest Territories remained small and static.

Highlight of the year was the approval given by the Federal Power Commission of United States to Pacific Northwest Pipeline Corporation, also of United States, to import Canadian natural gas from Westcoast Transmission Company Limited into the Pacific northwest states at the British Columbia - Washington border, thus opening up market outlets to Peace River natural gas. Plans to supply eastern markets with Alberta natural gas, however, remained incomplete after several years of negotiations.

Natural gas reserves in Western Canada are rising at an annual rate of at least 2 trillion cu ft, and at the end of 1955 were in excess of 20 trillion cu ft. The fast-growing reserves, plus the considerable amount of field waste, which at 42.3 billion cu ft. in 1955 was equivalent to 28 per cent of the natural gas used, further emphasize the need for greater market outlets.

Development and Production

British Columbia

Thirty-six wells were completed resulting in 12 gas wells, one oil well, 21 dry holes and 2 wells pending final classification. Two other wells were being completed at the end of 1955 and eight more were being drilled. The average depth of all wells completed was 6,012 feet.

Six indicated gas areas were discovered, the most significant being at Paddy River, 110 miles north of Fort St. John, and at Milligan River, 56 miles north-northeast of Fort St. John. The remaining four are at Bougie Creek, Cameron River, Doig River, and North Blueberry. Other successful wells resulted in a southeast extension of the Fort St. John field, extensions of the Buick Creek and Nig Creek fields, and possible extensions of the Montney and Blueberry fields.

Some 26 million acres were held by exploration companies in 1955. At the end of the year, 22 geophysical parties were in the field, and the pace of exploratory activity had quickened considerably following the opening up of market outlets to Peace River area natural gas.

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Production of Natural Gas

	1955 M cu ft	1955 $	1954 M cu ft	1954 $
Alberta*				
Turner Valley	28,748,262		27,131,642	
Viking Kinsella	20,965,713		22,218,424	
Jumping Pound	14,890,662		12,242,139	
Leduc-Woodbend	12,250,318		10,947,269	
Pakowki Lake	11,523,280		7,250,569	
Medicine Hat	8,518,487		7,314,981	
Other fields and areas	36,110,771		20,068,753	
Total	133,007,493	9,975,562	107,173,777	8,038,033
Ontario	10,852,857	4,341,143	10,015,818	4,006,327
Saskatchewan				
Coleville	5,068,758		1,427,486	
Brock	1,488,936		1,481,222	
Lloydminster	936,145		439,743	
Unity	928,330		820,641	
Other fields and areas	2,830,801		454,736	
Total	11,252,970		4,623,828	
Waste	4,546,227		1,290,751	
Net production	6,706,743	637,140	3,333,077	291,644
New Brunswick				
Stony Creek	186,549	138,450	183,457	130,405
Northwest Territories				
Norman Wells	18,670	6,213	29,085	9,700
Canada Total	150,772,312	15,098,508	120,735,214	12,482,109

* Total production, less field waste.

Natural gas reserves, all in the Peace River area, were in excess of 2.5 trillion cu. ft at the end of 1955. Sizeable reserves have been developed in 11 fields, and 14 gas-bearing areas the Fort St. John field accounting for about one half of the provincial total.

Alberta

Over two thirds of Alberta's 1955 production came from six major fields. The year's increase of 24.5 per cent over 1954 came from the Pakowki Lake area in the southeastern part of the province, the Fort Saskatchewan field near Edmonton, and to a lesser extent from the Jumping Pound, Bonnie Glen, Golden Spike, St. Albert, and Turner Valley fields. In the Pakowki Lake area, a revision in the export permit held by Canadian Montana Pipe Line Company allows the company to double its previous allowable to 20 billion cubic feet annually.

The average well-head price in 1955 was 7.5 cents per M cu ft As in 1954, wastage accounted for 22 per cent of the total output.

More emphasis was placed on exploratory drilling in 1955 than in 1954 although initial completions remained at the same level as is shown in the following table.

	1955	1954
Exploratory well completions		
Gas wells	1	1
Potential gas wells	67	54
Outpost well completions		
Gas wells	0	0
Potential gas wells	9	15
Development well completions		
Gas wells	7	13
Potential gas wells	54	57
Total		
Gas wells	8	14
Potential gas wells	130	126

The 68 discovery wells completedin 1955 were widely distributed, with emphasis on the southeastern part of the province. Development drilling was also concentrated in this region, although the most productive development well, Mid-Western Alexander 6-16, was brought in 23 miles northwest of Edmonton.

As in 1954, considerable drilling was done in the vicinity of the proposed provincial gas grid system. Almost one-half of all successful exploratory wells drilled were within 35 miles of the planned gas pipe-line route of Alberta Gas Trunk Line Company from the Homeglen Rimbey field, 30 miles northwest of Red Deer, to the Saskatchewan border via Denhart, 110 miles east of Calgary.

Seven successful exploratory wells were drilled within 30 miles of Edmonton. Small groups of two or three were drilled near Provost, Wainwright, Athabasca and at Savanna Creek. Single exploratory successes were recorded near Parkland, Calgary, Crossfield and the Westward Ho oil field. Drilling was continued in the vast stretch between Edmonton and the Peace River area with important discoveries being made near Whitecourt and in the vicinity of Grande Prairie, and between Rycroft and Dawson Creek in British Columbia.

Exploratory successes which indicated large gas reserves include Husky-Northern Target Savanna Creek 1 and 2A, 60 to 65 miles southwest of

Calgary, Oilwell Operators C. & E. Harmatton 9-5, 48 miles north-northwest of Calgary, Fina-Stanolind-H.B.-Windfall 12-36, 110 miles northwest of Edmonton, Federated-United-Gulf Nevis 11-30 and 6-18, 82 miles south of Edmonton, and Socony-C.P.R. Rosedale 2-10, 64 miles northeast of Calgary.

At the end of 1955, Alberta had 470 gas wells capable of being operated and 609 capped gas wells. Many of the 6,138 oil wells in the province are also gas producers.

