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CANADA

DEPARTMENT OF TRADE AND COMMERCE

DOMINION BUREAU OF STATISTICS

CENSUS OF INDUSTRY

MINING, METALLURGICAL & CHEMICAL BRANCH

Report

on

MISCELLANEOUS METALS IN CANADA, 1944

including

Aluminum
Antimony
Beryllium
Bismuth
Boron
Cadmium
Calcium
Cerium
Chromium
Iron
Indium
Lithium
Magnesium
Manganese
Mercury
Molybdenum
Pitchblende
Selenium
Tantalum-Columbium
Tellurium
Tin
Titanium (ilmenite)
Tungsten
Vanadium
Zirconium

OTTAWA
1946

Price 50 cents

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Chief - Mining, Metallurgical and Chemical Branch: W. H. Losee, B.Sc.
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MISCELLANEOUS METALS, 1944

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 1944 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.

The mining of certain ores, classified as strategic during the war years, and including molybdenite, tungsten minerals, etc., was curtailed or terminated in 1944. The production of these ores, described in some instances as "projects" was conducted principally by or under the supervision of the Wartime Metals Corporation, a Canadian Government organization.

The number of firms reported as active in the miscellaneous metals mining industries during 1944 totalled 27; $2,809,013 were distributed in salaries and wages to 1,385 employees and the cost of fuels, process supplies, freight, treatment, etc., aggregated $2,074,107. The gross value of production totalled $5,360,993 and the corresponding net value of same was estimated at $3,286,886.

Table 1 - PRINCIPAL STATISTICS(x) OF THE MISCELLANEOUS METAL MINING INDUSTRY IN CANADA, 1943 and 1944

		1943	1944
Number of firms		54	27
Number of plants		59	27
Capital employed (a)	$	15,603,307	(b)
Number of employees - On salary		277	237
On wages		1,687	1,148
Total		1,964	1,385
Salaries and wages - Salaries	$	600,684	485,401
Wages	$	3,694,469	2,323,612
Total	$	4,295,153	2,809,013
Value of production (gross)	$	9,062,368	5,360,993
Cost of fuel and electricity	$	1,059,552	951,929
Process supplies used	$	1,215,049	657,430
Smelter charges	$	2,759	58,937
Freight	$	263,513	389,554
Value of production (net)	$	6,521,495	3,286,886

(x) Does not include data relating to smelters and refineries or to mining in the Northwest Territories.
(a) Exclusive of ore reserves.
(b) Data not recorded in 1944

Table 2 - AVERAGE NUMBER OF WAGE-EARNERS EMPLOYED, BY MONTHS, 1943 and 1944

Month	1942	1943	1944				
			Surface		Under-	Mill	
	Total	Total	Male	Female	ground	Male	Female
January	783	1,645	763	66	454	167	1
February	826	1,583	829	60	428	173	1
March	858	1,616	768	57	416	167	3
April	906	1,527	766	48	362	174	12
May	911	1,610	794	41	256	144	15
June	1,024	1,773	757	34	231	126	18
July	1,152	1,849	731	33	210	126	18
August	1,282	1,900	643	33	179	101	20
September	1,344	1,728	612	34	164	92	16
October	1,463	1,668	593	30	163	86	18
November	1,602	1,694	575	26	168	91	17
December	1,678	1,504	525	27	173	80	1

Table 3 - NUMBER OF WAGE-EARNERS WHO WORKED THE NUMBER OF HOURS SPECIFIED, DURING ONE WEEK IN MONTH OF HIGHEST EMPLOYMENT (Including overtime) 1944

	30 hours or less	31-43 hours	44 hours	45-47 hours	48 hours	49-50 hours	51-54 hours	55 hours	56-64 hours	65 hours and over	Grand total	Total wages paid in that week (x)
												$
Male	43	104	9	15	620	20	136	12	667	90	1,716	77,114
Female		2	3	2	49		2		27		85	2,064

(x) Including the actual money wages paid, any bonus, the value of room and board, where provided, deductions from employees for income tax and for social services, such as sickness, accident, insurance, pensions, etc., as well as any other allowances forming part of the employees' wages.

Table 4 - FUEL AND ELECTRICITY USED DURING 1944

Kind		Quantity	Cost at Plant
			$
Bituminous coal (a) From Canadian mines	short ton		
(b) Imported	short ton	2,611	30,070
Anthracite coal (a) From United States	short ton	34	661
(b) Other	...	...	...
Lignite coal	short ton	70	1,400
Coke (for fuel only)	short ton	24,159	96,512
Gasoline (including gasoline used in cars and trucks)	Imp. gal.	152,840	57,710
Kerosene or coal oil	Imp. gal.	10,420	2,142
Fuel oil and diesel oil	Imp. gal.	1,064,689	191,596
Wood (cords of 128 cubic feet of piled wood)	cord	10,289	113,967
Electricity purchased for power and lighting (including service charge)	K.W.H.	741,712,764	457,871
TOTAL	...	...	951,929
Electricity generated (a) For own use	K.W.H.	2,311,490	...
(b) For sale	...	...	...

Table 5 - POWER EQUIPMENT, 1944

Description	Ordinarily in Use		In Reserve or Idle	
	Number of units	Total horse power	Number of units	Total horse power
Steam engines	..	..	1	125
Steam turbines	..	..	..	..
Diesel engines	12	2,468	6	1,095
Gasoline, gas and oil engines, other than Diesel engines	17	763	3	415
Hydraulic turbines or water wheels	..	..	..	..
Electric motors -				
(a) Operated by purchased power	494	18,075	38	1,829
Total	523	21,306	48	3,464
(b) Operated by power generated by the establishments	54	1,715	5	335
Stationary boilers	9	890	3	260
Motor generator sets	4	349	2	175

ALUMINUM - The reduction of aluminum ores and the production of primary aluminum metal in Canada is confined to the province of Quebec. In this province the Aluminum Company of Canada Limited operates an ore treatment plant at Arvida and reduction works at Arvida, Shawinigan Falls, La Tuque, Isle Maligne and Beauharnois. These were all in continuous production throughout 1944. Secondary fabricating plants are also operated by the company at Shawinigan Falls in Quebec and at Toronto and Kingston in Ontario. No aluminum ores are mined in the Dominion and Canadian production of aluminum represents the recovery of the metal from foreign ores. During recent years imports of bauxite (aluminum ore) into Canada have come largely from British and Dutch Guiana with lesser quantities from the United States. At Arvida, Quebec, the bauxite is treated by a standard chemical process to remove impurities prior to its reduction to the metal. Cryolite, necessary in the production of aluminum, is largely imported from Greenland; synthetic cryolite is also used in making aluminum. A very large amount of electrical energy is utilized in the production of new aluminum metal from bauxite concentrates and the extensive expansion in the development of hydro power resources recently completed in the Saguenay district of Quebec has provided the aluminum industry with a greatly increased supply of electrical power.

The principal bauxite producing countries are France, Hungary, United States, Yugoslavia, Italy, British Guiana, Dutch Guiana and Russia. Complete data relating to aluminum and bauxite production by countries have not been available since 1938. Canadian production of new aluminum during 1944 totalled 924,130,162 pounds compared with 991,499,296 pounds in 1943 and 93,812,965 pounds in 1937. The output during 1943 was the largest ever attained by the Canadian aluminum industry.

Aluminum prices, New York, January, 1945, were: per pound delivered, commercial and mill ingot, 99 per cent, 15 cents; in pigs, 14 cents. The London home market, ingot £110 per long ton (nominal).

Data relating to employment, etc., in the Canadian aluminum industry are included with those of the Canadian non-ferrous smelting and refining industry, and are therefore not included with corresponding statistics shown in this report.

Table 6 - PRODUCTION OF PRIMARY ALUMINUM IN CANADA, 1935-1944

Year	Pounds	Year	Pounds
1935	46,342,747	1940	218,288,565
1936	59,280,250	1941	427,746,554
1937	93,812,965	1942	681,192,951
1938	142,407,743	1943	991,499,296
1939	165,680,869	1944	924,130,162

Table 7 - IMPORTS OF ALUMINUM AND BAUXITE INTO CANADA, 1943 and 1944

Item	1943 Cwt.	1943 Value	1944 Cwt.	1944 Value
		$		$
Alumina	1,780	31,795	2,442	38,530
Bauxite ore	60,211,389	21,242,907	26,560,509	9,984,818
Cryolite	448,521	1,893,762	50,373	248,562
Aluminum pigs, ingots and blocks	23	650	1,324	27,085
Aluminum scrap	1,548	17,013	4,564	33,034
Aluminum angles, channels and beams	7,481	355,880	3,372	180,226
Aluminum bars, rods and wire	22,270	533,720	35,424	853,672
Aluminum leaf	...	3,054	...	47,845
Aluminum pipes and tubes	1,429	129,718	594	70,323
Aluminum plates, sheets and strips	12,578	438,034	27,007	945,287
Aluminum powder	38.5	2,083	28	2,435
Aluminum wire and cable	7	285	...	...
Aluminum household hollow ware	...	3,551	...	11,635
Aluminum manufactures n.o.p.	...	489,593	...	420,261

Cwt. = 100 pounds.

Table 8 - EXPORTS OF ALUMINUM FROM CANADA, 1943 and 1944

Item	1943 Cwt.	1943 Value	1944 Cwt.	1944 Value
		$		$
Aluminum scrap	2,005	18,305	36,040	214,572
Aluminum in bars, ingots, blocks, etc. (b)	7,507,670	124,460,894	...	...
Aluminum wire and cable	...	2,082	...	59,498
Aluminum manufactures, n.o.p.	...	4,780,904	...	9,441,522
Aluminum in bars, blocks, ingots and blooms (a)	...	...	5,904,532	93,493,588
Aluminum in rods, sheets and circles (a)	...	...	62,485	2,310,424
Aluminum kitchen utensils and hollow ware	...	...	...	799

(a) From January, 1944 (b) To December 31, 1943 Cwt. = 100 pounds.

