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Published by Authority of the Rt. Hon. C. D. Howe, M.P.,  
Minister of Trade and Commerce

**CANADA**

**DEPARTMENT OF TRADE AND COMMERCE**

**DOMINION BUREAU OF STATISTICS**

+ + + *Census of Industry* + + +

**MINING, METALLURGICAL & CHEMICAL STATISTICS**

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**Report**

**on**

**MISCELLANEOUS METALS IN CANADA, 1946**

**including**

Aluminum  
Antimony  
Beryllium  
Bismuth  
Boron  
Cadmium  
Calcium  
Cerium  
Chromium  
Iron  
Indium  
Magnesium

Manganese  
Mercury  
Molybdenum  
Pitchblende  
Selenium  
Tantalum-Columbium  
Tellurium  
Tin  
Titanium (ilmenite)  
Tungsten  
Vanadium  
Zirconium



Price 50 cents



Dominion Statistician:  
 Director - Division of Census of Industry and Merchandising:  
 Chief - Mining, Metallurgical and Chemical Statistics:

Herbert Marshall  
 W. H. Losee  
 H. McLeod

### MISCELLANEOUS METALS, 1946

The mining of certain metal-bearing ores, other than those commonly classified as gold, silver, copper, nickel, cobalt, lead and zinc, have been grouped, for statistical purposes, as a single industry by the Dominion Bureau of Statistics. Their production in some instances is confined to a relatively few operators and the annual extraction of certain types often fluctuates in an erratic manner according to demand and supply. Included in this report, with the finally-revised statistics relating to the Canadian production of these ores or metals, are notes and statistical data pertaining to various rare or semi-rare metals or metalliferous ores produced in other countries. Metals and metal-bearing ores produced in Canada during 1946 and classified as miscellaneous include antimony, bismuth, cadmium, chromite, iron ore, magnesium, manganese ore, mercury, molybdenite, pitchblende, selenium, tellurium, titanium ore, tin and tungsten concentrates. In addition to particulars relating to these metals or minerals, the bulletin contains notes of a summary nature on aluminum, beryllium, lithium, vanadium and a few of the rarer metals.

It is to be noted that the majority of the metals listed above as Canadian products and including bismuth, cadmium, selenium and tellurium, represent by-products recovered in the refining of lead, zinc or copper and, for this reason, such statistics as relate to their production in Canada are included with those of either the silver-lead-zinc mining industry, the copper-gold-silver mining industry, or the non-ferrous smelting and refining industry.

There were 21 active firms in the miscellaneous metals mining industries in 1946; employees numbered 1,037 to whom \$2,338,442 was paid in salaries and wages; fuel, electricity, supplies, freight and ore treatment cost \$3,479,336. The gross value of production was \$7,187,445 in 1946 compared with \$4,276,130 in 1945.

Table 1 - PRINCIPAL STATISTICS (x) OF THE MISCELLANEOUS METAL MINING INDUSTRY IN CANADA, 1945 and 1946

	1945	1946
Number of firms .....	24	21
Number of plants .....	23	21
Number of employees -		
Administrative and office ...	178	102
Workmen .....	807	935
Total .....	985	1,037
Salaries and wages - Salaries .....	\$ 324,594	291,452
Wages .....	\$ 1,716,755	2,046,990
Total .....	\$ 2,041,349	2,338,442
Value of production (gross) .....	\$ 4,276,130	7,187,445
Cost of fuel and electricity .....	\$ 753,184	739,531
Process supplies used .....	\$ 356,248	670,648
Smelter charges .....	\$ 35,875	...
Freight .....	\$ 1,374,264	2,069,157
Value of production (net) .....	\$ 1,756,559	3,708,109

(x) Does not include data relating to smelters and refineries or to mining in the Northwest Territories. Data for 1945 and 1946 cover only chromium, iron, molybdenum and titanium.

Table 2 - AVERAGE NUMBER OF WORKMEN, BY MONTHS, 1945 and 1946

Month	1 9 4 5					1 9 4 6				
	Surface		Under-ground	Mill		Surface		Under-ground	Mill	
	Male	Female		Male	Female	Male	Female		Male	Female
January .....	527	19	99	85	1	607	9	139	100	1
February .....	554	20	94	95	1	630	9	152	111	1
March .....	543	20	93	95	1	595	10	142	118	1
April .....	582	22	95	98	19	595	10	141	129	1
May .....	592	21	90	106	22	644	11	132	123	1
June .....	622	21	87	118	22	732	11	143	128	1
July .....	648	25	144	135	23	770	10	130	129	1
August .....	629	22	92	118	18	730	10	142	158	1
September .....	518	22	90	115	18	739	10	139	160	1
October .....	528	22	90	124	9	748	6	72	136	...
November .....	530	9	96	139	7	689	5	70	121	...
December .....	515	9	91	125	1	600	5	80	115	...
AVERAGE .....	566	19	97	113	12	675	9	123	127	1

Table 3 - FUEL AND ELECTRICITY USED, 1946

Kind		Quantity	Cost at Plant
			\$
Bituminous coal - Imported .....	short ton	1,000	11,286
Anthracite coal - From United States .....	short ton	2,184	24,345
Coke (for fuel only) .....	short ton	134	866
Gasoline (including gasoline used in cars and trucks) ..	Imp. gal.	132,098	36,364
Kerosene or coal oil .....	Imp. gal.	998	280
Fuel oil and diesel oil .....	Imp. gal.	1,057,708	137,539
Wood (cords of 128 cubic feet of piled wood) .....	cord	1,293	11,577
Electricity purchased for power and lighting (including service charge) .....	K.W.H.	57,333,782	303,151
Electricity purchased for other purposes .....	K.W.H.	48,769,820	214,123
TOTAL .....	...	...	739,531

Table 4 - POWER EQUIPMENT, 1946

Description	Ordinarily in Use		In Reserve or Idle	
	Number of units	Total horse power	Number of units	Total horse power
Steam engines .....	...	...	...	...
Steam turbines .....	...	...	...	...
Diesel engines .....	27	3,270	...	...
Gasoline, gas and oil engines, other than Diesel engines .....	31	679	3	111
Hydraulic turbines or water wheels .....	...	...	...	...
Electric motors operated by purchased power .....	348	15,566	15	1,159
TOTAL .....	406	19,515	18	1,270
Stationary power boilers .....	7	415	...	...
Motor-generator sets .....	2	13	...	...

ALUMINUM

Although Canada has no bauxite, the principal ore of aluminum, the Canadian aluminum smelting industry is the second largest in the world, being exceeded only by that of the United States. The principal factor favouring the establishment of the industry in Canada is abundant and low-cost hydro-electric power at points where necessary raw materials can be cheaply and conveniently assembled.

Production is entirely by the Aluminum Company of Canada, Limited, which has an ore treatment plant at Arvida, Quebec, and reduction works at Arvida, Ile Maligne, Shawinigan Falls, La Tuque and Beauharnois, all in the province of Quebec. These reduction plants had a total rated yearly capacity of 550,000 tons of aluminum or over 20 per cent of the estimated productive capacity of the world. In 1946 operations were concentrated at Arvida and Ile Maligne.

Fabricating plants are located at Kingston, Toronto and Etobicoke in Ontario, and at Shawinigan Falls in Quebec. These secondary plants consume only a small part of the primary ingot production, from 80 to 90 per cent being exported to all parts of the world.

The demand for aluminum was good in 1946. Increased facilities for the production of aluminum sheet and foil were installed. In pre-war years, Germany controlled the greater part of the trade in foil and Canada is now taking a large part of that market.

The principal imported raw materials used in the Canadian aluminum industry are bauxite from British Guiana, coal and coke from the United States, fluorspar from Newfoundland, and cryolite from Greenland and the United States.

No bauxite occurs in Canada, but clay, shale, nepheline syenite, and anorthosite, containing from 20 to 30 per cent alumina, are found in many parts of the country. The utilization of these low-grade materials has been the object of much research and various processes have been developed. The economic success of any of these processes will depend in large part upon local conditions, but it has yet to be proved that any of them can compete on an even basis with the Bayer process, the standard method for producing alumina, and which utilizes bauxite containing less than 7 per cent silica and from 55 to 60 per cent alumina.

Aluminum metal being only one-third as heavy as steel, untarnishable, and also a good conductor of electricity, is finding an increasingly wide field of usefulness. It is available from fabricating plants in many forms as sheets, foil, castings, forgings, rolled and extruded shapes, tubes, rods, wire, powder and paste. Because of its light weight and strength when alloyed, it is widely used in the making of aircraft and for many other purposes where lightness of structural metal is particularly desirable. Large tonnages are used for making cable for transmission of electricity, and for making cooking utensils and containers for food and beverages. It is finding increasing use in architecture and in construction of transportation equipment such as railway cars, automobiles, and boats.

The price of aluminum ingot throughout 1945 was 15 cents per pound f.o.b. plant, but early in 1946 the price was reduced to 13½ cents per pound.

Table 5 - PRODUCTION IN CANADA, DOMESTIC CONSUMPTION, IMPORTS AND EXPORTS OF ALUMINUM INGOTS, 1937-1946

Year	Production	Domestic Consumption	Exports	Imports
		(Tons of 2,000 pounds)		
1937 .....	46,906	10,903	48,500	40
1938 .....	71,203	9,396	64,724	69
1939 .....	82,840	10,544	70,578	189
1940 .....	109,144	18,197	86,536	133
1941 .....	213,873	19,717	192,757	3
1942 .....	340,596	32,700	314,483	...
1943 .....	495,749	40,100	375,383	1
1944 .....	462,065	38,400	295,226	66
1945 .....	215,712	40,800	382,286	51
1946 .....	194,117	33,825	137,336	246

Table 6 - IMPORTS OF ALUMINUM AND BAUXITE INTO CANADA, 1945 and 1946

Item	1 9 4 5		1 9 4 6	
	Cwt.	Value \$	Cwt.	Value \$
Alumina .....	6,384	99,975	3,620	58,732
Bauxite ore .....	18,794,253	7,262,766	25,663,512	8,524,873
Cryolite .....	99,658	424,486	56,720	490,349
Aluminum - Pigs, ingots and blocks ....	1,013	19,383	4,924	83,970
Scrap .....	6,408	47,118	11,651	108,640
Angles, channels and beams .	307	14,692	872	72,024
Bars, rods and wire .....	5,264	131,791	4,980	57,280
Leaf .....	...	69,437	...	97,861
Pipes and tubes .....	120	9,384	481	25,969
Plates, sheets and strips ..	16,332	476,162	83,361	2,314,616
Powder .....	46	4,435	228	19,449
Wire and cable .....	27	1,734	38	720
Household hollow ware .....	...	98,186	...	676,530
Manufactures n.o.p. ....	...	951,138	...	2,161,739

Cwt. = 100 pounds.

Table 7 - EXPORTS OF ALUMINUM FROM CANADA, 1945 and 1946

Item	1 9 4 5		1 9 4 6	
	Cwt.	Value \$	Cwt.	Value \$
Aluminum scrap .....	130,335	770,825	129,155	935,670
Aluminum wire and cable .....	...	1,049,797	...	1,219,416
Aluminum manufactures, n.o.p. ....	...	8,810,816	...	2,757,112
Aluminum in bars, blocks, ingots and blooms .....	7,645,729	121,778,512	3,746,717	49,146,887
Aluminum in rods, sheets and circles ....	37,821	1,070,281	48,977	1,307,178
Aluminum kitchen utensils and hollow ware	...	86,763	...	663,776

Table 8 - WORLD PRODUCTION OF ALUMINUM, 1939, 1945 and 1946 (From the Annual Report of the American Bureau of Metal Statistics)

Country	1 9 3 9	1 9 4 5	1 9 4 6
		(Metric tons)	
United States .....	148,367	450,403	371,614
Canada .....	75,152	195,694	175,500
Total America .....	223,519	646,097	547,114
Austria .....	4,283		1,039
France .....	52,500	37,225	50,500
Germany (x) .....	195,145		
Great Britain .....	25,000	32,407	32,050
Italy .....	34,200		
Norway .....	31,130	4,608	
Russia .....	73,000		Not
Spain .....	1,080	592	avail-
Sweden .....	1,966		able
Switzerland .....	28,000		
Total Europe (x) .....	376,704		
Japan .....	30,000		
India .....	...	1,500	

(x) Including estimates for uncertain productions in Hungary and Yugoslavia.