As of June 30, 1955, established disposable reserves of natural gas stood at 15.6 trillion cu ft, according to estimates by The Petroleum and Natural Gas Conservation Board of Alberta. During the 15 months prior to this date, reserves had showed an increase of 2,200 billion cu ft, one third of which was attributed to new discoveries, and two thirds to expansion of previously known reserves. Formations of Devonian, Mississippian and Lower Cretaceous (Viking) ages together account, almost equally, for about 75 per cent of the province's reserves. Upper Cretaceous and Lower Cretaceous formations, other than the Viking, account for most of the remainder.

Saskatchewan

Production from the Coleville - Smiley gas field, which accounted for almost one-half of the province's total production in 1955, was four times that of 1954, reflecting the importance of the field as a source of supply for the Saskatoon gas pipe line. By the end of the year, 36 wells has been completed in the Viking gas reservoir of this field, and 14 were in operation. The Brock gas field, the other main source of supply for Saskatoon, continued to operate at its 1954 output of almost 1,500,000 M cu ft. Production in the Success field, near Swift Current, increased five times over 1954 to 546,862 M cu ft resulting in the establishment of a pipe-line outlet to Swift Current.

Forty per cent of the total gas production was disposed of as waste, compared with 25 per cent in 1954. Marketing arrangements completed during 1955 will greatly reduce field waste.

Six natural gas discoveries were made during 1955. All are in southwestern Saskatchewan, five being within a 130-mile stretch northwest of Swift Current, and the sixth, 86 miles west-southwest of Saskatoon.

Development drilling was carried out in the Hoosier field in preparation for tying in this source to the gas pipe line running from the Colevill-Smiley field to Saskatoon. The Hatton gas field, which is an eastward extension of the Medicine Hat gas field, was further assessed. Development drilling was also continued in the Brock, Coleville, Glidden, Lloydminster and Success fields.

At the end of 1955, Saskatchewan had 130 gas wells, 13 more than in 1954. Only 47 were in operation pending completion of market arrangements. Proven recoverable natural gas reserves had risen to 442 billion cu ft, 73 per cent of these being in the Coleville-Smiley, Brock and Hatton fields.

Manitoba

Although oil is being produced in 11 fields in the southwestern part of the province, no gas reserves have as yet been established.

Northwest Territories and Yukon Territory

The small natural gas production of Northwest Territories, which during the past few years has ranged from 25,000 to 30,000 M cu ft, comes from the Norman Wells field. No natural gas is produced in Yukon Territory.

During 1955 exploratory drilling in Northwest Territories totalled 28,612 feet in 29 wells, close to the record set in 1945. Twenty-eight of these wells resulted in abandonment and one gas discovery was made 100 miles west of Hay River. All drilling was done in the relatively small area between the northwest corner of Alberta and the upper reaches of the Mackenzie River.

Ontario

Drilling for natural gas in 1955 resulted in six successful exploratory wells and 138 successful development wells. The best wells were completed in Lambton and Kent counties. Of the Kent county wells, six were drilled in Lake St. Clair, offshore from Dover township. One of these recorded the largest initial flow of the year. Seven successful Kent county wells drilled in Lake Erie, offshore from Port Alma, constitute an extension of the Tilbury gas field. Considerable development drilling was done in Haldimand, Norfolk and Welland counties.

A total of 475,973 feet of drilling was done in 390 wells in the search for both gas and oil. The average depth of all exploratory wells was 1,718 feet and of development wells, 992 feet. Natural gas production comes from formations of Silurian age at depths ranging from 600 to 1,500 feet. At the end of the year, gas reserves amounted to at least 175 billion cu ft.

New Brunswick

Natural gas is produced in the Stony Creek field, Albert county. Four unsuccessful development wells were drilled in the field during 1955; two others found oil but there were no new gas producers. Gas production has declined from the 1944 peak of 702,000 M cu ft and was 186,549 M cu ft in 1955.

Pipe-Line Transportation

Westcoast Transmission Company Limited

During 1955 arrangements were finally completed for the marketing of Peace River area natural gas by Westcoast Transmission Company Limited. The Federal Power Commission in Washington gave approval in November to the plans of Pacific Northwest Pipeline Corporation to import natural gas from Canada. This decision permitted Westcoast Transmission to proceed with the building of a 650-mile, 30-inch pipe line from the Peace River area southward through British Columbia to the International Boundary at Huntington. There it will connect with the line of Pacific Northwest Pipeline Corporation being constructed from the San Juan basin area of New Mexico. This dual project will link the gas reserves of the Peace River area and of the San Juan basin with markets in British Columbia, the Pacific Northwest States, California and the Rocky Mountain States.

The source of supply for the Westcoast Transmission line will be the Peace River area of British Columbia and Alberta. The British Columbia reserves are available to the line and the amended Alberta permit provides for the export of 1,080 billion cu ft over a 20-year period. Revision of this permit in 1955 raised the yearly allowable to the Westcoast Transmission line from 42 to 56 billion cu ft. Present development of Peace River area reserves indicates that from 55 to 60 per cent of the Westcoast Transmission supply will come from British Columbia gas fields.

The pipe line, which is expected to be completed by the end of 1957, will pass through McLeod, Prince George, Williams Lake, Hope and Chilliwack. Distribution in the Fraser Valley and Vancouver will be made by British Columbia Power Corporation. Inland Natural Gas Company Limited will distribute gas in the interior of British Columbia. For a year prior to the completion of the main line, gas will be delivered to theVancouver area from the newly-constructed Pacific Northwest pipe line from the San Juan basin.

The purchase price in Peace River gas fields will be 10 cents in 1958 rising to 12 1/2 cents 20 years later. The 20-year contract between Westcoast Transmission and Pacific Northwest provides for the sale of 300 million cu ft daily, at 90 per cent load factor, at a price of 22 cents per M cu ft. Gas purchased from Westcoast Transmission for distribution in British Columbia will be priced at 30.4 cents per M cu ft on a 100-per-cent load factor basis. The same price will be paid throughout the Pacific Northwest area of United States. Certain quantities will also be made available to industry, on an interruptible basis, at 22 cents per M cu ft.

Initial cost of the Westcoast Transmission Line will be $142 million but it is expected that some $162 million will ultimately be spent. In addition to the mainline expenditure, an estimated $135 million will be spent in 1956 and 1957 on the lower mainland and British Columbia interior systems, on household installations and industrial systems, and on further development of the Peace River area gas fields.