Table 9 - WORLD PRODUCTION OF ALUMINUM 1938, 1941 and 1944 (American Bureau of Metal Statistics)

Country	1938	1941(b)	1944
	Metric tons	Metric tons	Tons 2000 lb. (Available data)
United States	130,129	280,383	776,400
Canada	66,000	193,000	462,065
Total America	196,129	473,383	1,238,465
Austria (a)	(c)	(c)	...
France	45,300	60,000	...
Germany (a)	165,600	300,000	...
Great Britain (a)	22,500	23,400	61,700 (e)
Hungary	1,500	5,000	...
Italy	25,768	50,000	...
Norway	29,035	35,000	...
Russia	48,000	60,000	...
Spain	800	1,120	...
Sweden	1,892	2,500	...
Switzerland (a)	26,500	29,000	...
Yugoslavia	1,200	3,000	...
Total Europe	368,095	569,020	...
Japan (d)	17,000	90,000	...
TOTAL WORLD	581,224	1,132,403	...

(a) Metallgesellchaft. (b) Estimated, except for U.S.A., Canada, Great Britain and Spain.

(c) Austrian production included with Germany

(d) Probably includes Manchuria and Formosa, and anyway is quite conjectural.

(e) 1943 data.

ANTIMONY - Production of antimony metal in Canada during 1944 totalled 1,937,933 pounds valued at $281,000 compared with 1,114,166 pounds worth $189,408 in 1943. Production in both years represents antimony electrolytically refined by the Consolidated Mining and Smelting Company of Canada Limited at Trail, British Columbia; the metal is recovered at Trail as a by-product from the flue dust of the company's silver refinery. It was reported that the antimony plant at Trail was closed down in September, 1944, largely as a labour economy measure.

Antimony ore in the form of stibnite occurs in various parts of Canada and for a number of years prior to 1917 small amounts of refined antimony and of antimony ore were produced intermittently in the Maritime Provinces. Small shipments of antimony ore have also been made during recent years from the Fort St. James district of northern British Columbia, Nova Scotia, and from the Yukon. In 1942 an antimony deposit at Gates Lake, in the Kenora district of Ontario, was investigated. No crude antimony ores were commercially produced in Canada in either 1943 or 1944.

The world production of antimony in 1938 (1939-1942 figures not available), as published by the United States Bureau of Mines, amounted to about 38,000 tons. The production in 1937 was 42,100 tons, the highest figure since the 1914-1918 war years. The decline in output from China has been more than made up by the large increase in production in other countries. World production at present is probably in excess of 50,000 tons a year.

Most of the production of antimony has come from China, although Bolivia and Mexico have been important producers for years. In recent years, there has been a marked increase in output from Bolivia, Mexico, Yugoslavia, and Algeria and, to a lesser extent, from several other countries. In 1939 Bolivia produced 29 per cent of the world output of antimony; Mexico, 23 per cent; China, only 20 per cent; and Yugoslavia, 10 per cent. Prior to the war, most of the refined antimony was produced in the United States, Great Britain, France, and Belgium from ores of foreign origin.

Canada's requirements are now supplied mainly from the electrolytic plant at Trail, British Columbia, according to the Bureau of Mines, Ottawa.

Antimony is an important war metal. It is used largely in alloys for storage-battery plates, bearing and babbitt metals, and solder, and it is also used in the manufacture of rubber goods, paints, and fixtures. The greatest single gain in use in 1944 was of antimony oxide in the flameproofing of textiles, principally duck for military purposes. The use of antimony in the manufacture of chemicals increased considerably during the past two years. The principal compound is the oxide of antimony, which is employed extensively as a pigment in sanitary enamelware and in nitrocellulose enamels. Demand for antimony in the post-war years will possibly exceed that of the pre-war level partly because of the large requirements for storage batteries and other metal products and partly because of the new applications developed during the war.

Prices in Canada for imported antimony metal of a purity of 99.6 per cent or higher (grade R.M.M.) as set in August 1944 by the Wartime Prices and Trade Board (Order No. A-1315) were as follows:-

Quantity lbs.	Montreal cents per lb.	Toronto cents per lb.
10,000 and over	17.90	17.60
10,000 - 2,000	18.65	18.35
2,000 - 1,000	20.65	20.35
Less than 1,000	21.15	20.85

Chinese grade with a purity of not less than 99.0 per cent:-

Quantity lbs.	Montreal and Toronto cents per lb.
10,000 and over	18.00
10,000 - 2,000	18.75
2,000 - 1,000	20.75
Less than 1,000	21,25.

The New York price of antimony metal (ordinary brand) in 1944 remained fixed at 15.84 cents per pound throughout the year. The price for Chinese brand, duty paid, remained at 16.5 cents. The price of antimony ore, c.i.f. New York in 1944 per unit of antimony contained was: for 50 to 55 per cent Sb, $2.10 to $2.20; for 55 to 60 per cent Sb, $2.15 to $2.20; and for 60 to 65 per cent Sb, $2.20 to $2.30.

It was reported that all restriction on the use and distribution of antimony in Canada was removed in August, 1945.

Table 10 - ANTIMONY PRODUCED IN CANADA, 1937-1944

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

Table 11 - ANTIMONY USED IN SPECIFIED CANADIAN INDUSTRIES, 1942 and 1943

Industry	1942		1943	
	Pounds	$	Pounds	$
White metal alloys	1,818,370	264,838	1,814,414	269,718
Electrical apparatus and supplies	234,545	35,200	251,763	39,455

Table 12 - IMPORTS OF ANTIMONY AND SPECIFIED ANTIMONY-BEARING PRODUCTS INTO CANADA, 1943 and 1944

	1943		1944	
	Pounds	$	Pounds	$
Antimony or regulus of, not ground, pulverized or otherwise treated	240,700	38,755	1,558,198	237,334
Antimony oxide and titanium oxide (x)	16,889,500	1,533,462	20,174,795	1,871,434
Antimony salts - tartar emetic, etc.	10,990	6,066	68,765	26,749
Type metal in blocks, bars, plates and sheets	268	63	...	...
Plates, cylinders (engravers)	...	144,952	...	137,635
Stereotypes for books (sq. inches)	1,756,520	131,684	2,494,489	183,211
Stereotypes for advertisements (sq. inches)	1,827,222	78,143	1,691,220	73,324
Printing plates for publications	...	162,648	...	208,155
Storage batteries and parts	...	513,463	...	356,068

(x) Including white pigments containing not less than 14 per cent by weight of titanium.

BERYLLIUM

(Bureau of Mines, Ottawa)

Beryl, a silicate of aluminium 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 cobbed 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 Lacorne 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 aluminium-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 alundum, 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 specialities, 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. All of these companies considerably expanded their production facilities in 1944, under Government subsidy.

War demands occasioned a sharp increase in the price of beryl during the 1940-1944 period. Metals Reserve Company quotations rose progressively from the pre-war figure of $30 to $35 per short ton, f.o.b. mines, for ore with 10 to 12 per cent BeO content, respectively, to $145 per ton for 10 per cent grade, or $14.50 per unit of contained BeO, in 1944. Completion of an adequate United States Government stockpile reserve, and return of purchase to consumers at the end of 1944, is expected to result in a material lowering of the above price in 1945.

In June, 1945, it was announced by the United States War Production Board that the supply of beryllium exceeded essential requirements, and that the controls on the use of the metal had been removed through the revocation of order M-160. On June 4, 1945, it was announced that the United States War Production Board, in amending General Imports order M-63, removed beryllium ore, metal, and salts from import control.

BISMUTH - Production of bismuth in Canada during 1944 totalled 123,875 pounds valued at $154,844 compared with 407,597 pounds worth $562,484 in 1943. Production during recent years usually consisted of the metal recovered from silver-lead ores smelted by the Consolidated Mining and Smelting Company of Canada Limited at Trail, British Columbia, together with the bismuth content of a silver-lead-bismuth bullion produced in the treatment of silver-cobalt ores at Deloro, Ontario. Production in 1944 came entirely from the Trail metallurgical plants. The total output of bismuth in the Dominion to the end of 1944 amounted to 2,476,820 pounds worth $3,064,123.

Statistics of the world production of bismuth are incomplete, but the output is estimated at about 1,800 tons annually. The United States, Peru, Canada, and Mexico, supply about 90 per cent of the world output, their order of importance as producers being as given. The remainder of the output is obtained from Argentina, Australia, Belgium, Bolivia, China, France, Germany, Japan, Spain, and other countries.

The demand for bismuth increased considerably during the war period owing to its greater use in metallurgical and pharmaceutical applications. Bismuth is used mostly in the manufacture of pharmaceutical products. A much larger portion than formerly is now used in the making of so-called fusible or low-melting alloys. Fusible bismuth alloys usually include lead, tin, cadmium, mercury, or antimony. An alloy of bismuth, lead, tin, and antimony has been introduced for use in mounting dies and punches. Alloys containing bismuth are used to a greater extent than formerly in the aircraft, machine tool, munitions, and other industries. Additions of 0.1 to 1.5 per cent bismuth to stainless steel, copper and aluminium alloys improve machinability. There are numerous alloys of bismuth containing from 33 to 56 per cent bismuth.

The price of bismuth in 1944 (London price in Canadian funds) remained at $1.38 a pound. The price at New York remained fixed at $1.25 a pound throughout 1944. The American product is protected by a duty of 7½ per cent ad valorem.

Imports of bismuth salts into Canada during 1944 were appraised at $2,667 compared with $15,675 i n 1943; there were no imports of bismuth metal in 1944. Data relating to the bismuth content of alloys imported are not available. No separate records of exports of either bismuth or bismuth salts are available.

Table 13 - PRODUCTION OF BISMUTH IN CANADA, 1931-1944

Year	Pounds	$	Year	Pounds	$
1931	118,207	157,650	1938............	9,516	9,754
1932	16,855	7,340	1939	409,449(/)	466,362
1933	78,303	81,526	1940	58,529	81,004
1934	253,644	301,215	1941	7,511	10,396
1935	13,797	13,245	1942	347,556	479,627
1936	364,165	360,524	1943	407,597	562,484
1937	5,711	5,654	1944	123,875	154,844

(/) High record output.