ANTIMONY

(Text from the Annual Review of the Bureau of Mines, Ottawa)

Antimony continued in short world supply in 1946 largely due to decline in production from Bolivia. Production from China, which prior to the war was the chief producer, has not been fully resumed, although at the close of the year shipments of Chinese antimony said to be from current production were being offered. As a result of shortage antimony remained under Government control both as to price and use.

No metallic antimony has been produced in Canada since 1944 in which year Consolidated Mining and Smelting Company of Canada discontinued the production of electrolytic antimony. However the company continued the production of an antimonial lead (25 per cent antimony) from antimonial fume residues which are a by-product of its lead-zinc smelting operations at Trail, British Columbia.

Certain occurrences of antimony in Canada have been explored and developed to some extent, but results generally have not been favourable to prolonged mining operations. The following is a summary of the more important known occurrences of antimony.

In Nova Scotia, the West Gore deposit at West Gore, in Hants county, is the best known. For many years prior to 1917, some antimony was produced in the form of a concentrate containing gold.

In New Brunswick, stibnite occurs in quartz veins at Lake George in a deposit that appears to have some promise. Mining operations had been carried on intermittently over a number of years, the latest production being in the period 1929-31 when high-grade ore was shipped. Ore dumps on the property are understood to contain a substantial amount of antimony and the various quartz veins have not been thoroughly explored. At the end of 1946, negotiations were under way with a Canadian metal firm to exploit this deposit.

In British Columbia, there are several occurrences, a few of which have been developed to some degree. Test shipments were made from Bridge River area in 1941; and from the Fort St. James area in 1940 after the sinking of a test shaft.

Antimony is chiefly used in the manufacture of hard lead for storage batteries, and cable covering. It is alloyed with tin in the manufacture of babbitt bearings, and with lead and tin in solders and type metal. Its property of expansion on cooling when alloyed makes it particularly useful in the manufacture of type metal. During the war it was used to harden the lead used in bullets and to flame proof canvas goods used by the armed forces.

Sulphides of antimony are used as a pigment in paint manufacture, and in the making of india-rubber. The oxides of antimony are used in the ceramic enamel trade as an opacifier. Compounds of the metal are used in the medicinal trade.

Administrator's Order No. A-2245 which came into force on January 22, 1947, sets the maximum prices of antimony, according to the Wartime Prices and Trade Board, as "The maximum price at which antimony of Chinese grade or higher grade may be sold or purchased by any person shall, according to the quantity, be sold as follows:

Quantity	Montreal, Toronto and Hamilton. (cents per pound)
10,000 lbs and over .....	29.50
2,000 lbs and less than 10,000 lbs .....	30.25
1,000 lbs and less than 2,000 lbs .....	32.25
less than 1,000 lbs .....	32.75

The said maximum prices are exclusive of sales tax".

E & M J Metal and Mineral Market average price for domestic antimony at New York was 17.306 cents in 1946, compared with 15.839 cents in 1945.

Table 9 - PRODUCTION OF ANTIMONY IN CANADA, 1937-1946

Year	In Ores Exported		Metal Produced in Canada		Total	
	Pounds	\$	Pounds	\$	Pounds	\$
1937 .....	48,163	7,394	...	...	48,163	7,394
1938 .....	24,560	2,200	...	...	24,560	2,200
1939 .....	25,405	3,139	1,200,180	148,330	1,225,585	151,469
1940 .....	44,700	3,800	2,549,792	392,668	2,594,492	396,468
1941 .....	15,292	2,141	3,169,785	443,770	3,185,077	445,911
1942 .....	78	13	3,041,030	516,975	3,041,108	516,988
1943 .....	...	...	1,114,166	189,408	1,114,166	189,408
1944 .....	...	...	1,937,933	281,000	1,937,933	281,000
1945 (x) .....	...	...	1,667,951	290,557	1,667,951	290,557
1946 (x) .....	...	...	642,145	96,332	642,145	96,322

(x) No refined metal in 1945 or 1946; figures represent antimony content of antimonial lead.

Table 10 - PRODUCTION OF ANTIMONY METAL IN CANADA, CONSUMPTION, IMPORTS AND EXPORTS, 1937-1946

Year	Production in Canada	Consumption in Canada	Imports	Exports (x)
	(Tons of 2,000 pounds)			
1937 .....	...	430	588	...
1938 .....	...	385	428	...
1939 .....	600	426	119	275
1940 .....	1,275	558	118	359
1941 .....	1,585	955	1	676
1942 .....	1,521	1,187	...	166
1943 .....	557	1,303	120	6
1944 .....	968	1,515	779	...
1945 .....	...	778	517	...
1946 .....	...	871	455	...

(x) Shipped for export - data not available from Customs' Records.

Table 11 - CONSUMPTION OF ANTIMONY METAL, BY INDUSTRIES, 1942-1946

Industry	1942	1943	1944	1945	1946
	(Tons of 2,000 pounds)				
In Steel foundries .....	1	...	...	...	...
White metal foundries .....	909	907	1,191	614	743
Electrical apparatus plants ..	117	165	183	114	78
Brass foundries .....	13	14	10	9	21
Non-ferrous smelters .....	44	134	76	1	...
Silverware factories .....	7	8	8	9	29
Ammunition plants .....	91	71	41	26	...
Miscellaneous .....	5	4	6	5	5
TOTAL .....	1,187	1,303	1,515	778	871

B I S M U T H

(Text from the Annual Review of the Bureau of Mines, Ottawa)

Bismuth is produced in Canada by The Consolidated Mining and Smelting Company of Canada, Limited at Trail, B.C. from the residues resulting from the electrolytic refining of lead bullion. The plant has been operated intermittently since 1928. The capacity is 60 tons per year.

A recent producer is the La Corne mine, Quebec, operated by the Molybdenite Corporation of Canada which commenced the production of a 30 per cent bismuth concentrate in May 1946. Prior to 1946 molybdenum concentrate produced by the La Corne mine contained undesirable amounts of bismuth and copper. During the war the concentrate was refined solely for its molybdenum content. A process was worked out in the Bureau of Mines Laboratory, Ottawa early in 1946 whereby the bismuth could be removed and sold at a relatively high price, and which improved the saleability of the molybdenite concentrate. The mine produced about 45 tons of bismuth concentrate before the end of the year.

The known deposits or occurrences of bismuth ore in Canada are few in number. It is possible, however, that the metal may occur with other molybdenite deposits of Canada as in the case of the La Corne mine.

Some bismuth ore was removed from the Glacier Gulch Group near Smithers, British Columbia on the Canadian National Railway. The bismuth associated with a gold ore was shipped to the smelter at Tacoma, Washington.

The greatest use of bismuth is in medicinal and cosmetic preparations. Bismuth is too brittle to be used alone, but its alloys find many uses in industry. Alloys are used in the manufacture of sprinkler plugs and other fire protection devices, electrical fuses, low melting solders, dental amalgams, and tempering baths for small tools. As does antimony, bismuth expands on solidification and retains this property in a number of alloys, and is used in type-metal. Salts of bismuth are used in the X-ray examination of the digestive tract due to the absorptive powers of bismuth for X-rays. A certain amount is used in optical glass manufacture.

E & M J Metal and Mineral Market prices for bismuth during 1946 was \$1.60 per pound in ton lots until December 2nd when the price was raised to \$1.80 to effect December, 1946, and later shipments.

Table 12 - PRODUCTION OF PRIMARY BISMUTH IN ALL FORMS (x) IN CANADA, 1937-1946

Year	Pounds	\$	Year	Pounds	\$
1937 .....	5,711	5,654	1942 .....	347,556	479,627
1938 .....	9,516	9,754	1943 .....	407,597	562,484
1939 .....	409,449	466,362	1944 .....	123,875	154,844
1940 .....	58,529	81,004	1945 .....	189,815	260,047
1941 .....	7,511	10,396	1946 .....	240,504	336,706

(x) Refined metal plus bismuth content of bullion exported.

Table 13 - PRODUCTION OF BISMUTH METAL IN CANADA, CONSUMPTION, IMPORTS AND EXPORTS, 1937-1946

Year	Production	Domestic Consumption	Exports (x)	Imports
		(Tons of 2,000 pounds)		
1937 .....	...	14	37	...
1938 .....	...	18	40	...
1939 .....	205	14	64	5
1940 .....	20	12	77	...
1941 .....	...	16	51	...
1942 .....	159	36	199	...
1943 .....	204	65	73	...
1944 .....	62	46	25	...
1945 .....	95	35	41	...
1946 .....	120	40	95	...

(x) Shipped for export by Canadian producers.

Table 14 - CONSUMPTION OF BISMUTH METAL IN CANADA, BY INDUSTRIES, 1942-1946

Industries	1942	1943	1944	1945	1946
			(Tons of 2,000 pounds)		
In medicinals and pharmaceuticals .	13	28	23	15	11
White metal foundries .....	13	28	20	16	23
Miscellaneous .....	10	9	3	4	6
TOTAL .....	36	65	46	35	40

BERYLLIUM

(Text from the Annual Review of the Bureau of Mines, Ottawa)

Beryl, a silicate of aluminum and beryllium, is the commonest beryllium mineral, and is the only present commercial source of the element. It generally contains from 10 to 12 per cent of beryllium oxide, corresponding to from 4 to 4.5 per cent of beryllium. The occurrence of beryl is restricted to pegmatite dykes, in which it is usually found as disseminated crystals, sometimes of very large size. Only rarely, however, is the beryl content of pegmatites sufficient to enable the deposits to be worked for this mineral alone, and a large part of the comparatively small world production has been obtained as a by-product from the mining of feldspar, mica, or lithium minerals.

Canada produces no beryl and very little beryl is used or required by domestic industries. Most of the world supply in recent years has come from Brazil, Argentina, India, the United States, and South Africa.

The most noteworthy occurrences of beryl in Canada are in Ontario, south-eastern Manitoba, and the Northwest Territories.

In Ontario, intermittent work was done prior to 1941 on a beryl pegmatite in Lyndoch township, Renfrew county. A few tons of clean cobbled crystals were obtained, and about 200 tons of milling grade rock was stockpiled. Most of the work on the property was done by the present owners, Canadian Beryllium Mines and Alloys, Limited, 901 Royal Bank Building, Toronto, who, however, have reported no sales. A detailed examination of the main, easterly workings, made in 1943 by the Bureau of Mines, Ottawa, and the Metals Controller's Office, indicated an average content of 0.188 per cent beryl in the total rock excavated, with a maximum for the richest quarry sections of 1.24 per cent. Grade of selected clean beryl crystals was 10.41 per cent BeO.

In Manitoba a little work was done several years ago on beryl showings in pegmatites opened originally for feldspar and lithium minerals in the Winnipeg River and Oiseau (Bird) River areas, but no shipments were reported.

In the Northwest Territories, exploration in the area north and east of the Yellowknife gold camp has disclosed numerous occurrences of beryl in pegmatites which also contain lithium minerals and tantalite-columbite. Some of these are considered to be of possible economic interest.

In Quebec, scattered occurrences of beryl are known in La Corne and Preissac townships, Abitibi county, often associated with molybdenite. None of these, however, is believed to be of economic importance.

Beryllium is used chiefly in the form of beryllium-copper alloys, the most important of which contains about 2 per cent beryllium. A beryllium-aluminum alloy containing 5 per cent beryllium is used as a deoxidizer in making aluminum-magnesium products. Straight beryllium metal has only limited applications, notably for the windows of X-ray tubes, where it is used for its transparency to the rays.

Various beryllium salts, principally the oxide and carbonate, are used in industry. A growing demand has developed for the oxide for the preparation of zinc-beryllium silicate, used as a coating for fluorescent lighting tubes and lamps, and for fluorescent screens. The oxide and carbonate, activated by uranium salts or rare earths, act as "phosphors" and are utilized in luminescent paints. The oxide is a super-refractory, with a melting-point of 2,570°C., or 520 degrees above that of aluminum, and is used in crucibles, insulators, electrodes, furnace linings, and as a filament coating in lamps. Beryllium acetate is used as a coagulating, hardening bath for sodium alginate, a new English textile made from seaweed.