Trans-Canada Pipe Lines Limited

During 1955 Trans-Canada Pipe Lines Limited obtained six-month extensions on its provisional permits from the Government of Alberta and the Federal Government in April and again in September. In addition to approving gas export from the province, the Alberta Government increased the maximum daily withdrawal from 540 to 620 million cu. ft. It left unchanged the total 25-year reserve allowance of 4.35 trillion cu ft and the yearly exportable amount of 183 billion cu ft. Federal Government authorization was given to a change in the proposed route through northern Ontario from the Lake Superior to the "clay belt" route.

Several plans to assist in getting the pipe-line project underway were formulated during the year. One of these calls for the building of the Alberta - Manitoba and Kapuskasing - Toronto - Montreal sections of the line by Trans-Canada, with a Crown Company being responsible for the link across northern Ontario between the Manitoba border and Kapuskasing. The 675-mile line through northern Ontario would be financed jointly by the Federal and Ontario Governments at an estimated cost of $117.6 million. In addition to gas sales in Canada, 200 million cu ft a day would be sold to Tennessee Gas Transmission Company at Emerson on the Manitoba - Minnesota border. Tennessee would in turn sell this gas along a pipe line to be constructed to the company's present facilities in the State of Tennessee. It would deliver at Niagara up to 86.7 million cu ft a day for market build-up purposes in Ontario and Quebec until the line through northern Ontario was completed.

At the end of 1955 the Federal and Ontario governments were awaiting guarantee from Trans-Canada that it could carry out its own commitment and the entire project had yet to be debated in Parliament. The United States Federal Power Commission had not, as yet, given a decision on the application of Tennessee Natural Gas Transmission Company to import Canadian gas. Consequently Trans-Canada had not finalized its export arrangements. The company had, however, completed negotiations for most of its gas supply in Alberta and had signed several important marketing contracts.

Alberta Gas Pipe Lines

Canadian Western Natural Gas Company Limited built a 59-mile extension from its main line at Lethbridge to the towns of Raymond, Magrath and Cardston and installed 40 miles of distribution lines in these towns. Northwestern Utilities, Limited added 26 miles to its gathering and transmission lines and 58 miles to its distribution system. No appreciable change took place in the pipe-line systems of 26 smaller companies serving towns throughout the province.

Major changes were made in the proposed route of The Alberta Gas Trunk Line Company's line which is to supply gas to the pipe line taking Alberta gas eastward. The new route passes closer to the gas fields of southeastern Alberta and is considerably shorter than the original proposal.

Saskatchewan Pipe Lines

Saskatchewan Power Corporation carried out the biggest gas pipe-line construction program in western Canada in 1955, constructing a total of 245 miles of transmission lines and expanding its distribution facilities. The program included the laying of a 116-mile, 14-inch line from the Coleville-Smiley field to Saskatoon to loop the original line built in 1953, and the construction of a 110-mile line from Saskatoon to Prince Albert. Pipe-line construction in the past three years has linked the two cities and a number of towns in the north-central part of the province with the Brock and Coleville-

Smiley gas fields. In the south, a 19-mile line was built from the Success field to Swift Current and plans were finalized for a line to Moose Jaw.

Ontario Gas Pipe Lines

The Consumers' Gas Company added 110 miles to its distribution system in Toronto and constructed a 12-mile line to Brampton. Dominion Natural Gas Company laid 16 miles of new distribution lines in southwestern Ontario. Provincial Gas Company Limited of Fort Erie added 30 miles to its distribution system. Union Gas Company of Canada Limited set aside its plans to extend its system 160 miles eastward to Hamilton as it was unable to secure extra gas supplies from its present United States supplier, Panhandle Eastern Pipeline Company.

Natural Gas Pipe Line Mileage

Expenditures on natural gas pipe line construction in 1955 totalled $42 million compared with $28 million in 1954. Mileage at the end of each year from 1952 to 1955 is shown in the following table.

	Gathering and Transmission				Distribution			
	1952	1953	1954	1955	1952	1953	1954	1955
New Brunswick	20	20	20	20	65	65	65	65
Ontario	2,303	2,326	1,959	1,940	2,068	2,118	3,419	3,614
Saskatchewan	36	115	144	420	24	31	135	225
Alberta	1,262	1,466	1,672	1,757	1,349	1,503	1,506	1,629
British Columbia	-	-	6	6	-	-	5	5
	3,621	3,927	3,801	4,143	3,506	3,717	5,130	5,538
Total all lines					7,127	7,644	8,931	9,681

Natural Gas Processing

As in 1954, eight natural-gasoline plants with a total capacity of 331.5 MM cu ft of natural gas, were in operation in 1955, all in Alberta.

Production of natural-gas by-products during the period 1950-55 inclusive is shown below.

	Natural Gasoline	Propane	Butane	Sulphur
	Bbl	Bbl	Bbl	Short Tons
1955	868,416	796,482	492,051	29,093
1954	673,564	529,117	245,189	22,320
1953	602,368	433,083	198,401	18,295
1952	579,873	337,678	140,228	16,075
1951	515,027	248,554	84,527	-
1950	431,362	141,070	33,906	-

Plans were completed for the construction of three new natural-gasoline plants, one each at Nevis and Redwater in Alberta, and the third at Taylor Flats in the Peace River area of British Columbia, and for a sulphur-hydrocarbon treatment and cycling plant at the Pincher Creek gas field.

Markets for Natural Gas

Natural-gas sales by utilities to domestic, commercial and industrial customers are summarized in the following table. About four-fifths of the total increase in sales in 1955 was due to growth of the western Canada market.

Sales of Natural Gas in 1955

	Volume M cu ft	Value $	Number of Customers As of Dec. 31, 1955
Eastern Canada			
Domestic	14,265,129	21,858,824	303,073
Commercial	3,437,608	4,477,053	3,008
Industrial	2,684,689	4,155,661	17,518
Miscellaneous	74,882	61,268	424
Total	20,462,308	30,552,806	324,023
Western Canada			
Domestic	31,001,100	12,250,451	144,238
Commercial	45,261,165	6,337,180	553
Industrial	20,640,442	5,970,048	15,432
Miscellaneous	435,296	70,994	60
Total	97,338,003	24,628,673	160,283
Canada total 1955	117,800,311	55,181,479	484,306
Canada total 1954	87,466,838	36,140,718	309,854

Exports and Imports

Canadian natural-gas exports in 1955 rose 59 per cent over 1954 to 11,359,596 M cu ft as the result of an increase in gas exported by Canadian-Montana Pipe Line Company, the sole exporter.