Table 14 - BISMUTH USED IN THE MANUFACTURE OF CANADIAN MEDICINAL AND PHARMACEUTICAL PREPARATIONS, 1942 and 1943

Item	1942		1943	
	Pounds	$	Pounds	$
Bismuth metal	24,420	30,534	56,019	70,107
Bismuth salts	18,153	35,793	22,080	43,786

Canadian white metal alloy foundries consumed approximately 55,115 pounds of bismuth metal in 1943 compared with 25,979 pounds in 1942.

BORON - 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 Mineral Industry" reported in 1941 that tests demonstrated that the use of boron deoxidizers and the incorporation of 0.002-0.007 per cent boron in 0.4 per cent carbon steel increases the hardenability, ductility and toughness; the boron is best supplied as a complex alloy of B-Mn-Si-Ti, rather than as ferroboron.

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 1944, in packages of 25 pounds or over, totalled 9,570,148 pounds valued at $280,930. Borax was quoted in the United States in 1945 at $41.50 per ton, granular technical, March 1945 - United States prices:- Ferroboron, per pound of alloy, f.o.b. shipping point, ton lots $120. Nickel boron, per pound of alloy, f.o.b. shipping point: ton lots, $2.00 (15-18% boron). Manganese-boron, per pound of alloy, f.o.b. shipping point, $1.89 - ton lots (15-20% boron).

CADMIUM - A report prepared by the Bureau of Mines, Ottawa, contains the following information:-

"Cadmium is present in small amounts in most zinc ores and in some lead ores, and is obtained as a by-product in the production of these metals.

"Metallic cadmium is produced by Consolidated Mining and Smelting Company at Trail, British Columbia, and by Hudson Bay Mining and Smelting Company at Flin Flon, Manitoba. The plant at Trail started to produce early in 1928 and like the plant at Flin Flon which has been in operation since 1936, treats the cadmium residue from the zinc refinery, the procedure being similar. The cadmium plant at Flin Flon was in continuous operation and treated all current purification precipitates from the zinc plant.

"Canadian production of cadmium in 1944 was 526,970 pounds valued at $579,677, compared with 786,611 pounds valued at $904,602 in 1943. The exports of cadmium in 1944 were 383,324 pounds valued at $412,332, compared with 572,215 pounds valued at $626,379 in 1943.

"The world production in 1944 is estimated at 5,500 short tons, the production in 1938, the latest year for which complete figures are available being 4,200 short tons. The chief Allied producing countries are: the United States, Canada, Mexico, Belgium, Australia (Tasmania), Poland, Norway, England, Russia, and France. The Mexican output is contained in ores exported for treatment mainly to the United States.

"Cadmium production is limited entirely to the by product recovery from electrolytic zinc and from the manufacture of lithopone, and is thus dependent on the output of these products.

"Cadmium is used mainly in electroplating and in the manufacture of alloys and compounds. The most common use of cadmium is as a protective coating for steel, and to a much lesser extent for 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. In the United States, the consumption of cadmium is distributed approximately as follows: electroplating, 87 per cent; alloys and solders, 7.5 per cent; pigments and chemicals, 5.5 per cent. 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 selenide.

"Cadmium sulphide and cadmium sulphoselenide are standard agents for imparting bright resistant yellow and red colours 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 electroplating solution; the carbonate in ceramics; and the halides in photography.

"The price of cadmium in 1944 (in Canadian funds) averaged $1.10 a pound, compared with $1.15 in 1943. The price of metallic cadmium, f.o.b. New York, in commercial sticks remained at 90 cents a pound throughout 1942, 1943, and 1944. The American product is protected by a duty of 7½ cents a pound. Previous to the Trade Agreement of November 1938, the duty was 15 cents a pound."

Table 15 - CADMIUM PRODUCTION IN CANADA, 1928-1944

Year	British Columbia		Manitoba		Saskatchewan	
	Pounds	$	Pounds	$	Pounds	$
1928 (x)	491,894	341,374	...	...	...	...
1929	773,976	675,294	...	...	...	...
1930	456,582	337,871	...	...	...	...
1931	323,139	180,958	...	...	...	...
1932	65,425	26,824	...	...	...	...
1933	246,041	78,733	...	...	...	...
1934	293,611	95,665	...	...	...	...
1935	580,530	441,203	...	...	...	...
1936	526,034	468,170	148,133	131,838	111,749	99,457
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

(x) First production.

Table 16 - CADMIUM CONSUMED BY SPECIFIED CANADIAN INDUSTRIES, 1939-1943 (Pounds)

Industry	1939	1940	1941	1942	1943
White metal alloys	76,072	121,008	243,717	347,725	267,586
Steel foundries	1,825	6,000	32,000	18,000	15,477
Iron foundries	2,658	9,528	12,000	34,000	23,178
Non-ferrous smelters	1,344	...	...	2,000	...
Other industries	309	5,483	11,000	12,000	34,709
TOTAL ACCOUNTED FOR	82,208	142,019	298,717	413,725	340,950

CALCIUM - The commercial production of calcium in Canada was commenced for the first time in 1945 when the metal was recovered from dolomite by Dominion Magnesium Limited in its plant located at Haley, Ontario.

Calcium metal was imported into the United States from France and Germany prior to the second world war. However, in 1939 a new plant was built for the production of the metal at Sault Ste. Marie, Michigan, by the Electro Metallurgical Company. Metallic calcium is utilized as a scavenger in steel and secondary aluminum, to produce magnesium castings and calcium hydride, and to harden lead. Calcium is used as a deoxidizer and final addition in obtaining particularly clean steels and in imparting better working properties to high nickel-chromium steels. Calcium-silicon (28-35 per cent calcium and 60-65 per cent silicon) and calcium-manganese-silicon are likewise employed for this purpose, although the unalloyed metal may have specific effects. Calcium-bearing alloys are now being made in Canada.

New York quotation for calcium, September, 1945, was $1.85 per pound, ton lots. Data relating to imports into Canada of calcium are not shown separately in Canadian trade reports.

CERIUM - The following information was supplied by the Bureau of Mines, Ottawa:-

"Cerium is obtained from monazite, a monoclinic phosphate of cerium metals containing about 32 per cent cerium oxide (Ce_2O_3) and up to 18 per cent thoria (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 Cerium 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.

"Thoria, which was used in gas mantles, was formerly the only commercial constituent of monazite, and monazite is still marketed on the basis of its thoria content, although its content of ceria (Ce_2O_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.

"Nominal prices for monazite as given by Metal and Mineral Markets, New York, remained at $60 per short ton, 8 per cent minimum thoria, throughout 1944. No quotations are published for most of the rare-earth products, although prices for small lots may be obtained on request from mineral dealers and chemical manufacturers."

CHROMITE - The following information was supplied by the Bureau of Mines, Ottawa:-

"The improvement in the Allied supply situation, which started in 1943, continued to such an extent in 1944 that the government-operated Chromeraine mine at Black Lake, Quebec, was closed in August. At the end of the year the only shippers were Chromite, Limited, near Richmond, Quebec, and Orel Pare, operating the 'Montreal' pit in the Black Lake district for Union Carbide Company. Chromite, Limited discontinued operations in the spring of 1945.

"Pure chromite (FeO, Cr_2O_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. Fresh dunite is a fine-grained, dark grey-green olivine rock. 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 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. The chromite in the mine occurs as fairly uniformly disseminated zones, scattered through which are plums of the massive mineral. The ore zone has been traced on the surface for about 1,700 feet and varies in width from 5 to 20 feet. The mine has been developed at 5 levels to a depth of 500 feet.

"The ore in the Chromeraine mine is chiefly low-grade, banded and disseminated chromite with a small amount of the massive mineral. The zone has been traced intermittently for 2,000 feet, has an average width of 30 feet, and in places is 60 feet wide. A small amount of diamond drilling has indicated that the ore extends to a depth of at least 440 feet. The ore was extracted by caving methods to a depth of 375 feet.

"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.

"About 78 per cent of the total imports of 41,520 tons valued at $645,560 came from Southern Rhodesia and Transvaal, and nearly all the rest from India. All of the exports, which amounted to 18,868 tons, were to the United States.

"Production was started in the 100-ton mill of Chromite, Limited early in 1942 and its capacity was increased to 150 tons late that year. In 1944 about 37,000 tons of ore averaging 15 per cent Cr_2O_3 was treated, mostly from between the second and fifth levels south of the shaft. Over 12,000 tons of concentrate containing 48 per cent Cr_2O_3 was shipped to the United States. The development loan received from the Dominion Government in September, 1942, was all repaid by September, 1944, after which the mine was taken over by Basin Montana Tunnel Company, which had originally financed the operations. The contract for shipments to the United States Metals Reserve Company was not renewed and the mine was closed in the spring of 1945. Total shipments of concentrates and high-grade crude ore since the outbreak of the war were nearly 36,000 tons.

"Wartime Metals Corporation operated the old Reed-Belanger deposits (Chromeraine project) 2 miles southwest of Black Lake. Production in the 600-ton mill was started in May, 1943, and in that year 77,500 tons of ore averaging about 8 per cent Cr_2O_3 was treated, in addition to which about 750 tons of custom ore averaging 18 per cent Cr_2O_3 was treated. In 1944, until operations ceased near the end of August, 87,500 tons was milled. No custom ore was received in 1944, but 2,400 tons of such ore that was received in 1943 was treated. About 11,000 tons of concentrate averaging 47 per cent Cr_2O_3 was shipped in 1944, compared with about 8,000 tons in 1943.

"Orel Pare shipped about 4,000 tons of high-grade crude ore direct to a Canadian consumer from Union Carbide Company's 'Montreal' pit, 5 miles southeast of the Chromeraine project. The old workings were reopened in the fall of 1941 and since then regular monthly shipments have been maintained. The deposit was first opened 50 years ago, and 20,000 tons was shipped from it during the last war. From the fall of 1941 to the end of 1944 a total of about 14,000 tons of ore was shipped. About 500 tons of high-grade crude ore was shipped by Chrome Association, Limited from the old Greenshields mine, and three car lots were shipped by LaBonte and Metevier from the Hall mine, both in Coleraine township.