Ground beryl is used as a batch ingredient in sparkplugs and other ceramic specialties, to which it imparts high electrical and impact resistance and transverse strength. Some is also used in cooking utensil enamels. Consumption for such uses in the United States is estimated at about 100 tons a year.

Most of the present world production of beryl is marketed in the United States, where the following companies engaged in the primary production of beryllium metal, alloys, and compounds are the chief purchasers: Beryllium Corporation of Pennsylvania, Temple (Reading), Pennsylvania; Brush Beryllium Company, 3714 Chester Avenue, Cleveland, Ohio; and Clifton Products Incorporated, Painesville, Ohio.

The New York price quotations remained steady throughout the year - Beryllium ore, per unit of BeO, 8 to 12 per cent, f.o.b. mine \$8-\$10 - Beryllium-copper master alloy, 4 per cent beryllium, remainder copper, in lots 1 pound or more of beryllium, \$14.75 per pound of contained Be.

B O R O N

According to the United States Bureau of Mines, boron alloys are supplied by United States manufacturers, small quantities being used in the non-ferrous metals industries and in steel making. In cast iron, boron opposes graphitization on solidification and exerts an energetic whitening effect, producing a hard strong iron but reducing malleability. Recently boron has been found to be one of the so-called minor elements that stimulate plant growth and inhibit the development of certain plant diseases.

The most interesting use of boron was in the production of "atomic bomb" constituents. It has a strong tendency to absorb neutrons, and as the net number available for a self-sustaining uranium fission reaction is very small, boron was not suitable as a "moderator" - that is, a mechanism for slowing neutron speeds to the range where they would be effective in disintegrating the U235 uranium isotope. How serious neutron loss was considered is indicated by the statement that high-purity graphite containing only about 2 parts per million of boron was undesirable as a moderator. However, the same characteristic makes boron useful in controlling the operating rate of the uranium-graphite piles used to produce the new element, plutonium. Boron or boron steel was so used. Boron trifluoride (BF<sub>3</sub>) also was used in instruments employed for measuring neutron intensity in the piles.

Boron carbide, boron carbide shapes and calcium boride are now produced in Canada.

World reserves of boron minerals are abundant, but known sources are confined to a few countries, chiefly the United States, Chile, Argentina, Peru, Italy and Turkey, although Borax also has been reported in Tibet, Persia, India and Ceylon.

Imports of Borax into Canada during 1946, in packages of 25 pounds or over, totalled 14,512,114 pounds valued at \$395,431. Borax was quoted in the United States in 1946 at \$41.50 per ton, granular technical.

C A D M I U M

(Text from the Annual Review of the Bureau of Mines, Ottawa)

Cadmium occurs as a minor constituent in most zinc ores and in some lead ores. In Canada its production is limited to the by-product recovery from the manufacture of electrolytic zinc. Some important uses have been developed during the past fifteen years and indications are that a strong demand will continue for the metal.

Cadmium metal is produced by The Consolidated Mining and Smelting Company of Canada, Limited, at Trail, British Columbia, and by Hudson Bay Mining and Smelting Co. Limited at Flin Flon, Manitoba. The cadmium produced at Trail originates largely in the silver-lead-zinc ores of the Sullivan mine at Kimberley, B. C. A small amount is contained in zinc concentrate shipped to Trail from Zincton Mines Limited in the Slocan district. At Flin Flon it is contained in the copper-gold-zinc ores of the Flin Flon deposit on the Saskatchewan-Manitoba boundary. At Trail and Flin Flon cadmium is recovered from the residue resulting from the refining of zinc.

Cadmium is used mainly in electroplating and in the manufacture of alloys and compounds, the most common use being as a protective coating for steel. To a much lesser extent it is used in copper alloys. The use of cadmium alloys in motor vehicle bearings and for solders has created a strong demand for the metal. Cadmium is used also in the arts, paints, ceramics, and dyeing, etc.

Cadmium sulphide and cadmium sulphoselenide are standard agents for imparting bright resistant yellow and red colors respectively to paints, ceramics, inks, rubber, leather and other products. Paper coated with cadmium sulphide acts as a mustard-gas detector. Cadmium nitrate is used in white fluorescent lamp coatings. The oxide, hydrate and chloride are used in electro-plating solution; the carbonate in ceramics; and the halides in photography.

Cadmium is marketed in metallic form, 99.5 per cent pure and better, and as a sulphide. The principal compounds are cadmium sulphide, cadmium oxide, cadmium lithopone, and cadmium selenite.

The price of cadmium metal, E & M J Metal Markets, was 90 cents per pound at the beginning of 1946. The price rose to \$1.25 July 8th and a further rise to \$1.50 per pound was effective on December 2nd.

Table 15 - PRODUCTION OF CADMIUM, IN CANADA, 1937-1946

Year	British Columbia		Manitoba		Saskatchewan	
	Pounds	\$	Pounds	\$	Pounds	\$
1937 .....	436,431	715,747	164,223	269,326	144,553	237,067
1938 .....	510,342	410,090	115,166	92,543	73,630	59,166
1939 .....	799,253	563,241	73,830	52,029	66,608	46,939
1940 .....	778,791	905,734	57,742	67,154	71,594	83,264
1941 .....	1,081,374	1,269,533	61,085	71,714	108,832	127,769
1942 .....	972,413	1,147,447	29,236	34,498	147,314	173,831
1943 .....	598,673	688,474	20,985	24,130	166,955	191,998
1944 .....	386,410	425,051	20,921	23,013	119,639	131,603
1945 .....	510,432	505,328	27,891	27,612	107,741	106,663
1946 .....	636,315	776,304	63,410	77,360	102,923	125,566

Table 16 - CONSUMPTION OF CADMIUM METAL IN CANADA, CONSUMPTION AND EXPORTS, 1937-1946

Year	Production	Domestic	Exports
		Consumption (Tons of 2,000 pounds)	
1937 .....	372	33	283
1938 .....	349	23	233
1939 .....	470	41	525
1940 .....	454	75	399
1941 .....	625	149	455
1942 .....	574	207	400
1943 .....	393	168	286
1944 .....	263	108	192
1945 .....	319	87	175
1946 .....	401	96	296

Note - Statistics on imports are not available.

### C A L C I U M

The commercial production of calcium in Canada started in 1945 when the metal was recovered from lime by Dominion Magnesium Limited at its plant located at Haley, Ontario.

Calcium has found increasing use as a deoxidizer in ferrous metallurgy and as an alloy constituent with non-ferrous metals. It has been employed in the reduction of difficultly reducible metals, such as chromium, thorium, uranium, and zirconium. During the war an important calcium use was to make hydride, which is a convenient and portable source of hydrogen for inflating weather balloons. Uranium metal had been made by reaction of calcium with chloride or oxide and by reducing the oxide with calcium hydride; the latter was perhaps the first-applied (1941) relatively large scale production method. The uranium was, however, in the form of highly impure pyrophoric powder and was not usable in the atomic bomb project. However, by the end of 1942 acceptable metal was being turned out.

New York quotations for calcium, 97-98 per cent as cast, was \$1.85 per pound. The Canadian producer is able to sell an exceptionally high purity product for two-thirds of the quoted price.

Table 17 - PRODUCTION OF CALCIUM IN CANADA, 1945 and 1946

Year	Pounds	\$
1945 .....	22,720	19,312
1946 .....	53,548	68,720

C E R I U M

(Text from the Annual Review of the Bureau of Mines, Ottawa)

Cerium is obtained from monazite, a monoclinic phosphate of cerium metals containing about 32 per cent cerium oxide ( $\text{Ce}_2\text{O}_3$ ) and up to 18 per cent thorium ( $\text{ThO}_2$ ). Monazite is distributed widely in igneous rocks throughout the world, especially in gneisses that have been intruded by pegmatites, but usually it forms only a small fraction of one per cent of the containing rock and only the natural concentrations in stream gravels and beach sands have paid for exploration. The chief commercial sources of monazite sand are beach deposits in Brazil and India. There are a few occurrences of monazite in Nova Scotia, Quebec and British Columbia, none of which is of commercial interest. It is usually found as small crystals in granites and pegmatites in the Canadian Shield and small quantities occur in association with the black sands of the Quesnel river, Lillooet district, British Columbia. In the United States there are commercial deposits in Carolina, Florida, and Idaho, and known occurrences in many other States.

Cerium is usually regarded as belonging to the general group of "rare earths", as it invariably occurs in nature associated with the other fourteen members of the group and is very similar to the other rare-earth elements in many of its chemical properties.

In Canada, Shawinigan Chemicals, Limited, Shawinigan Falls, Quebec, has been producing cerium products from cerium chloride since 1940. The output is sold to the Belgo Canadian Manufacturing Company, Limited, of Montreal, for the manufacture of sparking flints.

Prior to the war the leading producers of rare-earth products for the European market were located in Berlin, London, and Paris, and those for the American market, in Chicago. In the United States the present supply of cerium products is provided by Cerium Metals Corporation, Niagara Falls, N.Y.

World production of monazite is approximately 5,000 tons a year.

Thorium, which was used in gas mantles, was formerly the only commercial constituent of monazite, and monazite is still marketed on the basis of its thorium content, although its content of ceria ( $\text{Ce}_2\text{O}_3$ ) and of other rare-earth oxides is of chief interest at present. Probably 50 per cent of monazite derivatives are consumed, chiefly as fluorides, in the cores of arc carbons to increase lighting intensity in searchlights, motion-picture projectors, and therapeutic lamps. About 25 per cent of the consumption of monazite derivatives is used in pyrophoric (sparking) alloys or in ferroceriums for use in sparking flints for lighters. The remainder is used for a variety of purposes, but principally for making optical glassware. Cerium metal is used in the evacuation of radio tubes.

Imports of salts of cerium or of thorium, for the manufacture of gas mantles, was appraised at \$33,074 in 1946 compared with \$12,428 in the preceding year.

C H R O M I T E

(Text from the Annual Review of the Bureau of Mines, Ottawa)

Pure chromite ( $\text{FeO}$ ,  $\text{Cr}_2\text{O}_3$ ) contains 68 per cent chromic oxide, but in nature it always contains besides iron, varying amounts of magnesia and alumina. It is a heavy, almost black, lustrous and brittle mineral, and the ore usually occurs in dunite bands in serpentine rocks. Chromite is distinguished in the field from other black minerals of similar appearance by its chocolate brown powder or streak when struck or scratched with a hammer.

Most of the Canadian deposits from which production has been obtained are between Quebec City and Sherbrooke in the Eastern Townships of Quebec.

Chromite Limited obtained its output from the old Sterrett mine in Cleveland township, Quebec. The chromite occurs as fairly uniformly disseminated zones, scattered through which are plums of the massive mineral. The ore zone, which varies in width from 5 to 20 feet, has been traced on the surface for about 2,000 feet. The mine has been developed at 5 levels to a maximum length of 1,800 feet and to a depth of 550 feet. The ore, which averaged 18 per cent  $\text{Cr}_2\text{O}_3$ , was treated in a 150 ton mill.

The old Montreal pit was operated over 50 years ago and was re-opened by Union Carbide Company in 1941, since when production has been continuous.

The Chromeraïne mine, also in the Black Lake area, was operated in 1943 by Wartime Metals Corporation, but was closed in August, 1944. The ore is chiefly low-grade, banded and disseminated chromite, averaging 8 per cent  $\text{Cr}_2\text{O}_3$ , with a small amount of the massive mineral. The zone has been traced intermittently for 2,000 feet, has an average width of 33 feet, and in places is 60 feet wide. A small amount of drilling has indicated that the ore extends to a depth of at least 440 feet.

Chromite Association did some prospecting in the Black Lake district in 1945.

In Manitoba, little prospecting was done on the large bodies of low-grade chromite deposits that were discovered early in 1942, north of Oiseau (Bird) River in the southeastern part of the province. Various zones have been traced for lengths of several thousand feet. The ore is high in iron and an economical method of bringing the chrome-iron ratio to within market requirements has not been devised.

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

In the metallurgical field, chromium is one of the principal alloying elements in a great variety of steels, chief of which in the amount of chromium used are the stainless and the corrosion-resistant steels. It is the vital ingredient with nickel and molybdenum in the making of armour plate, armour-piercing projectiles, and high-speed tool steels, and is used as a hard, toughening element in tank axles and frames, in aeroplane parts, and in other essential war materials.