Natural-gas imports totalled 11,165,756 M cu ft valued at $2,698,272. Except for the import of 31,116 M cu ft into Alberta, all gas was delivered to Ontario from the pipe-line systems of Panhandle Eastern Pipeline Company and Tennessee Gas Transmission Company.

The Canadian import duty on gas used for heating and cooking is 3 cents per M cu ft. There is no export duty.

Federal Government control over gas imports was provided for in the Exportation of Power and Fluids and Importation of Gas Act which was passed in 1955 (S.C. 1955, C. 14). The new Act also provides that export licences, once granted, are not subject to cancellation unless the licencee violates the terms or conditions of his permit.

PEAT

By A. A. Swinnerton

Peat moss is widely distributed in Canada, and commercial production is from plants in British Columbia, Manitoba, Ontario, Quebec, New Brunswick, and Nova Scotia. Eighty-three per cent of the 117,579 tons produced in 1955 came from the delta of the Fraser River in British Columbia and the Rivière-du-Loup area of Quebec.

The peat moss industry in Canada is steadily expanding, production in 1955 being about 18 per cent greater than that in 1954, partly owing to the exceptionally favourable drying conditions in the summer of 1955. Canadian peat moss continues to be in demand in the United States and it is sometimes difficult to fill export orders. As a result some of the larger operators are opening new deposits and some United States importers are interested in developing peat bogs in Canada in order to have a dependable source of supply.

Practically all of the Canadian output is exported to the United States, where it is in competition with peat moss from Germany. In 1955, 117,701 tons of German peat valued at 3,684,959 dollars (U.S.) were exported to the United States.

Peat moss is the dead, slightly humified, fibrous moss found in peat bogs. When dried and shredded it has a high absorptive capacity, for which reason it finds wide use in horticulture as a packing material, a means of introducing humus into the soil, and in stables and poultry runs as litter.

In British Columbia, the harvesting of peat moss is largely mechanized, but considerable manual labour is still required for digging. One operation is almost completely mechanized. The peat is excavated by hydraulic jets and pumped to the plant, where it is dried by steam heat in a modified paper-making machine. In eastern Canada, generally, there is little mechanization, except for one bog in Quebec, one in Ontario and one in Nova Scotia which operate a "milling" process. In this process the peat is lightly harrowed to a depth of one or two inches, when it dries rapidly, under favourable weather conditions. It is then gathered up by large scale "vacuum cleaners" mounted on caterpillar treads and when the containers are full they are dumped into field railway cars and transported to the mill for baling and shipment.

Dried peat has been used as fuel for many years, but the amount used in Canada for this purpose in recent years has been less than a hundred tons a year. The type of peat required for use as fuel is a well-humified grass or

Peat Moss - Production and Trade

	1955 Producers	1955 Short Tons	1955 $	1954 Producers	1954 Short Tons	1954 $
Production						
British Columbia.....	13	65,436	2,289,846	13	57,348	1,902,990
Quebec.......	15	32,383	638,696	13	27,784	730,250
New Brunswick	3	8,743	234,599	2	9,888	217,421
Manitoba	1	6,146	190,381	1	3,494	146,477
Ontario	2	4,284	123,862	2	640	19,809
Nova Scotia...	1	587	7,903	1	118	1,675
Total.........	35	117,579	3,485,287	32	99,272	3,018,622
Production, by uses						
For horticulture...		110,431	3,255,814		82,825	2,517,615
For poultry and stable litter		7,091	225,294		16,359	496,002
For other uses..........		57	4,179		88	5,005
Total		117,579	3,485,287		99,272	3,018,622
Exports						
United States..		102,948	5,385,671		87,306	4,498,695
Other Countries......		49	2,691		27	1,257
Total.........		102,997	5,388,362		87,333	4,499,952

sedge peat rather than the partly humified sphagnum variety required for the preparation of peat moss. Some fuel peat has been produced in recent years at a small bog at Gads Hill Station, near Stratford, Ontario, but only in very small quantities. On the Burin Peninsula in Newfoundland small quantities of peat fuel have been dug for local use.

Producers

British Columbia

The peat operations in the Fraser River delta near New Westminster are the largest in Canada. Four bogs are being worked, namely: Pitt Meadows, Byrne Road, Lulu Island, and Delta (or Burns), and from this small area 13 companies in 1955 produced 65,436 tons, 55 per cent of the Canadian production. The largest producers are Industrial Peat Limited, Atkins and Durbrow Limited, and Lulu Island Peat Company Limited.

Manitoba

Western Peat Company Limited, the only producer, operates the Julius, or Shelley, bog about 50 miles east of Winnipeg.

Ontario

Two companies are in operation at present. Most of the output in 1954 was produced by Atkins and Durbrow (Erie) Limited at its plant near Port Colborne which operates a milling process as described above. The other producer, Humar Corporation Ltd., processes and sells humus from a bog near Dundas.

Quebec

The peat moss deposits being worked are mainly in the lower St. Lawrence region. Fifteen companies contributed to the output in 1955, but most of the production came from three, namely: Premier Peat Moss Corporation with operations at Rivière-du-Loup, Isle Verte, and Cacouna; Tourbières Rivière-Ouelle in the Rivière du Loup area; and Quebec Peat Moss Company, St. Guillaume, A new peat operation was started in 1955 at Les Escoumains on the north shore of the St. Lawrence River about 20 miles below Tadousac.

New Brunswick

The most important peat moss deposits are in Northumberland and Gloucester counties on both shores of Miramichi Bay, and on Miscou and Shippigan Islands. Three companies produced peat moss in 1955, namely; Fafard Peat Moss Company at Pokemouche; Atlantic Peat Moss Company, Limited at Shippigan and on Shippigan Island; and Bog Trotters Ltd., at Centreville.