"In the United States the output of the 80 producers in 1944 amounted to about 40,000 tons, compared with a peak output of 160,000 tons from 175 producers in 1943.

"The world annual production of chromite just prior to the present war was about 1,300,000 tons. Russia, Turkey, Southern Rhodesia, and the Union of South Africa were each producing 200,000 tons or more a year, and the Phillippines, Cuba, New Caledonia, Yugoslavia, Greece, and India 50,000 tons or more each. Turkey is one of the most important sources of high-grade chromite.

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 highly important stainless and 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. Large quantities of chromite, with certain specifications as to physical and chemical properties, are used in the making of refractories. Chromite is the source of such chemicals as sodium and potassium chromates.

"Chromium Mining and Smelting Corporation, Sault Ste. Marie, Ontario, produces an addition agent known as Chrom-X.

"Metallurgical chromite should contain a minimum of 48 per cent Cr_2O_3 and a chrome-iron ratio of not less than 3 to 1. When possible, lower grade ores are mixed with those of the highest grade, the proportion depending upon whether the ferrochrome produced is to be used for low- or for high-carbon steels. The maximum allowance for sulphur is 0.5 per cent and for phosphorus 0.2 per cent. Although lump ores are preferred, fines and concentrates are used in quantity and in some instances they are briquetted before use. The low iron content of the ore or concentrate is of the utmost importance.

"Specifications for refractory ore suitable for bricks depend upon the kind of brick to be made. The silica should be as low as possible. The chromite should be present in an evenly and finely distributed form, not a coarse grains mixed with blobs of the silicate. The ore should be hard and lumpy, and the lumps should be plus 12 mesh. Provided the impurities are within the above specifications, the Cr_2O_3 content may vary within certain limits, but it is generally over 40 per cent.

"Standard grades of ferrochrome contain a minimum of 60 to 70 per cent chromium and are produced in two grades, one being high (4 to 6 per cent) in carbon, and the other low (less than 2 per cent). Canadian production of high-carbon ferro was suspended early in the year.

"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, Quebec. The types and grades of ore acceptable to these buyers are indicated under "Specifications".

"United States prices of domestic and imported ores of 48 per cent Cr_2O_3 and 3 to 1 ratio are $43.50; ores of lower grade and ratio vary down to a minimum of $28 a long, dry ton at seaboard. Canadian prices of 47 to 48 per cent Cr_2O_3 concentrates are $25 to $40 a long ton, f.o.b. mines, depending upon the Cr-Fe ratio and percentage of certain impurities."

Table 17 - PRODUCTION OF CHROMITE IN CANADA, 1928-1944

Year	Short tons	$	Year	Short tons	$
1928	...	...	1937	(x)	43,250
1929	126	900	1938	...	...
1930	...	...	1939	...	...
1931	...	...	1940	335	5,780
1932	78	1,113	1941	2,372	42,679
1933	30	343	1942	11,456	343,568
1934	111	1,578	1943	29,595	919,878
1935	1,144	14,947	1944	27,054	748,494
1936	(x)	13,578			

(x) Quantity not published.

Table 18 - CONSUMPTION OF CERTAIN CHROMIUM PRODUCTS AND CHROME ORE IN SPECIFIED CANADIAN INDUSTRIES, 1942 and 1943

Industry	Item	1 9 4 2		1 9 4 3	
		Pounds	$	Pounds	$
Ingots and castings	Chrome ore	2,464,000	58,095	2,738,000	63,838
Ingots and castings	Ferrochrome	11,262,000	1,445,089	12,994,000	1,417,215
Paints, pigments and varnishes	Chrome colours ...	2,669,978	551,855	2,563,058	535,527
Paints, pigments and varnishes	Sodium bichromate	1,015,065	105,731	941,456	95,805
Leather tanning	Sodium bichromate	2,107,737	203,305	2,114,862	211,913
Glass manufacture	Chromite	16,000	460	12,000	432

Note: In addition to the items listed above, a considerable quantity of chromite is utilized in the manufacture of Canadian ferro-alloys, also a relatively small quantity of sodium bichromate is consumed in the chemical industry. Chromite is also employed in Canada in the manufacture of refractories.

Table 19 - CHROMITE MINING IN CANADA, 1942-1944 (All in Province of Quebec)

		1942	1943	1944
Active firms	No.	14	15	7
Capital employed	$	380,027	1,691,315	(x)
Employees - Salaried	No.	45	48	42
Wage-earners	No.	286	322	202
TOTAL	No.	331	370	244
Salaries and wages -				
Salaries	$	57,926	108,674	80,065
Wages	$	354,529	460,610	293,529
TOTAL	$	412,455	569,284	373,594
Gross value of production	$	343,568	919,878	748,494
Fuel and electricity used	$	34,567	75,806	60,009
Process supplies used	$	116,725	75,995	83,828
Freight	$	17,945	37,969	45,373
Net Value	$	174,331	730,108	559,284

Note: In addition, exploratory work, including diamond drilling, was conducted in 1942 on chromite deposits located in south-eastern Manitoba, but no data are available. Also, data shown in this table are included in tables 1 - 4.

(x) Data not recorded in 1944.

INDIUM - 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. Indium is used for plating and as an alloy with other metals. The Bureau of Mines, Ottawa, reports that the augmented production of engine bearings and war restrictions on ordinary plating metals have stimulated interest in indium during the past three years. "E and M J Metal Markets", New York, August, 1944, quoted indium at $7.50 per troy ounce 99.9 per cent pure.

IRON ORE

(Bureau of Mines, Ottawa)

Deposits of iron ore in Canada are widespread and include hematite, siderite, magnetite, bog iron, and magnetic sand. Because of the availability at low cost of higher grade ores in the Lake Superior iron ranges of the United States and in Newfoundland, no iron ore from domestic sources was produced in Canada from 1923 until 1939.

Dominion Steel and Coal Corporation, Limited, Sydney, Nova Scotia, obtains its iron ore from its own mines at Wabana, Newfoundland. Steel Company of Canada, Limited, Hamilton, Ontario, and Canadian Furnace, Limited, Port Colborne, Ontario, obtain their iron ore from the Lake Superior region of the United States. Algoma Steel Corporation obtains most of its requirements from the United States, and the remainder from the New Helen mine, Michipicoten area, Ontario.

All but a small part of the iron ore produced in Canada in 1944 came from the New Helen mine of Algoma Ore Properties, Limited in the Michipicoten area, Ontario, and the remainder came from the hematite property of Steep Rock Iron Mines, Limited, near Atikokan, about 135 miles west of Port Arthur, Ontario. In 1943 a production of 125,000 tons of beneficiated magnetite was obtained from the Austin Brook mine near Bathurst, New Brunswick, but the property was idle in 1944.

Algoma Ore Properties, Limited (wholly owned subsidiary of Algoma Steel Corporation, Limited) began to develop the New Helen mine in 1937 and the first sinter was produced in July, 1939.

Large-scale tests on the treatment of ore from Algoma Properties' Goulais Iron Range, 50 miles northeast of Sault Ste. Marie, indicate that a product containing 65 per cent iron can be obtained, and further tests are being made. Based on the results of an extensive diamond-drilling program, the deposit is estimated to contain about 100,000,000 tons of siliceous magnetite. The active development of the Goulais Iron Range is not contemplated in the near future.

Directors of Steep Rock Iron Mines, Limited approved a three-year production program in the latter part of 1944 that calls for a total iron ore output of 5,000,000 tons from its hematite deposits in the Steep Rock Lake area, north of Atikokan, Ontario, during the shipping seasons of 1945 to 1947, inclusive. All mining is in the "B" ore-body, and open pit mining is planned to a maximum depth of 550 feet below bedrock. Exploratory work on the property in previous years had indicated that the deposits, which were discovered in the winter of 1937-38 under the bed of Steeprock Lake by diamond drilling through the ice, are large. High-grade ore presumably makes up a considerable, but as yet very incompletely defined, part of them. The company reports that the property has 17,244,000 long tons of "proven ore" and 14,336,000 long tons of "probable ore", making a total of 31,580,000 long tons. Most of this ore is available for open pit mining. No estimate has been prepared of "possible ore".

Diversion of the Seine River was completed in 1943, and included about 20 miles of road building; the excavation of over 1,200,000 cubic yards of earth and of 500,000 cubic yards of rock; the lowering of Finlayson Lake by a tunnel; the construction of a spillway and control works in Raft Lake; the construction of coffer-dams to isolate the eastern part of Steep Rock Lake; and the construction of a power line, the installation of pumps and barges, and works in preparation for pumping Steep Rock Lake. This pumping was commenced on December 10, 1943 and water was sufficiently down for the company to commence the production of iron ore by August, 1944. The first shipment from the Steep Rock mine left Atikokan on October 3, 1944 for delivery via Fort Frances to Superior, Wisconsin, for loading into Great Lakes boats. Difficulty was experienced, however, with viscous mud in the vicinity of the "B" ore-body which caused a curtailment of mining operations, but in the spring of 1945 the thickness of this mud had been reduced sufficiently by removal to overcome its tendency to flow over the site of the projected workings on the ore-body. Regular shipments to Lower Lake points via Duluth were commenced early in May, 1945. On June 22 advice was received to the effect that work on the ore docks at Port Arthur was by then sufficiently advanced to enable shipments of one of the three grades of ore through that port and that the docks would be ready for autumn use by September 1, 1945.

In 1944, the company erected a crusher and a screening plant capable of handling 700 tons an hour. In the screening plant the ore is separated into three sizes, namely 4 to 10-inch lump ore for open-hearth use; 1 to 4-inch charge ore for open-hearth use; and minus 1-inch blast furnace ore. The three sizes fall into separate sections of the bin below, where they are loaded into railway cars on the 3-mile spur (Canadian National railway) from Atikokan, and are hauled to the loading docks on the Great Lakes.