Chrome ore is used for making refractory bricks or materials used in basic open hearth furnaces, in arches of furnaces, in parts of combustion chambers, chambers of high pressure steam boilers, etc. It is used with magnesia to make chrome-magnesia refractories, an important use in Canada being in the manufacture of brucite magnesia bricks that contain up to 30 per cent  $\text{Cr}_2\text{O}_3$ .

In the chemical industry, chromite is mainly fundamental salts such as sodium and potassium bichromates that are used in electroplating, tanning, dyeing, glass making, pigments, photography, bleaching, safety matches, antiseptics, some aniline dyes used in printing, etc. Finely powdered chrome oxide is used as a buffing compound for polishing stainless steels. During the war a large amount of chrome chemicals was used for military purposes.

The principal Canadian buyers of chromite for metallurgical use are: Chromium Mining and Smelting Corporation, Sault Ste. Marie, Ontario, and Electro-Metallurgical Company of Canada, Welland, Ontario. The only important purchaser of refractory ore is Canadian Refractories, Limited, Canada Cement Building, Montreal.

At the end of 1946 United States price of domestic and imported ores of 48 per cent  $\text{Cr}_2\text{O}_3$  and 3 to 1 ratio was \$39.00; ores of lower grade and ratio vary down to a minimum of \$27.00 a long, dry ton at seaboard. Canadian prices of 47 to 48 per cent  $\text{Cr}_2\text{O}_3$  concentrates are \$25 to \$40 and crude ore \$15 to \$20 a long ton, f.o.b. mines, depending upon the chrome-iron ratio and upon the percentages of certain impurities.

Table 18 - PRODUCTION OF CHROMITE IN CANADA, 1937-1946

Year	Short tons	\$	Year	Short tons	\$
1937 .....	(x)	43,250	1942 .....	11,456	343,568
1938 .....	...	...	1943 .....	29,595	919,878
1939 .....	...	...	1944 .....	27,054	748,494
1940 .....	335	5,780	1945 .....	5,755	160,752
1941 .....	2,372	42,679	1946 .....	3,110	61,123

(x) Quantity not published.

Table 19 - PRINCIPAL STATISTICS FOR THE CHROMITE MINING INDUSTRY (x) IN CANADA, 1944-1946

		1 9 4 4	1 9 4 5	1 9 4 6
Active firms .....	No.	7	4	2
Employees - Salaried .....	No.	42	7	6
Wage-earners .....	No.	202	23	16
Total .....	No.	244	30	22
Salaries and wages -				
Salaries .....	\$	80,065	12,590	13,000
Wages .....	\$	293,529	22,699	17,056
Total .....	\$	373,594	35,289	30,056
Gross value of production .....	\$	748,494	160,752	61,123
Fuel and electricity used .....	\$	60,009	8,224	8,299
Process supplies used .....	\$	83,828	15,023	10,000
Freight .....	\$	45,373	...	...
Net Value .....	\$	559,284	137,505	42,824

(x) All in the province of Quebec.

Table 20 - IMPORTS OF CHROME ORES INTO CANADA, 1938-1946

Year	Tons	\$	Year	Tons	\$
1938 (x).....	9,103	142,399	1943 .....	103,471	2,121,228
1939 .....	16,584	232,851	1944 .....	39,089	618,231
1940 .....	29,938	554,413	1945 .....	60,691	1,154,985
1941 .....	92,952	1,460,209	1946 .....	15,836	269,248
1942 .....	87,628	1,271,482			

(x) Nine months only - not shown separately prior to April 1938.

Table 21 - IMPORTS OF CHROME ORES INTO CANADA, BY PRINCIPAL COUNTRIES OF SUPPLY, 1945 and 1946

Imported from	1 9 4 5		1 9 4 6	
	Tons	\$	Tons	\$
British South Africa .....	2,420	76,197	11,040	118,556
Southern Rhodesia .....	31,590	458,176	...	...
British India .....	14,660	223,918	...	...
Cuba .....	71	1,956	159	4,394
Turkey .....	828	35,711	2,023	64,685
United States .....	11,122	359,027	2,614	81,613
TOTAL .....	60,691	1,154,985	15,836	269,248

I N D I U M

Indium was commercially recovered in Canada only in 1942 when 470 troy ounces valued at \$4,710 were produced at Trail, British Columbia by the Consolidated Mining and Smelting Company of Canada, Limited. The metal was obtained in the treatment of zinc refinery residues. The United States produces a considerable quantity of indium but data relating to entire world production are not available.

The major use has been in heavy-duty composite metal bearings employed extensively in airplanes, tanks and other mobile equipment. A zinc-indium alloy was used in applying a noncorrosive plating to hollow-steel airplane propellers. Minor uses have been in solder and brazing alloys and alloyed with gold and silver for jewelry and plated articles. The first commercial use about 1927 was as a nontarnish coating on silverware. Low-melting-paint alloys also have been manufactured recently. Indium foil was used as a neutron indicator in the atomic bomb project uranium-graphite piles. Low-energy neutrons, about 1.5 electron-volt, are particularly effective in inducing artificial radioactivity in indium.

Quoting from E & M J Metal and Mineral Markets - June 28, 1945 - "The price situation in indium remains unsettled. During the last week producers lowered the quotation to \$3 an ounce troy, a reduction of \$1. Supplies are ample, reflecting increased recovery of this by-product of zinc operations that has occurred in recent years. Use of indium has expanded but not at a rate to keep pace with production. At the beginning of the year indium was quoted at \$7.50 an ounce troy and a year prior to that at \$10."

At the close of 1945 the quoted price of indium was \$2.25 per ounce troy. The price remained at this level through 1946.

IRON ORE

(Text from the Annual Review of the Bureau of Mines, Ottawa)

Only two of the many known iron-bearing districts in Canada produced ore in 1946, namely Michipicoten, northeast of Lake Superior, and Steep Rock, 150 miles west of Port Arthur. No work was done on the magnetite deposits of eastern Ontario. Plans for the use of the magnetite ore of the Pacific coast did not mature.

Algoma Ore Properties, Limited - Helen Mine - The large body of siderite at the Helen mine extends several thousand feet eastward from the original hematite deposit from which 2,520,865 long tons of ore was shipped between 1900 and 1918. The siderite has been drilled beneath the former hematite deposit and eastward beneath the siderite outcrop, to outline 100,000,000 tons of siderite ore.

During 1946 ore was extracted from two open-pits, the New Helen pit adjacent on the east of the former hematite deposit, and the Victoria pit, about  $\frac{3}{4}$  mile to the east of the New Helen pit. The crude ore from the Victoria pit was treated by the sink and float process to reduce the silica content.

The New Helen and Victoria pits furnished 843,420 long tons of siderite to the sintering plant on the Algoma Central Railway at Wawa. The Josephine mine, 8 miles northeast of the Helen mine shipped 97,480 long tons of hematite concentrate to Wawa. From this siderite and hematite there was made 552,056 long tons of sinter. Somewhat more than half this sinter was used in the furnaces of Algoma Steel Corporation at Sault Ste. Marie, Ontario, owners of the mine, and the remainder was exported to the United States. Algoma Ore Properties is the sales agent.

Michipicoten Iron Mines, Limited - Josephine Mine - On September 15, 1946 caving commenced above one of the stopes and continued through the surface, which is the bottom of a small lake that had been drained to facilitate mining. This let into the mine an estimated 80,000 cubic yards of mud and slime which flooded the lower levels. As the mine had been operated at a loss up to this time, Sherritt Gordon Mines Limited, (which controls Michipicoten Iron Mines Limited) decided not to pump it out.

Steep Rock Iron Mines, Limited - Steep Rock Mine - Preparations were commenced to open the "A" orebody,  $1\frac{1}{2}$  miles north of "B". This involves some preliminary drilling, pumping out the remainder of the Middle Bay of Steep Rock Lake, and removing the overburden. The surface of "B" orebody lies 170 feet, and "A", 333 feet below the former surface of the lake. From the preliminary drilling, it appears that "A" orebody will be capable of providing an annual output somewhat larger than that from "B", after it has been fully prepared for mining. It is estimated that two or three years will be required to complete the preparations, though a limited output may be attained in the meantime.

Steep Rock crude ore is separated by screening into three shipping grades.

Shipments in 1946 were all made through the ore dock of Canadian National Railways at Port Arthur. Most of the ore was sold in the United States, Cleveland-Cliffs Iron Company being the sales agent.

Labrador and Quebec - Prospecting of this extensive iron range, astride the Labrador-Quebec boundary in the central part of the Ungava peninsula, has indicated high-grade hematite deposits for a length of 100 miles. The width of the iron-bearing formation varies from 20 to 40 miles. It has been impossible up to the present to cover the whole of this large area of 3,000 square miles or more of favourable ground with more than rather cursory and wide-spaced traverses. Work has been concentrated on the central section about 50 miles in length and 5 miles in width within which are located most of the large and high-grade deposits so far discovered. Within and beyond this central area, large deposits of medium grade ore (40 to 50 per cent iron in the outcrops) have been found, as well as very large areas of the siliceous iron formation. On none of these deposits has enough work been done to determine the full dimensions. Hollinger North Shore Exploration Company, a subsidiary of Hollinger Consolidated Gold Mines Limited, holds the concession on the Quebec side of the border, and Labrador Mining and Exploration Company Limited, controlled by Hollinger Consolidated, the concession on the Labrador side. M.A. Hanna Company of Cleveland has a minority interest.

Development work during the brief field season of 1946 consisted mainly of drilling on some of the larger outcrops in the central section astride the height-of-land which constitutes the Quebec-Labrador boundary. This drilling showed that, in some deposits at least, the hard, dense hematite of the surface outcrops constitutes a covering or crust on top of softer ore that resembles fairly closely the characteristic high-grade ore of the Mesabi range in Minnesota. Several of the outcrops are thousands of feet in length and hundreds of feet in width. A satisfactory depth has been determined in several places. There is thus some definite evidence that large open-pit operations can be established in due course.

Table 22 - PRINCIPAL STATISTICS FOR THE IRON ORE MINING INDUSTRY IN CANADA, 1944-1946

		1944	1945	1946
Active firms .....	No.	8	10	11
Employees - On Salary .....	No.	99	145	72
Wage-earners .....	No.	580	657	751
Total .....	No.	679	802	823
Salaries and Wages - Salaries .....	\$	242,271	272,716	224,505
Wages .....	\$	1,220,182	1,481,956	1,719,931
Total .....	\$	1,462,453	1,754,672	1,944,436
Gross value of production .....	\$	1,909,608	3,635,095	6,822,947
Fuel and electricity used .....	\$	642,761	709,398	687,011
Process supplies used .....	\$	200,438	304,666	604,081
Freight and treatment charges .....	\$	276,653	1,367,526	2,065,095
Net Value .....	\$	789,756	1,253,505	3,466,760

Table 23 - PRODUCTION OF IRON ORE (x) IN CANADA, 1939-1946

Year	Short tons	Value	Year	Short tons	Value
1939 .....	123,598	341,594	1943 .....	641,294	2,032,240
1940 .....	414,603	1,211,305	1944 .....	553,252	1,909,608
1941 .....	516,037	1,426,057	1945 .....	1,135,444	3,635,095
1942 .....	545,306	1,517,077	1946 .....	1,549,523	6,822,947

(x) Exclusive of titanium-bearing ores. All iron ore was from mines in Ontario, except 187 tons from Quebec in 1942 and 143,062 tons from New Brunswick in 1943.

Table 24 - IMPORTS INTO CANADA AND EXPORTS OF IRON ORE, 1937-1946

Year	Imports		Total (x)	Exports
	From United States	From Newfoundland		
	(Tons of 2,000 pounds)			
1937 .....	1,416,015	1,188,771	2,124,972	4,644
1938 .....	631,031	607,025	1,302,430	209
1939 .....	1,205,261	1,606,775	1,764,844	10,540
1940 .....	524,849	716,317	2,418,237	251,626
1941 .....	2,212,437	962,259	3,254,655	282,068
1942 .....	2,033,961	610,871	2,701,968	295,960
1943 .....	2,978,388	911,450	3,906,425	374,677
1944 .....	2,501,737	624,890	3,126,649	308,424
1945 .....	2,988,484	736,665	3,739,867	771,495
1946 .....	1,686,236	518,566	2,281,677	1,145,256

(x) Includes some ore from other countries, principally Brazil.