Nova Scotia

Annapolis Peat Moss Company, Limited, the only producer of peat moss, resumed operations on the Caribou bog near Berwick in 1955, employing the milling process already described.

Other Occurrences

Newfoundland

Peat moss is not produced in Newfoundland. Although deposits are available, they are close to the coast and their development would possibly be handicapped by the same poor drying weather that is sometimes experienced in northern New Brunswick. In 1954, the Provincial Department of Mines started a survey of its peat resources and a detailed report of bogs in the Avalon and Burin Peninsulas was issued in 1955.

Prices

The price of peat moss in 1955 varied from approximately $24 to $44 a ton, according to location, except for a small production from Nova Scotia.

CRUDE PETROLEUM

By R. B. Toombs

Crude-oil production in 1955 increased 34.7 per cent over 1954 to 129,440,247 barrels valued at $305,640,036 and for the third successive year, crude petroleum was the leading mineral in point of value. Alberta accounted for 87.3 per cent of the total production, compared with 91.3 per cent in 1954. Production in Saskatchewan and Manitoba increased two-fold, Saskatchewan supplying 8.7 per cent of the total output, and Manitoba, 3 per cent. Slightly less than one per cent came from Ontario, Northwest Territories, and New Brunswick combined.

Average daily production in 1955 amounted to 354,631 barrels almost 300,000 barrels below the daily potential reached at the end of the year. The large increase in production potential came mainly from reserve extensions in existing Alberta fields, and to a lesser extent, from new discoveries in Alberta and Saskatchewan.

Highlights of the year's activities were the rapid development of the Pembina field, the opening up of the Sundre-Westward Ho area in Alberta, and a number of significant discoveries in southeastern Saskatchewan. Oil reserves of the Pembina oil field are now the largest in Canada.

All phases of Canada's petroleum industry registered substantial gains. In terms of daily averages, crude-oil and natural-gasoline production rose from 265,079 to 357,010 barrels, and refinery capacity from 544,750 to 618,450 barrels; domestic demand for crude oil and natural gas increased from 560,940 to 638,416 barrels; and crude oil exports rose from 6,424 to 40,641 barrels. Despite an increase in export trade, market expansion continued to be an important objective as the gap between production potential and actual field output widened.

Development and Production

Geophysical Activity

Geophysical activity in western Canada increased towards the end of 1955 with 156 crews in the field compared with 140 at the end of 1954. Seismic operations, which account for almost 95 per cent of geophysical work, amounted to 1,543 crew months compared with the peak of 1,923 in 1952 and 1,535 in 1954. Gravity work decreased slightly to 100 crew months.

Production of Crude Petroleum

	1955		1954	
	Barrels *	$	Barrels *	$
Alberta[a]				
Redwater	28,506,532		24,895,984	
Leduc-Woodbend	20,421,285		20,560,789	
Pembina	14,795,375		843,003	
Bonnie Glen	7,826,622		6,960,330	
Fenn-Big Valley	7,546,666		6,492,733	
Joarcam	4,792,878		4,858,743	
Wizard Lake	3,720,011		3,706,921	
Golden Spike	3,400,517		2,549,518	
Acheson	2,698,527		2,756,232	
Turner Valley	2,056,439		2,137,907	
Stettler	1,832,836		897,168	
Westerose	1,742,259		1,372,193	
Joffre	1,690,090		566,423	
West Drumheller	1,227,687		1,089,720	
Lloydminster	1,221,505		1,101,235	
Excelsior	1,084,643		1,163,649	
Malmo	739,720		697,053	
Sturgeon Lake South	680,566		70,189	
Duhamel	599,574		538,010	
Erskine	567,184		201,102	
Fairydell-Bon Accord	555,028		312,045	
Homeglen-Rimbey	417,763		242,994	
New Norway	360,910		339,990	
Drumheller	272,370		277,258	
Cessford	233,007		267,319	
Clive	227,920		202,844	
Wainwright	207,517		123,558	
Battle South	173,705		-	
Chauvin	163,721		151,082	
Hamilton Lake	128,104		92,882	
Jumping Pound	120,687		109,424	
Battle	116,642		84,105	
Conrad	104,290		117,230	
Other fields	2,802,466		1,934,222	
Total	113,035,046	274,901,232	87,713,855	228,319,165

* 35 Imperial gallons

(a) "Oil and Gas Industry", P & N.G.C.B., Prov. of Alberta.

	1955 Barrels *	1955 $	1954 Barrels *	1954 $
Saskatchewan				
Coleville-Smiley	3,439,005		1,985,372	
Fosterton	1,353,259		211,875	
Success	1,154,977		337,993	
Lloydminster	945,815		892,332	
Lone Rock	727,846		695,810	
Cantuar	639,630		100,724	
Gull Lake	547,524		327,789	
Midale	478,586		152,048	
Dollard	322,533		217,404	
Nottingham	265,069		66	
Wapella	266,695		216,470	
Alida	247,357		5,613	
Frobisher	237,290		56,923	
Steelman	197,457		-	
McLaren	97,831		38,705	
Bone Creek	77,164		4,491	
Weyburn	66,765		-	
Other fields	252,365		179,284	
Total	11,317,168	18,317,968	5,422,899	8,183,304
Manitoba				
Daly	1,416,066		1,213,058	
Virden-Roselea	1,346,146		621,651	
North Virden	876,910		153,172	
Other fields	506,634		160,303	
Total	4,145,756	9,618,154	2,148,184	5,619,649
Ontario	525,510	1,599,335	412,474	1,391,687
Northwest Territories	404,219	1,185,780	369,887	344,960
New Brunswick	12,548	17,567	13,046	18,265
Canada Total	129,440,247	305,640,036	96,080,345	243,877,030

* 35 Imperial gallons

Land held under exploration and development at the end of 1955 totalled 166,000,000 acres, of which about 36,500,000 acres were in British Columbia, 79,500,000 in Alberta, 30,400,000 in Saskatchewan, 11,900,000 in Northwest Territories, 6,700,000 in Yukon, and 1,000,000 in Manitoba.