Michipicoten Iron Mines, Limited, which was formed in 1943 to take over the Josephine, Ruth, and Lucy iron properties, continued underground work in the Josephine mine throughout 1944. The three properties are owned jointly by Sherrit Gordon Mines, Limited and Frobisher Exploration Company, Limited (Ventures, Limited), and are about 20 miles from Michipicoten Harbour, Algoma district, Ontario. In 1941, a transmission line was built to connect the Josephine mine with the power line at Hawk Junction, and the necessary electrically driven plant for development operations was installed. Shaft sinking was started in February, 1942, and was completed to a depth of 1,055 feet early in September of that year. Six stations were cut, the lowest being at the 1,015-foot level. While shaft sinking was in progress the ore-body was further explored by lateral diamond drilling at the first and second levels. The drainage of Parks Lake was then undertaken.

The underground work in the Josephine mine in 1944 was confined mainly to the three lowest (fourth, fifth, and sixth) levels, and most of it was on the fourth and sixth levels. The ore reserves were increased by 1,174,000 gross tons and now total 3,840,000 gross tons, averaging about 52 per cent iron, 15 per cent silica, 2.12 per cent sulphur, 0.04 per cent phosphorus, and 0.43 per cent manganese. Considerable headway was made toward equipping the Josephine mine for production on a scale of 375,000 gross tons of ore a year. This work involves the erection of a crushing plant, including a primary crusher underground, a concentrator for the production of open-hearth lump ore and a jig plant for the production of hematite concentrate. The plant was expected to be ready for operation by the end of April, 1945.

A contract for sale of the output from the Josephine mine has been made with Algoma Ore Properties, Limited (Algoma Steel Corporation). The contract is for a period of seven years from April, 1945 and it calls for the delivery of a minimum of 75,000 gross tons of open-hearth lump ore and 194,000 gross tons of hematite concentrate a year. The concentrate will be mixed and sintered with the siderite ore from the New Helen mine in Algoma Ore Properties sintering plant at Wawa, Ontario.

The Ruth property, which is 2 miles from the Josephine, remained idle in 1944. It was drilled extensively in 1942 and in the first three months of 1943, the indicated ore reserves to a depth of 800 feet being 28,600,000 long tons of siderite averaging 31.26 per cent iron, 13.15 per cent silica, and 5.14 per cent sulphur. These reserves include 16,840,000 tons of low-silica siderite averaging 34.54 per cent iron and 6.81 per cent silica. The remainder averages 26.57 per cent iron and 21.46 per cent silica.

On the Lucy property in the same area, a small amount of assessment work was done.

No further work was reported on the magnetite deposits in Hastings county, Ontario. Some exploratory work was done on a few of these deposits in 1941, 1942 and 1943.

At Sarpedon Lake in Quetico Park, Rainy River district, Sarpedon Iron Mines, Limited has been diamond drilling an iron formation in search of ore under the lake. Most of the exposed iron formation in the area is magnetite-bearing. It is hoped, however, that large concentrations of hematite will be found.

No work in 1944 was reported on the Gunflint iron range at Round Lake, southwest of Port Arthur, nor on the Matawin iron range south of Shebandowan. In 1943 Gunflint Iron Mines, Limited did some diamond drilling on hematite deposits on these ranges.

Since 1936, Labrador Mining and Exploration Company, the control of which was acquired in 1943 by Hollinger Consolidated Gold Mines, Limited, has been making extensive surveys and doing exploratory work on iron deposits near Sawyer Lake and vicinity, along the Quebec-Labrador boundary. Work on the Labrador side is being done by Labrador Mining and Exploration, and that on the Quebec side by Hollinger North Shore Exploration Company. To date, 24 iron deposits have been found, 15 in Quebec and 9 in Labrador. In addition, 3 outcrops have been reported in Labrador. The Sawyer Lake deposit is the only one on which much exploration has been done, but it is proposed to conduct an extensive diamond-drilling program on the various deposits when conditions become favourable.

The following tabulation gives an idea of the great possibilities of the region:

Name of Deposit	Per cent Fe + Mn	Apparent width Feet	Apparent length Feet
Labrador			
Sawyer Lake	68.4	150	2,200
Ruth Lake No. 1	57.9	100	3,300
Ruth Lake No. 2	59.3	175	300
Ruth Lake No. 3	61.7	400	1,230
Wishart Lake	61.6	100	2,400
Fleming Lake No. 1	67.9	40	750
Fleming Lake No. 4	59.6	3	600
Timmins Bay	69.4	40	1,000
Ruth Lake Extension	64.9	175	1,250

No details are available on the deposits in Quebec, though one deposit with a known width at some places of 350 feet and a known length of 3,900 feet has been disclosed. Outcrops to the south indicate the possible extension of this body for a distance of over 2 miles.

The Sawyer Lake area is about 325 miles from the St. Lawrence River at Seven Islands, which port is open to navigation throughout the year. Ample power will be available from the nearby Grand Falls on Hamilton River, where surveys have shown a potential minimum of 1,250,000 h.p. Hollinger has completed negotiations with M. A. Hanna Company of Cleveland, Ohio, for participation in the future exploration and development of the iron deposits both in Quebec and in Labrador.

Canadian production of iron ore in 1944 was 553,252 tons valued at $1,909,608, compared with 641,294 tons valued at $2,032,240 in 1943. Consumption of iron ore in 1944 totalled 3,478,800 short tons, of which 266,149 tons came from Canadian mines.

Exports of iron ore were 308,424 tons valued at $1,153,166, compared with 374,677 tons valued at $1,450,985 in 1943. Imports were 3,126,649 tons valued at $7,393,926, compared with 3,906,425 tons valued at $9,066,389 in 1943.

Shipments of sintered ore from the New Helen mine in 1944 amounted to 474,405 gross tons, and total shipments to the end of 1944 amounted to 2,328,900 gross tons. The ore was shipped via Michipicoten Harbour, 8 miles from the sintering plant, partly to the company's blast furnaces at Sault Ste. Marie, Ontario, and partly to United States ports on the Lower Lakes for use in United States blast furnaces. The manganese content is of special interest to users. The deposit is estimated by the company to contain at least 100,000,000 tons of siderite or carbonate ore, averaging about 35 per cent iron. To fit it for commercial use in blast furnaces, a sintering plant capable of treating 3,000 tons of ore a day was built, the analysis of the sinter produced being approximately as follows:

	Per cent		Per cent
Iron	51.50	Alumina	2.35
Phosphorus	0.02	Lime	3.60
Silica	9.50	Magnesia	7.96
Manganese	3.00	Sulphur	0.04

It is expected that production from the property of Steep Rock Iron Mines, Limited will have an average grade (dry analysis) of:

	Per cent
Iron	60.48
Silica	3.40
Phosphorus	0.023
Sulphur	0.043
Loss by ignition	8.5

The moisture content is estimated to be 7 per cent. The natural iron content (averaging 56.54 per cent) is 4.54 per cent higher than the average of ore shipped from the Lake Superior ranges in the United States. The low silica content of 3.42 per cent will permit the use of the ore to "sweeten" other ores, and the extremely low phosphorus content of 0.017 per cent is well below the Bessemer limit. Though these qualities make Steep Rock ore a premium product, probably its most valuable quality is its physical structure, which should make it a good open-hearth lump ore, producing little minus 100-mesh fines and reducing the percentage of scrap normally required.

There are no official Canadian price quotations for iron ore. Prices, f.o.b. Lake Erie ports, a long ton for Lake Superior, U.S.A., iron ore, 51 1/2 per cent iron ore are: Messabi, Non-Bessemer--$4.45, Bessemer--$4.60; Old Range, Non-Bessemer--$4.60, Bessemer--$4.75. The price of Brazilian ore, f.a.s. Brazilian ports, 68 per cent iron was 7 1/4 to 7 3/4 cents a long ton unit.

Complete data on world production of iron ores have not been available since the commencement of the present world war.

Table 20 - PRODUCTION OF IRON ORE(x) IN CANADA, 1939-1944

Year	Short tons	Value
		$
1939	123,598	341,594
1940	414,603	1,211,305
1941	516,037	1,426,057
1942	545,306	1,517,077
1943	641,294	2,032,240
1944	553,252	1,909,608

(x) Exclusive of titanium-bearing iron ores. All from Ontario with the exception of 187 tons from Quebec in 1942 and 143,062 tons from New Brunswick in 1943.

Table 21 - IMPORTS AND EXPORTS OF IRON ORE, 1943 and 1944

	1943		1944	
	Short tons	$	Short tons	$
Imports	3,906,425	9,056,389	3,126,649	7,393,926
Exports	374,677	1,450,985	308,424	1,153,166

Table 22 - ORES AND OTHER SPECIFIED MATERIALS USED IN CANADIAN STEEL FURNACES, 1942 and 1943

Ore	1942		1943	
	Net tons	$	Net tons	$
Crude iron ore	98,986	616,617	107,619	671,079
Calcined roasted, or treated ore	98,156	1,757,431	62,052	668,843
Manganiferous ore	32	1,600	-	-
Chrome ore	1,232	58,095	1,369	63,838
Calcium molybdate and molybdenum oxide				
briquettes	1,145	1,167,579	522	813,861
Nickel	3,392	2,025,604	2,775	1,867,729
Ferromanganese	19,190	2,484,783	19,096	2,356,754
Silicomanganese	8,065	918,774	9,568	1,094,239
Ferrosilicon	12,150	841,900	11,545	757,911
Ferrochrome - High Carbon	3,666	724,819	4,669	702,817
Low Carbon	1,965	720,270	1,828	714,398
Ferrotungsten	646	1,440,141	550	1,721,967
Ferrovanadium	203	524,007	204	558,717
Purchased Scrap iron or steel	962,374	21,377,022	804,096	17,554,265