Table 25 - IRON ORE CHARGED TO IRON BLAST FURNACES IN CANADA, 1937-1946

Year	Canadian	Imported	Total
	(Tons of 2,000 pounds)		
1937 .....	...	1,796,562	1,796,562
1938 .....	...	1,382,565	1,382,565
1939 .....	50,570	1,425,536	1,476,106
1940 .....	154,643	2,188,074	2,342,717
1941 .....	166,263	2,542,826	2,709,089
1942 .....	229,253	3,383,439	3,612,692
1943 .....	302,780	2,955,671	3,258,451
1944 .....	266,150	3,227,039	3,493,189
1945 .....	235,757	2,797,697	3,033,454
1946 .....	358,173	2,167,900	2,526,073

M A G N E S I U M

(Text from the Annual Review of the Bureau of Mines, Ottawa)

Production of magnesium in Canada in 1946 was confined to a small tonnage made in a pilot plant operated by Aluminum Company of Canada at Arvida, Quebec. Based on data obtained from this work, the company is building an electrolytic magnesium plant having an initial rated capacity of 1,000 tons a year. The raw material will be magnesia obtained from brucitic limestone at the company's Wakefield, Quebec, plant.

Dominion Magnesium Limited, Haley, Ontario, shipped a considerable tonnage of magnesium from stock and also made and shipped various magnesium alloys, but there was no production of the metal.

Progress was made in developing and furthering the use of magnesium and its alloys and prospects are good for the greater utilization of this light metal in the near future.

Light Alloys Limited, Renfrew, Ontario, enlarged the capacity of its magnesium foundry and installed die-casting equipment. Magnesium foundries were also operated by Robert Mitchell Company, Limited, Montreal, and by Western Magnesium Limited, Vancouver.

Dolomite, the double carbonate of calcium and magnesium, and which contains 13 per cent of magnesium, is found in all provinces of Canada except Prince Edward Island. It is particularly abundant in Ontario and Manitoba.

Magnesite, the carbonate of magnesium, containing 28.7 per cent magnesium, and hydromagnesite, containing 26.5 per cent of magnesium, are available in British Columbia. Deposits of magnesitic dolomite consisting of an intimate mixture of magnesite and dolomite occur in Argenteuil county, Quebec, where they are being worked for the production of basic refractories. The magnesite deposits in British Columbia are undeveloped, but magnesium has been made from them on an experimental scale. Magnesitic dolomite possesses no advantages over dolomite or magnesite as a source of magnesium.

Brucite, in the form of granules 1 to 4 mm. in diameter thickly disseminated throughout crystalline limestone and forming 20 to 35 per cent of the volume of the rock, occurs in large deposits in Ontario and Quebec. Brucite is the hydroxide of magnesium and contains 41.6 per cent of magnesium. The Canadian deposits are the largest known in the world. The brucite is being recovered in the form of granules of magnesia from one of these deposits near Wakefield, Quebec, and though the granular magnesia so obtained is being used principally for the manufacture of basic refractories and as an ingredient in chemical fertilizers, it is a very suitable raw material for the production of magnesium metal.

Serpentine, the silicate of magnesium, contains 25.8 per cent of magnesium, and occurs in many deposits throughout Canada. It is also available in huge waste dumps aggregating probably 100,000,000 tons in the asbestos-producing region of Quebec. The average magnesium content of these dumps is about 23 per cent. A process has been worked out for the recovery of magnesium from serpentine.

Sea-water, although it contains only 0.13 per cent magnesium, is a source of the metal in England and the United States. Dolomitic lime is used to precipitate the magnesia from the sea-water in the form of hydroxide, and the magnesia from both is recovered in the process.

Underground brines containing  $MgCl_2$  and residual brines from salt-making operations, containing  $MgCl_2$ , are used in the United States as sources of magnesia and magnesium, but brines containing sufficient  $MgCl_2$  to render them of value are not available in Canada.

Processes for the production of the metal from the various raw materials may be divided into two groups, namely, electrolytic, and thermal. The electrolytic process provides most of the magnesium made, except in Canada where a thermal reduction process is used. The three thermal reduction processes in use throughout the world involve reduction of magnesia with carbon (in use in the United States); reduction of magnesia with calcium carbide (in use in the United Kingdom); and reduction of calcined dolomite with ferrosilicon (in use in Canada, the United States, and Italy).

The field of usefulness of magnesium is steadily expanding. Magnesium was formerly used almost exclusively in pyrotechnics, but it is used also as a structural metal, particularly in the form of castings and extruded shapes. For structural use it is alloyed with various portions of other elements. It is used as a constituent in many aluminum-base alloys.

The price quoted by Engineering and Mining Journal for magnesium in ingot form in carload lots during 1945 was 20½ cents per pound, U.S. currency, f.o.b. New York.

Table 26 - PRODUCTION OF PRIMARY MAGNESIUM METAL IN CANADA, 1916-1918 and 1941-1946

Year	Quebec		Ontario		British Columbia		CANADA	
	Pounds	\$	Pounds	\$	Pounds	\$	Pounds	\$
1916-1918 ..	(a)	(a)	...	...	200,000(b)	(b)	...	...
1941 .....	...	...	...	...	10,905(c)	2,944	10,905	2,944
1942 .....	141,081	62,076	473,910	208,520	193,727	85,240	808,718	355,836
1943 .....	...	...	7,153,974	2,074,652	...	...	7,153,974	2,074,652
1944 .....	...	...	10,579,778	2,575,695	...	...	10,579,778	2,575,695
1945 .....	...	...	7,358,545	1,607,264	...	...	7,358,545	1,607,264
1946 .....	...	...	320,677	75,538	...	...	320,677	75,538

- (a) Magnesium metal produced in 1918 at Shawinigan Falls, Quebec by Shawinigan Electro Metals Company Limited from imported magnesium chloride but data not available.
- (b) Approximately 200,000 pounds produced at Trail from imported magnesium chloride; complete data not available.
- (c) Powder.

Table 27 - CONSUMPTION OF MAGNESIUM INGOTS IN CANADA, 1943-1946

	1943	1944	1945	1946
	(Pounds)			
In non-ferrous smelters .....	1,298,650	1,480,528	487,773	441,000
In white metal alloy foundries ...	16,821	55,496	37,740	142,445
In brass and bronze foundries ....	132,465	51,040	66,116	17,266
In aluminum products .....	89,523	34,930	45,452	15,061
TOTAL ACCOUNTED FOR .....	1,537,459	1,621,994	637,081	615,772

## MANGANESE

(Text from the Annual Review by the Bureau of Mines, Ottawa)

All manganese properties in Canada have been inactive since 1943. The small Canadian production in the past came mainly from deposits in the Maritime Provinces. Known deposits of high-grade manganese in Canada are small and are almost exhausted. No commercial grade deposits have been found and future production appears to be unlikely unless sufficient manganese is disclosed during the operation of the iron deposits of Steep Rock Iron Mines, Limited, west of Port Arthur, Ontario, to warrant its recovery as a by-product. Consumption is steadily increasing, however, as adequate supplies of high quality ore can now be obtained from foreign deposits, the output from which was restricted during the war.

World production of manganese ore is estimated to be between five and six million tons annually, the leading producing countries being Russia, British India, Gold Coast, United States, Union of South Africa, Brazil, and Cuba. Prior to the last war, Russia was the source of nearly half the world production, the principal deposits being in the Republic of Georgia and Ukraine. During the last quarter of 1945 Russia was the largest individual shipper of manganese ore to the United States.

Price quotations in New York, December 1946, show manganese ore at 70 cents per long ton unit of contained Mn, basis 48 per cent. Chemical grades, coarse or fine, minimum 80 per cent  $MnO_2$  were quoted at \$60 to \$65 per ton. Manganese metal, electrolytic, 99.9 per cent Mn had a nominal price of 32 cents per pound.

Table 28 - PRODUCTION OF MANGANESE ORE IN CANADA, 1937-1946

Year	Tons	Value	Year	Tons	Value
1937 .....	85	\$ 817	1942 .....	435	\$ 8,932
1938 .....	...	...	1943 .....	48	985
1939 .....	396	3,688	1944 .....	...	...
1940 .....	152	4,315	1945 .....	...	...
1941 .....	(x)	(x)	1946 .....	...	...

(x) 7,500 pounds manganese metal produced at the mine from Nova Scotia manganese ore.

Table 29 - IMPORTS OF MANGANESE ORE INTO CANADA, 1937-1946

Year	Tons	\$	Year	Tons	\$
1937 .....	77,226	802,269	1942 .....	57,389	860,248
1938 .....	21,050	463,673	1943 .....	51,234	1,445,252
1939 .....	29,787	621,931	1944 .....	85,795	2,370,109
1940 .....	70,460	777,416	1945 .....	198,277	4,571,592
1941 .....	104,473	1,170,768	1946 .....	144,023	2,484,707

Table 30 - IMPORTS OF MANGANESE ORE INTO CANADA, BY PRINCIPAL COUNTRIES OF SUPPLY, 1944-1946

	1 9 4 4	1 9 4 5 (Tons)	1 9 4 6
From - Gold Coast .....	42,442	182,779	130,907
British India .....	33,832	11,927	...
Chile .....	2,493	...	...
South Africa .....	...	...	345
United States .....	7,024	3,569	12,768
United Kingdom .....	4	2	3
TOTAL IMPORTS .....	85,795	198,277	144,023

MERCURY

(Text from the Annual Review by the Bureau of Mines, Ottawa)

No mercury has been produced in Canada since the summer of 1944, all shipments in 1945 being from stock. All of the Canadian production has come from the Pinchi mine of the Consolidated Mining and Smelting Company of Canada, Limited, and from the Takla property of Bralorne Mines Limited, both of these mines being in the Omineca Mining Division, British Columbia. The Pinchi mine was the largest single producer of mercury in the western hemisphere.

In contrast with the shortages of most other metals mercury was in abundant world supply in 1946, and prices for the metal continued to decline appreciably. Chief contributing factor to this decline was the excess of supplies in Europe, the principal source of output, in relation to the demand. Other factors of importance was the discovery of large stockpiles of mercury in the American zone of Germany and in Japan. Operation of the Mercurio Europeo Cartel also had a depressing effect on the market. During the latter part of 1946 this Italo-Spanish combine appointed London and Scandinavian Metallurgical Company as the agent for the United States and Elder, Smith and Company for the British Empire.

In the United States, the development for military use, of the small mercury cell of "tropical dry battery" accounted for a substantial increase in the consumption of mercury late in the war. Production of the cells for several types of military batteries and for hearing-aid use is under way. Work has been concentrated on the development of new designs and on more economical manufacture. The battery is not being made in Canada.

A comparatively recent development is the use of a mercury clutch for fire engine pumps, helicopters, for the electric motors of refrigerator equipment, washing machines, etc. A water repellent mercury fungicide is said to afford efficient protection against mildew and to destroy microbes that attack a large variety of articles such as textiles, paints, wood, and leather. In Germany, a considerable amount of mercury was consumed in a small cathode cell for the electrolytic production of chlorine and caustic soda. This cell has been introduced with considerable advantage in a number of alkali-chlorine plants in the United States.

The average United States price quotation at the beginning of 1946 was \$105 a flask, but prices dropped to \$88 in December, the year's average being \$98.24, compared with nearly \$135.00 in 1945. Late in 1946 the price of £30, pegged by the British Government, was lowered to £25 per flask, but in private hands the price was £20. In January, 1947, the Mercurio Europeo Cartel was asking \$67.50 in bond New York or \$86.50 with the U.S. import duty of \$19.00 per flask.