Drilling Activity

Development-well completions increased 50 per cent in 1955, accounting for a 31-per-cent net increase in total well completions in western Canada. Exploratory drilling declined five per cent below 1954, 885 exploratory wells being drilled in western Canada compared with 929 the year before. Of these, 27.8 per cent were successful compared with 26.7 per cent in 1954.

Wells Drilled to Completion - Western Canada

	Oil Wells		Gas Wells		Dry Holes		Total	
	1955	1954	1955	1954	1955	1954	1955	1954
British Columbia...	1	-	12	15	25	11	38	26
Alberta............	1,145	673	138	140	344	365	1,627	1,178
Saskatchewan	564	343	12	21	333	364	909	728
Manitoba	279	234	-	-	80	90	359	324
Northwest Territories.......	-	-	1	-	28	6	29	6
Total	1,989	1,250	163	176	810	836	2,962	2,262

Total Footage Drilled and Drilling Rigs in Use - Western Canada

	1955		1954	
	Footage	Rigs in use at year-end	Footage	Rigs in Use at year-end
British Columbia......	231,768	9	147,654	8
Alberta	8,444,578	171	5,674,759	139
Saskatchewan	3,245,666	45	2,588,810	31
Manitoba	841,580	18	765,032	20
Northwest Territories .	28,612	-	20,332	1
Total	12,792,204	243	9,196,587	199

Exploratory Drilling in 1955 - Western Canada

	Oil Wells	Gas Wells	Dry Holes	Total	Footage
British Columbia........	1	12	23	36	207,034
Alberta	78	70	264	412	2,210,921
Saskatchewan	53	15	294	362	1,355,949
Manitoba	16	-	53	69	191,944
Northewst Territories ...	-	1	5	6	12,266
Total	148	98	639	885	3,978,114

Crude Oil Fields and Oil Wells - Prairie Provinces*

	Oil Fields		Producing Wells		Wells Capable of Production	
	1955	1954	1955	1954	1955	1954
British Columbia	-	-	-	-	1	-
Alberta	74	65	5,511	4,583	6,138	5,070
Saskatchewan.........	37	30	1,251	791	1,655	1,094
Manitoba	11	6	486	269	554	284
N.W.T.	1	-	27	-	34	-
Total	123	101	7,275	5,643	8,382	6,448

* At end of year.

Liquid Hydrocarbon Reserves

The Canadian Petroleum Association reserve survey showed a net gain in liquid hydrocarbon reserves of 340,674,000 bbl during 1955, bringing total proved reserves at the end of 1955 to 2,756,619,000 bbl, of which 2,509,534,000 were crude oil and 247,085,000 were natural gas liquids. Alberta accounted for 80 per cent of the increase after allowance for production.

Oil reserves in formations of Devonian age account for about 60 per cent of Canada's reserves; formations of Cretaceous age account for at least 25 per cent, the recent increase being due to the development of the Pembina field; and Mississippian and Jurassic formations account for about 10 per cent and 5 per cent, respectively.

Developments by Areas

British Columbia

The province's first commercial oil well was brought in with the completion of the Texaco N.F.A. Boundary Lake No. 1 well, 38 miles northeast of Fort St. John. The discovery well struck oil of 34° A. P. I. gravity in rocks of Triassic age at a depth of 4,300 feet.

Most of the exploration work in the Peace River region continued to be for natural gas.

Alberta

Fifty-six per cent of the province's output of 113,035,046 bbl came from the Redwater, Pembina and Leduc-Woodbend fields. At the end of 1955, Pembina was the second largest producer, and the province had 6,138 wells compared with 5, 511 at the end of 1954.

Development drilling increased 63 per cent largely because of the high rate of drilling in the Pembina field where 655 of the 1,075 successful oil wells were completed. Considerable field drilling was also done in the Joffre and

Sturgeon Lake oil fields.

Exploratory drilling resulted in 78 oil discoveries compared with 86 in 1954. Much exploratory drilling was carried out in the Red Deer area and elsewhere in central-south Alberta, in the Pembina and Edmonton districts, and in the Sturgeon Lake-Peace River region. Significant results were obtained in the Sundre, Pembina, Clear Hills, and Red Deer areas. Twenty-three successful wells were completed in the newly established Sundre field following the drilling of the Sundre discovery well. The Westward Ho and Harmatton field discoveries ,were made a few miles to the south, and these three fields by the end of the year had opened up important Mississippian oil reserves at a depth of about 9,000 feet in gently sloping beds immediately east of the highly faulted foothills belt. Important extensions were made to the northwest, west, and south sections of the huge Pembina upper Cretaceous oil field. A major extension to the Joffre Viking and sand field was indicated from drilling done six miles south of Red Deer. At the Clear Hills location, 45 miles northwest of the town of Peace River, a significant discovery was made in the "Granite Wash" at the base of formations of Paleozoic age.

Saskatchewan

Saskatchewan had 1,655 oil wells at the end of 1955, a gain of 561 during the year. Of these, 1,251 were in operation. Completed pipe-line outlets played a major part in the twofold increase in production. Forty-two per cent of the increase in output came from the Fosterton, Success, and Cantuar fields, all of which gained access to United States markets via the newly constructed South Saskatchewan pipe line, and the Interprovincial pipe-line system. A large part of the increase came also from the Coleville-Smiley field in the western part of the province and from new fields in the southeastern sector. Light- to medium-gravity oil is produced from Mississippian strata at depths of 3,300 to 4,900 feet in the Williston Basin of the latter area. On the west side, medium- and heavy-gravity oil is produced from formations of Jurassic and Cretaceous age at depths generally less than 3,300 feet.

Exploratory drilling was carried out largely on the west side and in the southeast corner of the province, resulting in 20 new field oil discoveries being made compared with 18 in 1954. The three most important discoveries were in the Steelman, Hastings, and Kingsford areas in the southeastern section, and at Battrum in the southwest.

Development drilling was concentrated in the Nottingham, Frobisher, Alida, Hastings, Lampman, Steelman and Weyburn fields in the southeast. Since the discovery of the Midale field in 1953, 10 fields have been defined and other areas are being evaluated. Construction was commenced on a pipe line to deliver the rapidly mounting production to the Interprovincial pipe-line system. Development also proceeded rapidly in the Cantuar and Coleville-Smiley fields and in the Battrum area on the west side.