Table 23 - MATERIALS CHARGED TO IRON BLAST FURNACES, 1942 and 1943

Material	1942 Quantity	1942 Cost at Furnace	1943 Quantity	1943 Cost at Furnace
	Net tons	$	Net tons	$
Iron ore--Imported (crude)	3,383,439	13,726,346	2,955,671	12,247,784
Canadian (beneficiated)	229,253	798,974	198,244	737,276
Canadian (crude)	...	...	104,536	460,160
Mill cinder, roll scale, flue dust, etc. ...	177,343	386,730	125,477	315,483
Scrap (net charge)	64,624	803,172	43,032	543,930
Limestone -				
From Canadian quarries	301,143	447,107	464,497	867,146
From foreign sources	559,650	799,302	321,441	362,195
Dolomite	...	...	32,064	71,945
Coke	1,795,875	13,402,828	1,646,191	13,989,052
Other materials	...	163,675	...	315,061
TOTAL	...	30,528,134	...	29,910,032

Table 24 - IRON ORE MINING IN CANADA (a), 1942-1944

	1942	1943	1944
Active firms	7	14	8
Capital	2,508,650	7,570,964	(b)
Employees -- On salary	42	99	99
Wage-earners	318	404	580
Total	360	503	679
Salaries and Wages -- Salaries ....$	93,484	205,857	242,271
Wages ....$	582,635	1,229,098	1,220,182
Total ....$	676,119	1,434,955	1,462,453
Gross value of production ....$	1,517,077	2,032,240	1,909,608
Fuel and electricity used ....$	301,778	363,354	642,761
Process supplies used ....$	347,690	396,915	200,438
Freight and treatment charges ....$	236,307	222,013	276,653
Net value ....$	631,302	1,049,958	789,756

(a) Does not include data relating to titaniferous iron ores, also data in this table are included in tables 1-4. (b) data not recorded in 1944.

LITHIUM

(Bureau of Mines, Ottawa)

Amblygonite, spodumene, and lepidolite are the chief lithium minerals of commerce: their ores contain, respectively, about 8, 6, and 4 per cent of lithium oxide. Spodumene is in greatest supply, and is the base raw material for the manufacture of many lithium salts, lithium metal, and alloys. Amblygonite has similar uses, but is scarcer and more expensive. Lepidolite, or lithia mica, is employed mainly in the natural state as a batch ingredient in glass. The occurrence of all three minerals is confined to pegmatite dykes of a definite type, which usually have a localized, regional distribution and often carry, also, important amounts of beryl and tantalite-columbite. In some cases, such dykes have been worked for the recovery of all of these minerals.

There has been no recorded production of lithium minerals in Canada since 1937, when 32 tons of amblygonite and spodumene valued at about $1,700 was shipped, and little if any lithium ore is known to be used or required for any purpose in the Dominion. Thus, an outside market would have to be found for any production. Considerable development work has been done in recent years, however, on deposits in the Pointe du Bois area in southeastern Manitoba; and in the three years ended 1944 increased interest was shown in the commercial possibilities of lithium deposits in other sections of that province, though activities have been confined to exploratory drilling. Some attention has been given, also, to lithium-bearing deposits in the Yellowknife-Beaulieu area in the Northwest Territories.

Lithium ores and compounds early became of strategic importance in the present war, and to conserve supply for defence needs the United States Government placed both under allocation control in 1942. Government assistance also was given to the establishment of two spodumene mills, one in North Carolina, and the other in South Dakota. These measures resulted in a considerable easing of the general supply situation in 1944.

All of the small Canadian production of lithium minerals has come from the Pointe du Bois area in Manitoba. Lithium Corporation of Canada, 409 Avenue Building, Winnipeg, is the company that has been most actively interested in furthering the development of the lithium-bearing pegmatites in the area, and it has carried out considerable work on its holdings, mainly on those at Bernic Lake. It mined and stockpiled about 50 tons of mixed ore in 1941, but was inactive during 1942-1944. The material taken out in 1941 comprised about equal amounts of cobbed amblygonite and spodumene, and included also a few tons of triphylite, a phosphate of lithium and iron, containing, theoretically, about 9 per cent of lithium oxide.

Lithium is the lightest of the metals, having a specific gravity of only 0.53. A wide range of master alloys of lithium with calcium, silicon, brass, copper, manganese, zinc, lead, tin, magnesium, and aluminium has been developed in the United States. The alloys are being used to an increasing extent as deoxidizing, degasifying, and desulphurizing agents in copper, brasses, bronzes, etc.; as scavengers for cast iron and in the refining of high-carbon steel; and for the hardening of lead and aluminium. Alloys of lithium with zinc, aluminium, and magnesium are strong and highly resistant to corrosion.

Prices of lithium minerals in 1944 showed little change from those of the previous year. Amblygonite, 8 to 9 per cent Li_2O, was quoted at $40 to $50 per ton; spodumene, 6 per cent grade, at $5 to $6 per unit for mill concentrates; and lepidolite, 3 per cent Li_2O at $25 per ton, all f.o.b. mines. Lithium metal was unchanged at $15 per pound.

There are no plants in Canada for the chemical treatment of lithium ores. Most of the world production marketed prior to the war was treated by a few large chemical firms specializing in the business, the principal plants being in the United States, Great Britain, Germany, and France. Such firms usually purchased their requirements under individual contract, and there has thus been little in the way of an open market, price quotations given in trade journals being merely nominal. Some of the larger consumers own and operate their own mines.

MAGNESIUM

(Bureau of Mines, Ottawa)

Magnesium, industry's lightest metal, is available from many sources in Canada and elsewhere. The present source of the metal produced in Canada is dolomite. Other potential sources are magnesite, brucite, serpentine, and sea-water.

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 refratories 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 ferrosilicon reduction process in use in Canada involves the grinding and mixing together of ferrosilicon, calcined dolomite, and a catalyst, briquetting the mixture, and charging the briquettes to externally heated retorts operating under a vacumm. The magnesium vapour is condensed on the sides of a water-cooled condenser and is removed as a ring or crown of pure, solid metal. These crowns are re-melted and cast into ingots, with or without alloying elements.

Dominion Magnesium, Limited, Haleys, Ontario, which began production in August, 1942, is the only producer of magnesium in Canada. The plant is operated by a private company under supervision of Wartime Metals Corporation, a Crown company. Production in 1944 amounted to 5,290 tons valued at $2,575,695, compared with 3,577 tons valued at $2,074,652 in 1943.

No data are available for publication on exports and imports of magnesium, but most of the production is exported.

The three magnesium foundries in Canada are located at Toronto, Montreal and at Renfrew, Ontario. They are operated respectively by Aluminum Company of Canada, Limited, Robert Mitchell Company, Limited, and Light Alloys, Limited. A plant for the making of magnesium powder is operated at Trail, British Columbia, by Consolidated Mining and Smelting Company of Canada, Limited.

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 aluminium-base alloys.

The price quoted by Engineering and Mining Journal for magnesium in ingot form in carload lots during 1944 was 20 1/2 cents per pound, U.S. currency, f.o.b. New York.

Complete data on World Production of magnesium are not available. Production of Primary magnesium ingot in the United States in 1944 totalled 168,337 short tons; in Great Britain the production of ingot in 1943 totalled 25,800 short tons.

Table 25 - PRODUCTION OF PRIMARY MAGNESIUM METAL IN CANADA, 1916-1918 and 1941-1944

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(d)	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

(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.
(d) Produced in Ontario from Quebec brucite.

Table 26 - CONSUMPTION OF MAGNESIUM INGOTS IN CANADA, 1939-1943

	1939	1940	1941	1942	1943
			(pounds)		
In non-ferrous smelters	31,990	192,000	825,717	1,072,346	1,298,650
In white metal alloy foundries ...	774	7,770	9,515	9,850	16,821
In brass and bronze foundries	16	163	42,821	44,553	132,465
In aluminum products	...	240	127	...	89,523
In ammunition	...	404	...	...	...
In pharmaceuticals	200	...	...	...	...
TOTAL ACCOUNTED FOR	32,980	200,577	878,180	1,126,749	1,537,459

MANGANESE

(Bureau of Mines, Ottawa)

All mangenese properties in Canada were inactive in 1944. The small Canadian production in the past has come from deposits in the Maritime Provinces.

The manganese ores that have been mined in Canada are pyrolusite (MnO_2), psilomelane (H_4MnO_5), manganite ($Mn_2O_3H_2O$), and braunite (Mn_2O_3), all of which are black or grey-black and comparatively hard; bog manganese, a soft earthy black oxide; and a small amount of rhodochrosite ($MnCO_3$), a pink, fairly soft mineral. Pyrolusite, the most common and most important, contains, when pure, 63 per cent manganese. It is much softer than the other hard rock ores and can be distinguished in the field by the ease with which it blackens the fingers. Most of the hard rock deposits are replacements in limestone, but they also occur in the form of accumulated nodules and cementing material in siliceous sediments, and as veins in metamorphosed precarboniferous rocks.

Most of the 200 deposits of manganese known in Canada are in the Maritime Provinces. They are mostly low-grade replacement or bog deposits, and a small amount of high quality ore has been mined in only a few localities.

Since the outbreak of the war much attention has been given to the development of known deposits, to the search for new sources of supply, and to the exploration of several old properties. Little high-grade ore remains in these old properties, though it is possible that a fair tonnage of medium-grade ore is available. No new deposits have been found, however, and attempts to operate some of the better grade old properties were discontinued after a few months' work. Production ceased in the fall of 1943, in which year a carlot was shipped from Jordan Mountain, north of Sussex, New Brunswick. From 1939 until the fall of 1943 there was a small production in New Brunswick also from Gowland Mountain near Elgin, southeast of Sussex; Turtle Creek, near Berryton, and at Quaco Head, near St. Martin on the south coast.

In Nova Scotia, the principal output came from New Ross, 45 miles west of Halifax, and there was a small output from East Mountain, east of Truro.

From 1886 to the end of 1943, a total of about 18,600 short tons of manganese ore was produced in Canada, close to half of it from 1887 to 1890 inclusive.

Approximately 45 per cent of the imports of manganese ore in 1944 totalling 79,906 short tons, valued at $2,213,396, came from India; about 40 per cent from the Gold Coast; and the remainder from Egypt, Chile, and the United States. This was an increase of 56 per cent over the tonnage imported in 1943. Consumption was 81,824 tons, a 36 per cent increase over that of 1943.