Table 31 - PRODUCTION OF MERCURY IN CANADA, 1938-1946

Year	Pounds	\$	Year	Pounds	\$
1938 .....	760	760	1943 .....	1,690,240	4,559,200
1939 .....	436	1,226	1944 .....	735,908	1,210,375
1940 .....	153,830	369,317	1945 .....	...	...
1941 .....	536,304	1,335,697	1946 .....	...	...
1942 .....	1,035,914	2,943,807			

Table 32 - PRODUCTION OF MERCURY IN CANADA, CONSUMPTION, IMPORTS AND EXPORTS, 1939-1946

Year	Production in Canada	Consumption in Canada	Imports	Exports
			(Pounds)	
1939 .....	436	89,617	109,232	...
1940 .....	153,830	75,643	78,597	108,000
1941 .....	536,304	151,351	8,599	360,164
1942 .....	1,035,196	185,118	1,971	692,753
1943 .....	1,690,240	201,982	2,047	1,304,692
1944 .....	735,908	130,515	35,428	362,670
1945 .....	...	100,700	27,101	261,720
1946 .....	...	102,320	152,719	57,005

Table 33 - CONSUMPTION OF MERCURY IN CANADA BY PRINCIPAL USES, 1942-1946

Industries	1 9 4 2	1 9 4 3	1 9 4 4	1 9 4 5	1 9 4 6
			(pounds)		
Pharmaceuticals and fine chemicals ..	78,362	79,786	24,307	20,652	26,183
Heavy chemicals .....	50,968	72,531	78,300	53,701	45,005
Electrical apparatus .....	42,313	30,065	4,652	4,500(x)	12,192
Gold mines .....	10,000(x)	10,000(x)	10,000(x)	10,000(x)	6,500
Miscellaneous .....	3,475	9,600	13,256	11,847	12,490
TOTAL .....	185,118	201,982	130,515	100,700	102,320

(x) Estimated.

## M O L Y B D E N U M

(Text from the Annual Review by the Bureau of Mines, Ottawa)

Molybdenite Corporation of Canada, Limited, the only Canadian producer of molybdenum ore in 1946, has maintained a continuous output from the La Corne mine in La Corne township, Quebec, since July, 1945, when it took over the property from Wartime Metals Corporation. As there are no plants in Canada to convert the concentrate into addition agents, there is no sale for the concentrate in Canada. Sales to the United States are barred because of tariffs and the large productive capacity in that country, consequently all shipments go to Europe. The La Corne ore contains bismuth which until recently was a disadvantage as it remained in the concentrate and a concentrate containing more than 0.5 per cent bismuth is not acceptable. During 1946, however, a process was developed by the Bureau of Mines, Ottawa, which not only freed the concentrate of this metal, but also raised the molybdenum content of the concentrate and this content is probably higher than that of any other concentrate produced in the world. The bismuth is saved as a by-product, for which purpose a unit was installed.

Molybdenite, the chief ore of molybdenum, is a soft and shiny steel blue-grey sulphide containing 60 per cent of the metal. In eastern Canada it is usually found in pegmatite dykes or along the contacts of limestone and gneiss, commonly associated with greenish grey pyroxenites in which other metallic minerals such as pyrite and pyrrhotite often occur. In norther and western Ontario, Quebec, and in British Columbia, molybdenite usually occurs in quartz or in quartz veins, along the contacts of, or intruded into granites, or diorites. It generally occurs in the form of soft, pliable flakes or leaves, but it is sometimes semi-amorphous, filling cracks and smearing the rock surface. It can be readily distinguished in the field by the olive-grey-green smear it leaves when rubbed on glazed white porcelain or enamel. Graphite, for which it is often mistaken leaves a grey-black smear.

Molybdenite concentrate is converted into an addition agent that is introduced into steel as molybdenum trioxide, ferromolybdenum, or to a small extent as calcium molybdate. The oxide is usually moulded into briquettes which weigh 5 pounds each, and contain  $2\frac{1}{2}$  pounds of molybdenum.

Molybdenum has a widening range of uses, but by far the greater part of the output is used in steel to intensify the effect of other alloying metals, particularly nickel, chromium, and vanadium. These steels usually contain from 0.15 to 0.4 per cent molybdenum, but in some instances the percentage is considerably higher. For high-speed tool-steels as much as 9 per cent is added.

Molybdenum alloys are used widely for the hard-wearing and other important parts of airplanes. They are used in the automobile industry, in high-grade structural die and stainless steels; and to some extent in high-speed tool-steels. Molybdenum is used in cast iron and in permanent magnets. Much molybdenum wire and sheet is used in the radio industry; and new alloys suitable for electrical resistance and contacts and for heating elements contain molybdenum.

The chemical uses continue to increase, and the salts are used in pigments, in vitreous enamels for coating steels and sheet iron, in welding rod coatings, and for analytical work.

United States specifications for concentrate dried at  $212^{\circ}\text{F}$ . are:  $\text{MoS}_2$ , minimum 85 per cent; copper, maximum 0.6 per cent; iron, maximum 3.0 per cent; combined phosphorus, antimony and tin, maxima 0.2 per cent.

There is no Canadian market for concentrates as there are no conversion plants, and since July, 1945 the only shipments have been to Europe at a price of  $42\frac{1}{2}$  cents per pound.

The price per pound of contained molybdenum, f.o.b. Toronto, in Canadian funds, for the following imported compounds is approximately: calcium molybdate (42 per cent Mo), 90 cents; ferromolybdenum (60 per cent Mo), \$1.13 and molybdic oxide (52 per cent Mo), 90 cents. Calcium molybdate is sold in bags of about  $12\frac{1}{2}$  pounds containing exactly 5 pounds of molybdenum.

Table 34 - MOLYBDENITE MINING IN CANADA, 1944-1946

		1944	1945	1946
Active firms .....	No.	4	3	(x)
Employees - On Salary .....	No.	31	21	...
Wage-earners .....	No.	148	98	...
Total .....	No.	179	119	...
Salaries and wages - Salaries .....	\$	62,954	34,295	...
Wages .....	\$	332,512	189,729	...
Total .....	\$	395,466	224,024	...
Gross value of production .....	\$	1,079,698	411,663	295,640
Fuel and electricity used .....	\$	54,614	34,991 )	
Process and supplies used .....	\$	103,774	35,736 )	100,594
Freight and treatment charges .....	\$	72,681	42,613 )	
Net value of production .....	\$	848,629	113,340	195,046

(x) Only one firm in 1946

Table 35 - PRODUCTION OF MOLYBDENITE IN CANADA, 1937-1946

Year	Ores milled Tons	Ores and concentrates shipped or used		Total $\text{MoS}_2$ content of shipments Pounds
		Tons	Value (a)	
1937 .....	5,307	8.25	8,147	(b)
1938 .....	(b)	6.5	4,500	(b)
1939 .....	1,492	1.3	816	(b)
1940 .....	3,936	11.1	10,280	(b)
1941 .....	28,100	98.3	88,470	173,991
1942 .....	39,708	113.7	134,963	158,780
1943 .....	120,576	392.4	549,515	653,200
1944 .....	187,130	1064.0	1,079,698	1,870,132
1945 .....	80,575	489.1	411,663	839,419
1946 .....	84,280	318.2	295,640	676,844

(a) Value as given by the operators 1937 to 1939; 1940 to 1945 value estimated using market or Government prices.

(b) Not known.

PITCHBLEND E

Pitchblende, the ore of radium and uranium, is mined in Canada only in the Great Bear district of the Northwest Territories. Prospecting reports indicate that radioactive minerals have been found at Contact Lake, Northwest Territories, Lake Athabaska, Saskatchewan and Haliburton county, Ontario.

Statistics on pitchblende ores and products have not been available since 1940.

Table 36 - CANADIAN REFINERY PRODUCTION OF PITCHBLEND E PRODUCTS

Year	\$	Year	\$
1933 (a) .....	247,900	1938 .....	1,045,458
1934 .....	159,400	1939 .....	1,121,553
1935 .....	413,700	1940 .....	410,176
1936 .....	605,500	1941-1946 .....	(b)
1937 .....	876,540		

(a) First production.  
(b) Not available.

S E L E N I U M

Selenium is fairly widely distributed, but in no case does it occur in quantity large enough to be mined for itself alone. It is not widely used in industry though new uses are being steadily developed. Canada and the United States are the principal sources of supply.

In Canada selenium is recovered during the refining of blister copper produced in Manitoba, Ontario, and Quebec, and was first produced in the Dominion in 1931 in the copper refinery of International Nickel Company of Canada at Copper Cliff, Ontario. The only other producer is Canadian Copper Refiners, Limited, with refinery at Montreal East, Quebec, where production was commenced in November, 1934. The Copper Cliff product is derived from the treatment of the copper-nickel ore of the Sudbury district, and at Montreal East the selenium by-product is obtained from the treatment of the gold-copper ore of Noranda, Quebec, and the gold-copper zinc ore of the Flin-Flon mine on the boundary line between Manitoba and Saskatchewan. The plant at Montreal East is the largest producer of selenium in the world.

A plant for the manufacture of selenium compounds was erected in 1944 at Montreal East by Canadian Copper Refiners, Limited. The compounds being made in addition to refined selenium are double distilled selenium, C.P. selenium, commercial selenium dioxide, sodium selenite, and sodium selenate.

Selenium is marketed as a black to steel-grey amorphous powder, but cakes and sticks are also obtainable. Among the other products are ferroselenium, sodium selenite, selenious acid, and selenium dioxide. The most important outlets for selenium prior to the war were in glass, rubber, and paint industries. The greatest single development in the utilization of selenium since 1939 has been in its use in electrical rectifiers that played such an important role in connection with radar and with generators for aeroplanes and army field equipment. Considerable quantities are being used as accelerators in the vulcanization of synthetic rubber. Selenium is used to develop free machining qualities in stainless metal and as an ingredient of austenitic chromium steels. For the latter purpose it is supplied in bars of selenium-bearing stainless metal.

Selenium is useful in producing good ruby glass; is a quality-improver in lubricating oil; and is a potent ingredient of anti-fouling paints for ship bottoms.

Since 1938, the nominal price for selenium, black powdered, 99.5 per cent pure, at New York has been \$1.75 per pound.

Table 37 - PRODUCTION OF SELENIUM IN CANADA, 1931-1946

Year	Pounds	\$	Year	Pounds	\$
1937 .....	397,227	687,203	1942 .....	495,369	951,108
1938 .....	358,929	622,742	1943 .....	374,013	654,523
1939 .....	150,771	266,714	1944 .....	298,592	537,466
1940 .....	179,860	343,533	1945 .....	379,187	728,039
1941 .....	406,930	777,236	1946 .....	521,867	949,798

TANTALUM - COLUMBIUM

Canada produces no tantalite or columbite and according to the Bureau of Mines, Ottawa, the known Canadian occurrences of these minerals are scarce and of undetermined economic interest. The minerals tantalite and columbite are the tantalate and columbate, respectively, of iron and manganese, with the general formula  $(\text{Fe}, \text{Mn}) (\text{Ta}, \text{Cb})_2\text{O}_6$ . They grade one into the other according as whether tantalum or columbium predominates. Both tantalite and columbite were of increasing importance in the war effort and tantalite was placed in the group of "strategic" minerals having the highest priority rating. The occurrence of all tantalum-columbian minerals is restricted to granite-pegmatites, or to residual or alluvial deposits derived from such rock. The chief world sources of tantalite proper have been Western Australia, Belgian Congo, Southern Rhodesia, Uganda, United States and Brazil. The supply of columbite has come mainly from Nigeria, Belgian Congo, Southwest Africa, Argentina and Brazil. The annual world output of tantalite-columbite is small and complete data on same are not available at present. Tantalum metal is highly resistant to corrosion and possesses remarkable conductivity for heat; one of its important uses is in equipment, such as stills, condensers, tubes and heaters in chemical plants and laboratories; it is being used to an increasing extent in the field of electronics. Columbium is employed chiefly as an alloying component in various special-purpose steels, and also in copper, aluminum and other metals.

There are no users of tantalum or columbium ores in Canada, the chief world market being in the United States. The principal American consumer-buyer of tantalite is Fansteel Metallurgical Corporation, North Chicago, Illinois, and of columbite, Electro-Metallurgical Company, 30 East 42nd Street, New York City. These companies have been pioneers in the fields of industrial applications for tantalum and columbium metals, alloys, and products, respectively, and are the leading companies engaged in treating the ores.

United States quotations for tantalum ore, December, 1946 were, per pound  $\text{Ta}_2\text{O}_5$ , \$3 to \$3.50 for 60 per cent concentrate, the price depending on the source. Columbium metal, per kilo, base prices: rod \$560; sheet \$500. Tantalum metal, per kilo, base prices, \$160.60 for C.P. rod; sheet \$143; discounts on volume business.