Manitoba

Manitoba had 554 oil wells at the end of 1955 in 11 defined oil fields and several smaller areas. Seventy-nine new development wells were drilled in the Virden-Roselea field, the most actively developed and leading producing field. The North Virden and Daly fields were also considerably enlarged. At the end of 1955 these three fields, had 199, 138, and 119 oil wells, respectively. The provincial total at the end of 1954 was 284 oil wells.

Sixty-nine wildcat wells were drilled, the success ratio being almost one in six compared with one in nine in 1954. Of these, eleven were successful new field wells. Depths of these wells ranged from 2,032 to 2,700 feet, and all were in the Lodgepole formation of Mississippian age.

The readily available provincial market and the low cost of well drilling are incentives to continued active development of the favourable oil area in the southwest corner of the province.

Northwest Territories and Yukon

The small but steady production of light-gravity crude comes from Devonian formations in the Norman Wells field in Northwest Territories, where 27 wells were operated in 1955. The oil is refined in the Norman Wells refinery. There is no oil production in Yukon.

Exploratory work continued at a high level during 1955 but no oil discoveries were made. A total of 28,612 feet of drilling was done during the completion of 29 holes in the region south of the upper reaches of the Mackenzie River. Geological examination was continued of the Mackenzie basin and Yukon River drainage area. Eight seismic crews carried on geophysical studies, one crew being airborne.

Ontario

Ontario had 1,447 active wells at the end of 1955 compared with 1,396 in 1954. The Rodney field in Aldborough county, with 160 oil wells, accounted for well over one-half of the total production. The field contains at least 75 per cent of provincial oil reserves.

Exploratory drilling resulted in two oil wells, six gas wells and 115 dry holes. Development drilling added 49 oil wells, all but three of these being in the Rodney field, and 138 gas wells. Eighty wells failed to find oil or gas.

The average initial yield of new oil wells was 17 bbl a day. The average depth of exploratory wells drilled was 1,690 feet, and of development wells, 992 feet.

Practically all of Ontario's crude oil output is delivered to Sarnia for refining.

Quebec

Quebec has had no oil or gas production to date. In 1955 geological and geophysical investigations were carried out on the south side of the St. Lawrence River from Montreal to Quebec city. Nine exploratory wells were also drilled: three each in the vicinity of St. Johns and Three Rivers, two near Montreal, and one near St. Hyacinthe. No oil discoveries were made but one of the wells near Three Rivers found some natural gas.

New Brunswick

Oil and gas production comes from the Stony Creek field near Moncton. Oil production has gradually declined from the 1941 high of 31,369 bbl to the 1955 output of 12,548 bbl. Six development wells were drilled during 1955, resulting in two oil wells and four abandonments. At the end of the year there were 61 active wells in the field, 51 of which produce oil.

Transportation

Net deliveries of crude-oil and petroleum products amounted to 224,274,768 bbl in 1955 compared with 172,495,935 bbl in 1954. The largest transporters are Interprovincial Pipe Line Company, Montreal Pipe Line Company Limited, The Imperial Pipe Line Company Limited, Trans Mountain Oil Pipe Line Company, and Pembina Pipe Line Company Limited. Trans Mountain more than doubled its deliveries in 1955 and Pembina Pipe Line Company Limited became the fifth largest transporter in 1955, its first year of operation. Pipe-line construction was at a comparatively low level during the year, but plans indicated increased activity in 1956.

Oil Pipe-line Mileage in Canada

Year-end	Miles	Year-end	Miles
1950	1,423	1953	3,794
1951	1,577	1954	4,656
1952	2,500	1955	5,079

Extensions of pipe lines into the United States which carry Canadian oil exclusively totalled 1,514 miles at the end of 1955.

The pipe-line tariff from Edmonton to Sarnia is 72 cents a bbl and from Edmonton to Vancouver, 45 cents. From Pembina, Leduc, and Big Valley oil fields to Edmonton, the rates are 12, 7.5 and 18.5 cents, respectively, including field-gathering charges.

Interprovincial Pipe Line Company

Deliveries were up 24 per cent in 1955. Of the 80,700,000 bbl of oil delivered, 34,300,000 bbl went to refineries in western Canada, 5,300,000 to United States refineries, and 33,900,000 to Ontario refineries. An additional

4,200,000 bbl were delivered to tankers at Lake Superior and 3,000,000 bbl went into storage.

No major pipe-line construction was done.

Trans Mountain Oil Pipe Line Company

In 1955, its second full year of operation, Trans Mountain Oil Pipe Line Company reached a daily average delivery of 83,982 bbl compared with 39,787 bbl in 1954. At the end of the year, daily throughput was in excess of 100,000 bbl. A 36.5-mile extension was made to serve a new refinery at Anacortes, Washington, bringing deliveries of Alberta crude to six refineries in all; one at Kamloops, three near Vancouver, and two in the State of Washington. These refineries had an overall daily capacity of 151,500 bbl at the end of 1955. Capacity of the pipe line was 150,000 bbl and plans were being made to raise it to 200,000 bbl.

Pembina Pipe Line Company Limited

Deliveries over this new pipe line commenced in January and reached a peak of 73,800 bbl a day in mid-November. The Pembina field-gathering system for the 70-mile transmission line to Edmonton was increased from 20 to 172 miles, and pumping facilities were installed on the main line to raise its capacity to 111,000 bbl a day.

South Saskatchewan Pipe Line Company

At the end of 1955, the company's Swift Current-Regina line, completed in 1954, was carrying 13,000 bbl a day of medium-gravity crude oil to Regina for transmission to St. Paul, Minnesota, via the Interprovincial pipe-line system.

Peace River Oil Pipe Line Co. Ltd.

A 107-mile oil pipe line was built from the Sturgeon Lake field to Edson, Alberta, where it joins the Trans Mountain line. The new line which has a design capacity of 57,000 bbl daily, is scheduled to commence operations in 1956.