World production of manganese ore is between six and seven million tons annually, the leading producing countries being Russia, British India, Gold Coast, United States, Union of South Africa, Brazil, and Cuba.

It is estimated that over 90 per cent of the world consumption of manganese ore is used in the manufacture of iron and steel, the ore so used being termed "Metallurgical". The remainder is termed "Chemical". Metallurgical ore is used for making ferromanganese, silico-manganese, and spiegeleisen, in which forms it is added to the steel bath. Manganese is beneficial mainly in improving the workability of the steel and in improving the product by acting as a deoxidizer, a desulphurizer, and a re-carbonizer. About 13 pounds of manganese is used in each ton of steel. Ferromanganese, containing 75 to 82 per cent manganese and 5 to 7 per cent carbon, is by far the most important addition agent, and the highest "ferro" grade ore is used to make it. Such ore should contain at least 48 per cent of manganese and not more than 6 per cent iron, 10 per cent silica and alumina, and 0.18 per cent phosphorous; and the ratio of manganese to iron should not be less than seven to one. The ore should be hard and in lumps of less than 4 inches, and not more than 12 per cent should pass a 20-mesh screen. Soft ores, such as bog manganese, are objectionable unless they are briquetted. It takes about two tons of 48 per cent ore to make one ton of standard ferro.

The Canadian market for metallurgical ore is confined mainly to two manufacturers of manganese ferro-alloys; namely, Electro-Metallurgical Company, Welland, and Canadian Furnace, Limited, Port Colborne, both in Ontario.

Chemical grade ores are used mainly in the manufacture of dry batteries. Specifications call for high-grade pyrolusite because of its high available oxygen, which acts as a depolarizer. The ore should contain not less than 75 per cent manganese dioxide (MnO_2). Most of the ore is ground to 200 mesh, but some coarse ground ore of 8 to 12 mesh is also used. Canadian requirements of chemical ore range from 3,000 to 4,000 tons a year, most of it being ore from the Gold Coast. Nearly all of it is used by three manufacturers of dry batteries in Ontario, namely: Canadian National Carbon Company, Toronto; Burgess Battery Company, Niagara Falls; and General Dry Batteries of Canada, Limited, Toronto. Chemical ore is used also as colouring agents in the glass, ceramic, and paint industries; as pigments and dyeing materials; as salts in photography, fertilizers, disinfoctants, bleachers; and for other minor purposes.

Prices of ferro-grade ore depend upon the manganese content and the amount of harmful impurities. Imported ore is usually quoted in cents per long ton unit of 22.4 pounds of contained manganese. United States prices for metallurgical ores (based on a standard duty-free ore containing 48 per cent manganese and within the specifications outlined), are 85 cents per long unit of contained manganese at Gulf of Mexico ports, and 90 cents at New York and other Atlantic ports. The premiums and penalties for ores varying from the standard grade can be obtained from the Metals Controller, Ottawa. The prices paid in 1944 by the Government and Canadian consumers for approximately 48 per cent manganese ore were $46 for Indian ore at Welland and $37 per long ton for Gold Coast ore at Canadian ports.

The delivered prices of chemical grade (battery grade) manganese ores in Canadian currency for finely ground battery grade ore in bags imported into Canada from Africa or Montana, U.S.A., was $60 to $85 a short ton depending upon mesh and origin.

Known deposits of high-grade manganese ore 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 discovered during the operation of the Steep Rock iron deposits to warrant its recovery as a by-product.

Table 27 - PRODUCTION (SALES) OF MANGANESE ORE IN CANADA FOR YEARS SPECIFIED

Year	Tons	Value	Year	Tons	Value
		$			$
1915.............	201	9,360	1936	221	1,596
1916	957	89,544	1937	85	817
1917	158	14,836	1938	...	...
1918	440	6,230	1939	396	3,688
1924	584	4,088	1940	152	4,315
1925-1929	...	...	1941	(x)	(x)
1930	273	1,356	1942	435	8,932
1931	117	2,893	1943	48	985
1932-1934	...	...	1944	...	...
1935	100	800			

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

Table 28 - CONSUMPTION OF MANGANIFEROUS ORE AND MANGANESE COMPOUNDS IN SPECIFIED CANADIAN INDUSTRIES, 1942 and 1943

Industry	Items		Quantity	Value
				$
1 9 4 2				
Electrical apparatus and supplies	Manganese dioxide	pound	5,377,595	202,273
Paints, pigments and varnishes ..	Manganese naphthenate	pound	68,676	8,748
Steel ingots and castings	Ore, manganiferous (foreign) .	pound	64,000	1,600
	Spiegeleisen	short ton	2,911	153,054
	Ferromanganese	short ton	19,190	2,484,783
	Silicomanganese	short ton	8,065	918,774
White metal alloys	Manganese metal	pound	38,267	19,508
1 9 4 3				
Electrical apparatus and supplies	Manganese dioxide	pound	6,105,401	215,613
Paints, pigments and varnishes ..	Manganese naphthenate	pound	70,271	12,880
Steel ingots and castings	Ore, manganiferous (foreign) .	pound	...	...
	Spiegeleisen	short ton	367	31,474
	Ferromanganese	short ton	19,096	2,356,754
	Silicomanganese	short ton	9,568	1,094,239
White metal alloys	Manganese metal	pound	9,431	4,704

NOTE: In addition to the consumption recorded in the table above, a considerable quantity of manganiferous ore is employed in the manufacture of ferro-alloys.

MERCURY

(Bureau of Mines, Ottawa)

At the outbreak of the war the Allies were seriously deficient in mercury, as the bulk of world output came from Italy and Spain. Prices rose to nearly three times the pre-war level, but within two years, owing to the greatly increased production from the United States and from the Pinchi mine in British Columbia, supplies became sufficient to enable the export of mercury to the other Allied countries. Early in 1944 many of the activities in the United States and some in Canada were suspended as the supply was much greater than the demand, and prices declined. The Pinchi mine was closed down in July and at present (April, 1945) no mercury is being produced in Canada. Late in the summer, however, a complete reversal took place, mainly due to unforeseen requirements for a new application, and prices increased appreciably. Towards the close of the year, stocks in the United States were at their lowest level and some of the mines in that country were reopened.

Cinnabar (HgS), the principal ore of mercury, is a heavy (s.g.=8.1) mineral with a deep cochineal-red colour and scarlet streak, and contains 86 per cent mercury. In Canada, the ore occurs in porous rocks such as altered limestones (ankerite), volcanic breccias or greenstones, and green and purple andesitic lavas. The cinnabar often occurs in veins and stringers of calcite or dolomite within these rocks and may be associated with stibnite (antimony sulphide) and accompanied by globules of metallic mercury. The presence of mercury can be readily detected by heating a small piece of rock to about 300°C and placing it between an ultra-violet ray lamp with purple filter and a screen coated with powdered willemite (zinc silicate). If mercury is present a fume shadow will be cast on the screen. As little as 0.02 per cent mercury can be detected in this manner, but better results are achieved with a powdered sample.

The only known deposits of cinnabar in Canada are in British Columbia, by far the most important development being that on the northwest side of Pinchi Lake, Omineca mining division, about 40 miles north of Vanderhoof station on the Canadian National Railway. The ore-bodies are on a steep mountainside and consist of large cinnabar-bearing areas in veins and as imprégnations, mainly in dolomitized and brecciated limestone along zones of fracturing and shearing. The deposit was discovered in the summer of 1937 and was optioned late in 1938 to Consolidated Mining and Smelting Company. Production was started in June, 1940. The mine has been developed by a glory hole and by levels for 400 feet above the main 200-foot haulage level from which a 200-foot deep shaft was sunk early in 1944, giving a vertical distance of about 800 feet. Exploration and diamond drilling revealed ore all the way down to the bottom of the shaft, and at this depth the grade is better than the average (0.4 per cent mercury) of the milling ore. A number of cinnabar claims were staked and prospected in 1942 and 1943 along the so-called "Pinchi fault", which runs in a northwesterly direction for at least 100 miles from Pinchi Lake. Of chief importance is the Takla property, east of the headwater of Silver Creek, 85 miles northwest of the Pinchi mine.

During the period 1939 to 1943 some prospecting was also carried out and a few flasks were produced from deposits north of Kamloops Lake; from the Yalakom River, 30 miles northwest of Lillooet; from Relay Creek and 16 miles north of Minto City, both north of Bridge River. Part of the Empire Mercury Mines plant, north of Minto City, was removed to Copper Creek, Kamloops Lake, in the autumn of 1942, but apparently was not re-erected.

Canadian production in 1944 was 9,683 flasks (of 76 pounds each) valued at $1,210,375, as compared with 22,240 flasks valued at $4,559,200 in 1943. Since the outbreak of the war Canada has produced 54,641 flasks or about 2,076 tons.

Exports amounted to 4,682 flasks, a decrease of 70 per cent compared with 1943. They were valued at $959,810 and were shipped to India, United States, and Australia. Imports were 466 flasks valued at $44,182, and were nearly all from Mexico. Producers and consumers stocks at the end of the year were 8,315 flasks.

The plant at the Pinchi mine, consisting of wedge roasters, kilns, and condensers, is capable of treating about 1,200 tons of ore daily, but was treating only 400 tons daily before it was closed down in July because of the lack of a market and of an accumulation of stocks. The Pinchi mine was the largest single producer of mercury in the Western hemisphere, its output during its four years of operation being over 2,000 tons of refined mercury.

The Takla property was operated by Bralorne Mines, Limited, a production from the 100-ton plant was started in November, 1943. As the deposit is in comparatively flat country the mine is developed by shaft, mainly from the 100-foot level. Operations ceased in September, 1944, after the Metal Reserve Company (U.S.) cancelled the contract. Production during the period amounted to about 66 tons of mercury.