TELLURIUM

Tellurium was first produced in Canada in 1934 at Copper Cliff, Ontario by International Nickel Company of Canada, Limited. The only other producer, Canadian Copper Refiners, Limited, started production in 1935 at its plant in Montreal East, Quebec. The former plant treats the slime from the refining of the blister copper produced by International Nickel Company at Copper Cliff; and the latter, the slime from the refining of anode copper of Noranda Mines, Limited, Noranda, Quebec and the blister copper of Hudson Bay Mining and Smelting Company, Flin Flon, Manitoba.

Very finely powdered tellurium is used as rubber-compounding material, this being the most important use of tellurium at present. Small quantities are used as a colouring agent in the ceramic industry. When alloyed with lead the tensile strength and toughness of the lead are increased greatly. Lead alloys containing from 0.1 to 0.5 per cent tellurium have been in use for some time in applications requiring resistance to vibration and corrosion. Tellurium is used for improving the machining qualities of certain steels.

Table 38- PRODUCTION OF TELLURIUM IN CANADA, 1937-1946

Year	Pounds	\$	Year	Pounds	\$
1937 .....	41,490	71,777	1942 .....	11,084	17,735
1938 .....	48,237	82,967	1943 .....	8,600	15,050
1939 .....	2,940	4,769	1944 .....	10,661	18,657
1940 .....	3,491	5,607	1945 .....	484	929
1941 .....	11,453	18,394	1946 .....	15,848	24,405

Table 39 - CONSUMPTION OF TELLURIUM METAL IN STEEL AND WHITE METAL FOUNDRIES, 1940-1946

Year	Steel Foundries	White Metal Foundries
		(pounds)
1940 .....	400	629
1941 .....	185	492
1942 .....	50	612
1943 .....	135	453
1944 .....	398	531
1945 .....	...	308
1946 .....	...	1,372

THALLIUM

There has been no production of thallium since 1944 in Canada. The first commercial production of this element in this country was in 1944 when 128 pounds valued at \$1,690 was contained in residues produced by Hudson Bay Mining and Smelting Company, Limited at the Flin Flon smelter, Manitoba. These residues were exported for treatment in foreign plants. Thallium metal was quoted in the United States at \$17.50 per pound nominal, December 1946. The element has an atomic weight of 204 and has been used in alloys and glass-making.

Thallium sulphate is used as a rodenticide. Lead-thallium alloys are said to be very highly resistant to corrosion and use in bearing metals has been proposed. Patents on copper-thallium bearing metals were issued in 1945 in the United States.

TIN

(Text from the Annual Review by the Bureau of Mines, Ottawa)

Tin ore, or which cassiterite ( $\text{SnO}_2$ ) is the most important mineral, has so far not been found in Canada in deposits of economic importance. In many of the placer creeks of Yukon, especially the Mayo district, some crystalline cassiterite is found. Similar small occurrences have been reported from the gold-bearing placers of British Columbia. Considerable prospecting was done during the war, and although no deposits of economic value were disclosed, the geological conditions in these areas warrant further investigation.

A very small cassiterite content is found in the lead-zinc-silver ore of the Sullivan mine of The Consolidated Mining and Smelting Company of Canada, Limited, at Kimberley, British Columbia. In view of the acute shortage of tin which developed in the early stages of the war, consideration was given to its recovery from this source. On March 1, 1941, a concentration plant treating the tailings from the zinc flotation commenced operations, and in April, 1942, the commercial production of refined tin by electric smelting was commenced.

The recovery of tin from the Sullivan ore constitutes a particularly interesting metallurgical operation. The tailings from the zinc flotation cells, amounting to around 6,000 tons per day, contain about 1.2 pounds of tin per ton. The first operation consists in removing the iron sulphides by flotation. The tailings, containing the tin, are then treated in a series of gravity concentrations which finally result in a concentrate carrying from 63 to 68 per cent tin. This product is smelted in a three-phase 400 kilowatt electric furnace of 5 tons capacity to yield high grade refined tin. Three months operation of the smelter is sufficient to handle the year's accumulation of tin concentrate.

Tin is used chiefly in the manufacture of tin plate, mainly for use in making tin cans and containers of all kinds. To conserve supplies, the use of tin in solders and in babbitt metal has been restricted in recent years and there has been wide use of low-tin or virtually tin free solders. Smaller quantities of tin are used in foil, terneplate, type metal, bronze and galvanizing.

The price of tin in New York was fixed at 52 cents a pound in August 1941, and this price was changed in 1946; and the quotation at end of December, 1946 was 69 cents per pound.

Table 40 - PRODUCTION OF NEW TIN IN CANADA, DOMESTIC CONSUMPTION, IMPORTS AND EXPORTS, 1937-1946

Year	Production in Canada	Domestic consump- tion	Exports	Imports	Stocks at end of period
(Tons of 2,000 pounds)					
1937 .....	...	2,503	...	2,939	Not
1938 .....	...	2,305	...	2,637	avail-
1939 .....	...	2,787	...	2,913	able
1940 .....	...	3,868	...	5,918	2,655
1941 .....	32	6,436	...	8,719	4,621
1942 .....	619	3,571	...	3,601	5,120
1943 .....	390	2,865	...	1,311	3,920
1944 .....	258	3,383	...	1,341	2,622
1945 .....	425	4,108	...	3,597	2,565
1946 .....	437	4,152	...	3,514	2,430

Table 41 - PRODUCTION OF NEW TIN IN CANADA, 1941-1946

Year	Pounds	\$	Year	Pounds	\$
1941 (x) .....	64,744	33,667	1944 .....	516,626	299,643
1942 .....	1,237,863	643,689	1945 .....	849,983	492,990
1943 .....	776,937	450,623	1946 .....	874,186	507,028

(x) First commercial production.

Table 42 - CONSUMPTION OF TIN (Ingots or Bars) IN CANADA, BY PRINCIPAL INDUSTRIES, 1942-1946

	1942	1943	1944	1945	1946
	(Tons of 2,000 pounds)				
In white metal foundries (solder, babbitt, etc.)	1,530	1,264	1,200	1,320	1,321
In steel plants (chiefly for tinplate) .....	1,428	1,148	1,517	2,010	2,518
In brass and bronze foundries .....	247	200	406	532	208
In other industries .....	366	253	260	246	105
TOTAL ACCOUNTED FOR .....	3,571	2,865	3,383	4,108	4,152

## TITANIUM

(Text from the Annual Review by the Bureau of Mines, Ottawa)

Titanium-bearing ores found in Canada are of two classes. Ilmenite, containing 30 to 40 per cent  $\text{TiO}_2$  occurs in three localities in Quebec. In the St. Urbain district on the St. Lawrence, 60 miles below Quebec City, a part of the ore contains free  $\text{TiO}_2$  as rutile mixed with the ilmenite, and its content of  $\text{TiO}_2$  reaches 50 per cent and more. The other two deposits are at Ivry, 65 miles north of Montreal, and Allard Lake, 12 miles north of Havre St. Pierre on the Gulf of St. Lawrence.

Titaniferous magnetite, the second class of titanium-bearing ore, is composed of the two minerals, ilmenite and magnetite, mixed intimately in varying proportions, with a content of 5 per cent or more  $\text{TiO}_2$ . This ore is more abundant and occurs more widely in Canada than does ilmenite. It is not used in this country at present as a source of titanium. Large deposits occur at Mine Centre in North-western Ontario; in the southern part of Hastings county north of Belleville, Ontario; at Desgrosbois 65 miles north of Montreal; and on the Saguenay River near Arvida, Quebec.

Deposits of magnetic beach sands containing titanium occur at a number of places on the north shore of the Gulf of St. Lawrence. An interesting bed of such sand that has been consolidated into solid ore occurs at Burmis, Alberta, just east of the Crowsnest Pass.

Small shipments of ilmenite were made formerly from the Ivry deposit, but during recent years the only production has been from the St. Urbain deposits. The largest potential source of ilmenite is the recently discovered Allard Lake ilmenite deposits from which only experimental shipments have been made. These deposits are very large, though their full extent is not yet known. The ore as exposed in hills and ridges contains several million tons above ground level. It averages about 35 per cent  $\text{TiO}_2$ , 37 per cent iron, and 3 per cent silica. Its convenient location near ocean port will permit large-scale development when there are sufficient market outlets.

The two principal uses for ilmenite are as an alloying agent in steels, and as a pigment. At Niagara Falls, N.Y., ferro-titanium and ferro-carbon-titanium alloys are made from it for use in improving the quality of steel. By far the larger part of the ilmenite consumed in the world, however, is used to make the pigment, titanium white. New uses for this pigment are being found constantly and the demand continues to increase rapidly. There were reports during the year of a Canadian plant to make titanium white, but no definite action was taken.

To the present the substantial amounts of titanium white used in Canada have been imported from the United States. A part of the ore for the United States plants is produced in the southern states. Normally much of the ore for these plants was Transvaal sand from India, which is particularly well suited to the process at present in use. When this became unobtainable during the war the McIntyre titaniferous magnetite deposit in New York state was opened and operated on a large scale, but this property has been closed.

Prices f.o.b. Atlantic ports were: Ilmenite, 60%  $\text{TiO}_2$  - January \$28-\$30; 57-60%  $\text{TiO}_2$  - June \$24-\$26, November \$22-\$24. Rutile, 94%  $\text{TiO}_2$  - nominally 8-10 cents per pound (probably averaged around 6 cents).

Table 43 - PRODUCTION OF TITANIUM ORE IN Canada (x), 1937-1946

Year	Short tons	\$	Year	Short tons	\$
1937 .....	4,229	26,432	1942 .....	10,031	50,906
1938 .....	207	1,449	1943 .....	69,437	308,290
1939 .....	3,694	21,267	1944 .....	33,973	165,195
1940 .....	4,535	24,510	1945 .....	14,147	67,575
1941 .....	12,651	49,110	1946 .....	1,406	7,735

(x) All from Quebec.

Table 44 - IMPORTS INTO CANADA OF "ANTIMONY OXIDE, TITANIUM OXIDE AND WHITE PIGMENTS CONTAINING NOT LESS THAN 14 PER CENT BY WEIGHT OF TITANIUM"

Year	From the United Kingdom		From the United States		Total Imports	
	lb.	\$	lb.	\$	lb.	\$
1937 .....	2,220,330	262,660	3,410,121	264,085	5,630,451	4,710,481
1938 .....	1,599,659	199,814	4,110,672	312,384	526,745	512,219
1939 .....	1,689,329	227,805	7,302,923	574,193	9,003,693	803,198
1940 .....	477,912	65,747	8,292,103	717,210	8,700,015	782,957
1941 .....	418,962	64,302	12,801,017	1,257,065	13,219,979	1,321,367
1942 .....	115,360	27,697	14,527,348	1,395,345	14,642,708	1,423,042
1943 .....	33,700	8,094	16,855,800	1,525,368	16,889,500	1,533,462
1944 .....	...	...	20,174,795	1,871,434	20,174,795	1,871,434
1945 .....	79,440	16,752	21,279,636	2,029,137	21,359,076	2,045,889
1946 .....	76,800	11,678	23,854,188	2,182,007	23,930,988	2,193,685

Table 45 - CONSUMPTION OF TITANIUM OXIDE IN CANADA, BY INDUSTRIES, 1945 and 1946

Industry	1 9 4 5		1 9 4 6	
	Pounds	Cost at works \$	Pounds	Cost at works \$
Paints -				
Extended titanium dioxide pigments.	12,120,296	901,144	12,884,744	912,340
Titanium dioxide .....	6,306,213	1,192,404	6,832,585	1,160,696
Polishes and dressings .....	242,834	33,185	280,450	36,858
Pulp and paper .....	770,000	141,028	728,000	120,842
TOTAL ACCOUNTED FOR .....	19,439,343	2,267,761	20,725,779	2,230,736

Table 46 - CONSUMPTION OF FERROTITANIUM IN MANUFACTURE OF STEEL IN CANADA, 1939-1946

Year	Tons	\$	Year	Tons	\$
1939 .....	118	23,498	1943 .....	614	118,416
1940 .....	118	24,233	1944 .....	786	149,527
1941 .....	181	52,128	1945 .....	656	123,975
1942 .....	439	66,555	1946 .....	416	73,485

TUNGSTEN

(Text from the Annual Review by the Bureau of Mines, Ottawa)

Stimulated by a critical shortage during the war up to the fall of 1943, Canada produced tungsten concentrates from a number of deposits throughout the Dominion, but production ceased in November, 1943, owing to excess of supplies. Stocks on hand at mines have all been shipped. Late in 1946 the Emerald mine near Salmo in southern British Columbia was taken over by Canadian Explorations Limited, and production of concentrate in the 300-ton mill was expected to start late in the spring of 1947. Canada's requirements can be adequately supplied by this mine.