Other Crude Oil Pipe Lines

Daily capacity of the Portland, Maine-Montreal, Quebec, pipe-line system was raised from 189,000, to 209,000 bbl to keep pace with oil refinery expansion in Montreal. In Alberta, Imperial Pipe Line Company extended its service to the Fairydell and Peavey fields, and Canadian Gulf Oil Company linked the Joffre and Clive fields to its Stettler-Edmonton line. In Saskatchewan, construction was started on a 109-mile pipe line to deliver oil from fields in the southeastern corner of the province to the Interprovincial system at Cromer, Manitoba. In Manitoba, Trans-Prairie Pipe Lines Ltd. which transports oil from fields in the Virden area to Cromer, added 23 miles to its system. Winnipeg Pipe Line Company raised the daily capacity of its 75-mile line from Gretna to Winnipeg to 29,000 bbl.

Petroleum Processing

Canada had 42 petroleum refineries in operation at the end of 1955 with a total daily crude-oil throughput capacity of 618,450 bbl and a cracking capacity of 314,614 bbl. Daily crude-oil capacity was increased by 73,700 bbl during the year. An estimated $101 million was spent on refinery construction compared with $84 million in 1954. Two new refineries went on stream, one at Montreal and the other at Dawson Creek, B.C. The capacity of Canada's petroleum-refining industry has almost tripled since 1945. The post-war trend in catalytic-cracking installation, and the more recent emphasis on catalytic reforming, reflect the continuing demand for high-octane gasolines.

Petroleum Refining Throughput Capacity by Regions

Region	1939 Capacity bbl /d	%	1946 Capacity bbl /d	%	1955 Capacity bbl /d	%
Maritimes............	32,750	16.4	34,300	13.9	18,300	3.3
Quebec	64,500	32.2	71,000	28.9	210,000	34.0
Ontario	44,500	22.2	77,950	31.7	148,800	24.0
Prairies & N.W.T	35,570	17.8	40,815	16.6	174,850	28.3
British Columbia	22,700	11.4	21,800	8.9	66,500	10.7
Total	200,020	100	245,865	100	618,450	100

Canadian Crude Oil as a Percentage of Refinery Receipts

Region	1936	1939	1946	1950	1955
Maritimes...............	0	0	0	0	0
Quebec..................	0	0	0	0	0
Ontario	1.5	0.4	0.5	1	78.8
Prairies & N.W.T.	23.0	37.0	52.5	99	100
British Columbia.........	0	0	0	0	100.0
Canada	3.5	17.0	10.0	24.4	54.8

Marketing

Crude-oil receipts at Prairie refineries rose almost 11 per cent, at refineries in British Columbia almost 20 per cent, and in Ontario almost 11 per cent. Canadian crude is not delivered to refineries in Quebec and the Maritimes. Domestic crude oil supplies the western Canadian market, and 80 per cent of the Ontario refinery market. In all, 54.8 per cent or 105,683,878 bbl of the total refinery receipts of 192,827,322 bbl was produced in Canadian fields. Refinery receipts in 1954 totalled 169,452,850 bbl, the percentage of Canadian crude oil used being about the same. In addition to the expansion of existing markets in 1955, new outlets were acquired in the export market, deliveries rising to 14,833,971 bbl, from 2,344,948 bbl in 1954.

Degree of Petroleum Self-sufficiency

Canadian refineries, utilizing domestic and imported crude, met 85 1/2 per cent of the domestic demand for petroleum products. Canada's petroleum self-sufficiency was 53.4 per cent in 1955, while overall crude-oil production was equivalent to 67 per cent of refinery receipts, product imports and minor stock adjustments accounting for the difference in the apparent and actual self-sufficiency rates.

Trade

Canada's crude-oil exports totalled 14,833,971 bbl valued at $36,253,134, seven times the amount exported in 1954. Product exports increased 63 per cent to 1,170,714 bbl. Domestic crude-oil production was supplemented by 86,678,253 bbl of crude-oil imports worth $229,489,421, a 10-per-cent increase over 1954. Product imports increased 8 1/2 per cent to 37,780,245 bbl.

Of the total crude-oil imports, 78.7 per cent came from Venezuela, 9.4 per cent from the Middle East, 8.6 per cent from United States, and 3.3 per cent from Trinidad. Crude-oil exports went to United States, and petroleum products trade was principally with that country.

Consumption of Petroleum Products

Almost one-half of Canada's total energy requirements are met by oil. Three-quarters of the energy requirements of the transportation industries, which account for almost one-half of the total crude-oil and products demand, are supplied by oil. Oil also meets the requirements of over one-third of residential, commercial, industrial and related energy demand - residential and commercial energy needs making up over one-fifth of total oil demand, and industrial and related usage for over one-quarter.

Prices

A downward revision of most light-gravity crude-oil prices took place in September. Redwater crude was reduced from $2.55 to $2.49 a bbl, and Leduc crude from $2.66 to $2.60 a bbl. Similar revisions took place in most other Alberta crudes except Pembina crude which was raised from $2.43 to $2.52. Manitoba crude-oil prices were reduced by 20 cents to $2.35 a bbl. Light-gravity crude in southeastern Saskatchewan ranged in price from $2.03 to $2.29 a bbl at the end of 1955. Medium-gravity crudes of western Saskatchewan were priced at $1.29 a bbl.

Supply and Demand of all Oils

	1955	bbl	1954
New Supply			
Production			
Crude petroleum	129,440,247		96,080,345
Natural Gasoline	864,416		673,564
Total.........................	130,308,663		96,753,909
Imports			
Crude petroleum	86,678,253		78,772,277
Petroleum tops	114,210		111,394
Natural gasoline	237,943		581,117
Refined petroleum products	37,428,092		34,786,619
Total imports..................	124,458,498		114,251,407
Total supply	254,767,161		211,005,316
Daily average	697,992		578,097
Demand			
Domestic	233,751,969		204,743,199
Average daily domestic demand..	638,416		560,940
Exports			
Crude petroleum	14,833,971		2,344,948
Refined products	1,170,714		718,122
Total exports	16,004,685		3,063,070
Total demand	249,756,654		207,806,269
Daily average	682,264		569,322
Change in stocks	+ 5,010,507		+ 3,199,047

Tariffs

There is no Canadian tariff on crude-oil imports. The United States tariff on Canadian crude-oil exports is 5 1/4 cents per bbl on oil testing under 25° A.P.I. gravity, and 10 1/2 cents per bbl on oil testing at or above that gravity.