Wolframite,  $(\text{Fe,Mn})\text{WO}_4$ , is the principal ore of tungsten, the next in importance being scheelite  $(\text{CaWO}_4)$ , a calcium tungstate. The former is a dark brown to black, heavy mineral, which contains 76.4 per cent  $\text{WO}_3$  (tungstic oxide) when pure, and is not common in Canada. Scheelite, the chief Canadian ore of tungsten, is a heavy, fairly soft, usually buff, but sometimes white mineral with a dull lustre, which contains 80.6 per cent  $\text{WO}_3$  when pure. It is commonly associated with quartz and frequently occurs in gold-bearing veins and in certain contact metamorphic deposits. It can be detected readily in the dark by its brilliant, pale bluish-white fluorescence under ultra-violet light and purple filter.

As an alloying metal in steel, tungsten (usually as ferrotungsten, but sometimes as calcium tungstate or scheelite concentrate) is used essentially to impart hardness and toughness, which are maintained even when the steel is heated to a high temperature. Almost 80 per cent of the consumption of tungsten in the United States is used for the production of high-speed steels for cutting tools, in which the tungsten content is 15 to 20 per cent. Alloy steels containing tungsten have been used extensively in making armour plate, armour piercing projectiles, and other military equipment. The use of tungsten in hard facing compounds is increasing. Fused powdered tungsten is used for the diamond set bits for rock drilling. Minor amounts of tungsten are used in steels for dies, valves, and valve seats for internal combustion engines, and for permanent magnets. Stellite, the best known non-ferrous alloy, contains 10 to 15 per cent tungsten with higher percentages of chromium and cobalt. Tungsten carbide is widely used as an extra hard cutting tool. Pure tungsten is used in lamp filaments, in radio tubes, contact points, etc. In the United States there has been an increase in the consumption of tungsten as metal powder, in chemicals, and in high porosity alloys in gas turbines and other high temperature uses.

Until production ceased late in 1943, all sales of Canadian concentrate were made through the Metals Controller, Ottawa, at a price of \$26.50 a short unit (20 pounds) of  $\text{WO}_3$  for scheelite concentrate containing 70 per cent  $\text{WO}_3$  (within specifications), delivered at Welland, Ontario. Since then prices have fluctuated downward, but for the past year there have been no Canadian-made concentrates for sale. Foreign ores entering United States in 1946 were \$21 to \$25 per short ton unit (20 pounds) of contained  $\text{WO}_3$ , duty paid. Domestic ore was \$25 in car lots delivered to plants. Ferrotungsten of 75 to 80 per cent tungsten was \$1.90 per pound of contained tungsten.

Table 47 - PRODUCTION (Commercial Shipments) OF CRUDE TUNGSTEN CONCENTRATES IN CANADA, 1939-1946

Year	Pounds	\$	Average per cent $\text{WO}_3$
1939 .....	8,825	4,917	(a)
1940 .....	12,002	7,303	70-75
1941 .....	82,846(b)	38,712	51.1
1942 .....	520,981	406,275	61.8
1943 .....	1,508,621	1,083,538	54.2
1944 .....	886,745	245,780	31.9
1945 .....	1,153	1,045	68.7
1946 .....	...	...	...

(a) Not recorded.

(b) Includes export of considerable low-grade material to United States.

Table 48 - CONSUMPTION OF FERROTUNGSTEN IN STEEL FURNACES IN CANADA, 1938-1946

Year	Short Tons	Cost at works \$	Year	Short Tons	Cost at works \$
1938 .....	34	69,806	1943 .....	550	1,721,967
1939 .....	106	173,250	1944 .....	86	287,116
1940 .....	376	829,859	1945 .....	138	455,317
1941 .....	482	1,003,314	1946 .....	260	402,174
1942 .....	203	524,007			

VANADIUM

Some of the magnetites of the Rainy River district in Ontario are known to contain relatively small quantities of vanadium and some research has been conducted as to its economic recovery. There is no production of either the metal or its ores in Canada at the present time.

The principal occurrences of vanadium are in Arizona, Colorado and Utah in the United States; Minasragra in Peru; Broken Hill in Northern Rhodesia; and Grootfontein district in South West Africa.

The metal is employed chiefly in the manufacture of alloy steels and irons. It is also used in the form of ammonia meta-vanadate as a catalyst in the manufacture of sulphuric acid and in the non-ferrous, glass, ceramic and color industries.

The United States Bureau of Mines reports that vanadium has been and is now being obtained by some countries from other than vanadium ores, including petroleum, bauxite, phosphate rock and titaniferous magnetites; the ever-increasing demand for vanadium directs attention to all possible vanadium sources, as well as to efforts to extend known deposits. In the United States the principal ores are roscoelite and carnotite in sandstones, disseminated or in spots, bunches, lenses and seams.

Data relating to possible imports of vanadium ores or vanadium compounds or alloys are not shown separately in Canadian trade reports. In 1944 there were 257 tons of ferrovanadium valued at \$188,661 consumed in Canada in the manufacture of steel.

Vanadium ore was quoted December, 1946; 27½ cents per pound contained V<sub>2</sub>O<sub>5</sub>, f.o.b. shipping point, by "E & M J Metal and Mineral Markets", New York.

DIRECTORY OF FIRMS IN THE MISCELLANEOUS METAL MINING INDUSTRY IN CANADA, 1946.

(x) Active but not producing.

Name of Firm and Product	Head Office Address	Location of Mine or plant
<u>Aluminum</u> -		
Aluminum Company of Canada Limited	1700 Sun Life Bldg., Montreal, Que.	Arvida, Que. Shawinigan Falls, Que. La Tuque, Que. Ile Maligne, Que. Beauharnois, Que.
<u>Antimony</u> -		
Consolidated Mining & Smelting Company of Canada Ltd.	215 St. James St., Montreal, Que.	Trail, B. C.
<u>Beryl</u> -		
Canadian Beryllium Mines & Alloys Ltd. (x)	Room 401, 100 Adelaide St. W., Toronto, Ont.	Renfrew County, Ont.
<u>Bi-metals</u> -		
Deloro Smelting & Refining Co. Ltd. (x)	900 Victoria Bldg., Ottawa, Ont.	Deloro, Ont.
Consolidated Mining & Smelting Company of Canada Ltd.,	215 St. James St., Montreal, Que.	Trail, B. C.
Molybdenite Corp. of Canada Ltd.	59 St. James St. W., Montreal, Que.	La Corne Tp., Que.
<u>Cadmium</u> -		
Consolidated Mining & Smelting Company of Canada Ltd.	215 St. James St., Montreal, Que.	Trail, B. C.
Hudson Bay Mining & Smelting Co. Ltd.	500 Royal Bank Bldg., Winnipeg, Man.	Flin Flon, Man.
Western Exploration	Silverton, B. C.	Kaslo, B. C.
<u>Chromite</u> -		
Chrome Association	342 Notre Dame St., Black Lake, Que.	Black Lake, Que.
Chromite Ltd. (x)	404 Notre Dame St. W., Montreal, Que.	Cleveland Twp., Que.
Pare, Orel	Black Lake, Que.	Calernine Twp., Que.

DIRECTORY OF FIRMS IN THE MISCELLANEOUS METAL MINING INDUSTRY IN CANADA, 1946. (Concluded)  
(x) Active but not producing.

Name of Firm and Product	Head Office Address	Location of Mine or plant
<u>Iron Ore -</u>		
Hollinger North Shore Exploration Co. Ltd. (x)	721 Royal Bank Bldg., Montreal, Que.	N. E. Quebec, Que.
Labrador Mining & Exploration Co. Ltd. (x)	721 Royal Bank Bldg., Montreal, Que.	Labrador, Que.
Algoma Ore Properties Ltd.	Cornwall Bldg., Sault Ste. Marie, Ont.	Algoma district, Ont.
Michipicoten Iron Mines Ltd.	25 King St. W., Toronto, Ont.	Algoma district, Ont.
Rebair Gold Mines Ltd. (x)	9 Adelaide St. E., Toronto, Ont.	Atikokan, Ont.
Steep Rock Iron Mines Ltd.	25 King St. W., Toronto, Ont.	Rainy River dist., Ont.
Tomahawk Iron Mines Ltd. (x)	Suite 405, 67 Yonge St., Toronto, Ont.	Hastings Co., Ont.
Rawn Iron Mines Ltd. (x)	Atikokan, Ont.	Steep Rock Lake, Ont.
Kasabazua Hematite Ltd. (x)	719 Yonge St., Toronto, Ont.	Kasabazua, Que.
Noranco Exploration (Que.) Ltd. (x)	c/o Noranda Mines Ltd., Noranda, Que.	New Quebec, Que.
Andowan Mines Ltd. (x)	Kashabowie, Ont.	Matawin, Ont.
Lowphos Ore, Ltd. (x)	1809 Royal Bank Bldg., Toronto, Ont.	Hutton Twp., Ont.
Westland Mining Co. Ltd. (x)	24 King St. W., Toronto, Ont.	Algoma, Ont.
<u>Indium -</u>		
Consolidated Mining & Smelting Company of Canada Ltd. (x)	215 St. James St., Montreal, Que.	Trail, B.C.
<u>Lithium Ore -</u>		
Hudson Bay Mining & Smelting Co. Ltd. (x)	500 Royal Bank Bldg., Winnipeg, Man.	Cat Lake, Man.
Lithium Corporation of Canada Ltd. (x)	403 Avenue Bldg., Winnipeg, Man.	Bernic and Cat Lakes, Man.
Nepheline Products Ltd. (x)	320 Bay St., Toronto, Ont.	La Corne, Que.
Sheritt Gordon Mines Ltd. (x)	25 King St. W., Toronto, Ont.	Crowduck Bay, Man.
		East Braintree, Man.
<u>Magnesium -</u>		
Consolidated Mining & Smelting Company of Canada Ltd. (x)	215 St. James St., Montreal, Que.	Trail, B. C.
Dominion Magnesium Ltd.	Room 1107, 67 Yonge St., Toronto Ont.	Haley, Ont.
<u>Mercury -</u>		
Bralorne Mines Ltd. (x)	555 Burrard St., Vancouver, B.C.	Omineca District, B.C.
Consolidated Mining & Smelting Company of Canada Ltd. (x)	215 St. James St., Montreal, Que.	Pinchi Lake, B.C.
<u>Molybdenite -</u>		
Molybdenite Corp. of Canada Ltd.	59 St. James St. W., Montreal, Que.	La Corne, Que.
Quyong Molybdenite Co. Ltd. (x)	Quyong, Que.	Quyong, Que.
<u>Selenium-Tellurium -</u>		
International Nickel Co. of Canada Ltd.	Copper Cliff, Ont.	Copper Cliff, Ont.
Canadian Copper Refiners Ltd.	1600 Royal Bank Bldg., Toronto Ont.	Montreal East, Que.
<u>Thallium -</u>		
Hudson Bay Mining & Smelting Co. Ltd. (x)	500 Royal Bank Bldg., Winnipeg Man.	Flin Flon, Man.
<u>Tin -</u>		
Consolidated Mining & Smelting Company of Canada Ltd.	215 St. James St., Montreal, Que.	Trail, B. C.
Mountain Crest Mines Ltd. (x)	1445 MacKay St., Montreal, Que.	Charlevoix, Que.
<u>Titanium Ore -</u>		
Baie St. Paul Titanic Iron Ore Co.	Baie St. Paul, Que.	St. Urbain, Que.
Coulombe, J.	71 Ave. Royal Monument, Quebec, Que.	St. Urbain, Que.
Loughborough Mining Co. Ltd.	Sydenham, Ont.	St. Urbain, Que.
O'Brien & Fowler Ltd.	Buckingham, Que.	St. Urbain, Que.
<u>Tungsten Concentrates -</u>		
Hollinger Cons. Gold Mines Ltd. (x)	Timmins, Ont.	Timmins, Ont.
Wartime Metals Corp. (Emerald Tungsten Project) (x)	637 Craig St. W., Montreal, Que.	Salmo, B. C.



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