World production just prior to the war was estimated to be slightly in excess of 5,500 metric tons a year. For many years Italy and Spain have shared honours as the leading producer, and prior to the war they accounted jointly for 75 per cent of the world output, and the United States contributed about 11 per cent. The pre-war output from Russia, then the fourth largest producer, was about 300 metric tons a year. Production from Mexico in 1944 was reported to be about 900 tons. Czechoslovakia, China, Japan, Chile, and Peru are also producers of mercury. In the Union of South Africa, production was started at Monarch Kop in 1940 and its output has increased substantially each year since then. In 1944 it was nearly 1,200 flasks (45.3 tons).

Production in the United States in 1944 was about 37,500 flasks, compared with 51,929 in 1943, which was the highest since 1881. California contributed about 75 per cent of the output. The New Idria mine in San Benito county, California, continued to be the leading producing mine.

Canada uses about 3,000 flasks of mercury a year, about 75 per cent of it for medicinal and pharmaceutical purposes, and in heavy chemical industries. The consumption of mercury in Canadian gold mines, which is now about 7 per cent of the total, has decreased owing to wider use of cyanidation and to improvements in the recovery of the mercury after amalgamation.

In the United States the main cause for the recent marked increase in consumption was the large demand for mercury for use in the Ruben dry battery. This small cell, about 3/8-inch high, containing mercuric oxide and layers of zinc and paper in the form of a spiral, will last five times as long as the standard flash lamp battery. It is being used widely in all branches of the armed forces; in small portable radios (walkie-talkie), etc.; and large peacetime markets are forecast. Other uses for mercury are: as a catalyst or in the electrolytic preparation of chlorine, caustic soda, acetic acid, and acetone. In the past an appreciable amount of the metal was consumed as fulminate of mercury, a powerful detonator, but this has been replaced by other compounds such as lead azide, and only a small quantity of mercury is now used for a special type of detonator. Mercury is used in the manufacture of mercury salts, thermometers, medical supplies, mirrors, mercury vapour, and fluorescent lamps; in the manufacture of electrical and chemical apparatus; for automatic electrical contacts; in electric rectifiers; as cathodes in electrolytic chemical processes; in the manufacture of felt; in boiler compounds; in especially designed mercury boilers to replace steam in power production; in cosmetics; and for anti-fouling paint.

In the first quarter of 1944 the controlled United States price of mercury was $176 per flask, but by July the price had dropped to $96. It rose to $140 in December and to $170 in February, 1945. In 1938 the average price was $75.

Imports of mercury into Canada from the United States are not subject to duty, but are subject to a sales and war tax amounting to 18 per cent of the value in Canadian funds. The present price of Canadian mercury is largely governed by that of the United States. Canadian imports into the United States are subject to a tariff of 25 cents per pound, or $19 per flask in United States currency. Specifications call for a minimum of 99.5 per cent mercury and a maxima of 0.3 per cent antimony and 0.1 per cent arsenic.

Apart from direct war uses, it is possible that the demand for mercury will continue to rise, due to its new use in the manufacture of miniature dry batteries. In the event of an increased demand for this and other uses, Canada's output could be readily maintained at the record rate of 1943, when 22,240 flasks were produced, and, if necessary, this rate could be substantially increased.

Table 29 - PRODUCTION OF MERCURY IN CANADA

Year	Pounds	$	Year	Pounds	$
1895	5,396	2,343	1940	153,830	369,317
1896	4,408	1,940	1941	536,304	1,335,697
1897	684	324	1942	1,035,914	2,943,807
1924-1927 (x)	380	(x)	1943	1,690,240	4,559,200
1938	760	760	1944	735,908	1,210,375
1939	436	1,226			

(x) Data from a report issued by Bureau of Mines, Ottawa; value nor recorded.

Table 30 - CONSUMPTION OF MERCURY IN SPECIFIED CANADIAN INDUSTRIES, 1939-1943

	1939	1940	1941	1942	1943
			(Pounds)		
Medicinals and pharmaceuticals	20,473	30,246	67,607	78,362	79,786
Heavy chemicals (catalyst)	58,954	30,904	35,319	50,968	72,531
Electrical apparatus	2,161	1,899	25,738	42,313	28,786
Non-ferrous smelters	857	1,636	4,635	1,201	1,838
Petroleum refineries	359	328	920	684	372
Gold mines	6,313	6,000	11,091	10,000	...
Ammunition	...	4,630	8,217	...	...
Other industries	500	...	2,591	1,650	5,752
TOTAL ACCOUNTED FOR	89,617	75,643	156,118	185,178	109,279

MOLYBDENUM

(Bureau of Mines, Ottawa)

Molybdenum concentrates produced in Canada are shipped to Climax Molybdenum Company, Langeloth, Pennsylvania, for conversion into oxide or ferromolybdenum, and equivalent amounts of these products are shipped by that company to Railway and Power Company, Montreal, the distributor for Canada. The supply situation had improved to such an extent that in April, 1944, it was decided to discontinue operations at the Indian Molybdenum mine (Dome Mines, Limited) in Preissac township, Quebec, as the output from the LaCorne mine in LaCorne township, Quebec, would be sufficient to meet the Canadian requirements. In May, 1944, operations at the Quyon Molybdenite property near Quyon, Quebec, were also discontinued.

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 northern 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 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.

All of the production in 1944 came from the LaCorne and Indian Molybdenum mines in the Abitibi area and the Quyon Molybdenite mine near Quyon, Quebec, 35 miles northwest of Ottawa.

From the 187,130 tons of ore treated in 1944 by the three producers, about 1,097 tons of high-grade concentrate was produced and 1,064 tons of concentrate and molybdenum trioxide were shipped, the 561 tons of contained molybdenum being valued at $1,079,698. In 1943, 192 tons of contained molybdenum was shipped.

Wartime Metals Corporation took over the LaCorne property in July, 1942, and made arrangements for Siscoe Gold Mines, Limited, to operate the mine. Production at the enlarged mill was started in May, 1943, and by the end of December, 1944, nearly 150,000 tons of ore containing between 0.6 and 0.7 per cent MoS_2 had been treated, the average during 1944 being about 270 tons daily. The mine is producing over 30 tons of molybdenum (contained in high-grade concentrates) a month.

Indian Molybdenum's 600-ton mill entered production in September, 1943, and by April 30, 1944, when it was closed, it had treated a total of about 93,000 tons of ore.

Quyon Molybdenite Company treated about 150 tons of ore daily, which averaged 0.2 per cent MoS_2. The concentrate was converted to molybdic oxide in a small roasting plant on the property, and was then briquetted and shipped to steel manufacturers in Canada. During the last war this mine was the world's largest producer of molybdenum and it contributed nearly 80 per cent of Canada's output before 1939. The company was acquired by J. J. Gray, of Toronto, in May, 1944.

Prior to the war, 91 per cent of the world production, estimated at 16,500 tons of metallic molybdenum, came from the United States. Climax Molybdenum Company, Climax, Colorado, the world's largest producer, reduced its tonnage and is treating about 10,000 tons of ore daily containing about 0.5 per cent MoS_2. The company probably contributed about 60 per cent of United States total output of contained molybdenum in 1944. This total amounted to 19,267 tons, compared with 30,833 tons in 1943. Most of the remainder is obtained as a by-product of some of the large copper producers in Utah, New Mexico, and Arizona. Other producing countries are Norway, Mexico, Chile, Peru, French Morocco, Korea, Greece, Turkey, Yugoslavia, Australia, and recently Manchuria.

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.

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.

The Metals Controller's contract to purchase all domestic molybdenum products at a bonus price of not less than 85 cents a pound of contained sulphide in concentrate, f.o.b. Ottawa, was terminated on December 31, 1943, owing to changed conditions. New producers will have to sell in the open market at the normal price which is about 50 cents (Canadian funds).

The price a pound of contained molybdenum, f.o.b. Toronto, in Canadian funds, for the following imported compounds is approximately: Calcium molybdate (42 per cent Mo), 98 cents; ferromolybdenum (60 per cent Mo), $1.15; and molybdic oxide (52 per cent Mo), 98 cents. The calcium molybdate is sold in bags of about 12 1/2 pounds containing exactly 5 pounds of molybdenum. The molybdic oxide briquettes weigh 5 pounds each and contain 2 1/2 pounds of molybdenum.

Canadian ore and concentrate shipped to the United States is subject to a duty of 17 1/2 cents a pound of contained molybdenum.

Imports of calcium molybdate into Canada during 1944 totalled 3,960 pounds valued at $3,596. In 1944 the quantity of calcium molybdate and molybdenum oxide used in Canadian steel furnaces totalled 522 short tons valued at $813,861.

Table 31 - MOLYBDENITE MINING IN CANADA, 1942, 1943 and 1944

		1942	1943	1944
Active firms	No.	16	12	4
Capital	$	237,044	3,672,813	(x)
Employees -- On salary	No.	43	38	31
Wage-earners	No.	127	221	148
Total	No.	170	259	179
Salaries and wages -- Salaries	$	29,482	82,319	62,954
Wages	$	190,249	394,952	332,512
Total	$	219,731	477,271	395,466
Gross value of production	$	134,963	549,515	1,079,698
Fuel and electricity used	$	30,965	73,961	54,614
Process supplies used	$	21,124	81,072	103,774
Freight and treatment charges	$	34,243	3,249	72,681
Net value of production	$	48,631	391,219	848,629

(x) Data not recorded in 1944.

Table 32 - PRODUCTION OF MOLYBDENITE IN CANADA, 1902-1944

Year	Ores milled	Ores and concentrates shipped or used		Total MoS_2 content of shipments
	Tons	Tons	Value (a)	Pounds
			$	
1902	(c) 3	3.3	400	(b)
1903	(c) 600	85.0	1,275	(b)
1904-1913	...	...	...	...
1914	(c) 166	16.5	2,063	3,814
1915	216	39.0	28,920	29,210
1916	9,100	610.0	188,316	156,461
1917	22,605	1,554.3	320,006	330,316
1918	33,935	461.3	428,807	378,482
1919	6,783	46.0	69,203	83,002
1920-1923	...	...	...	...
1924	668	10.0	9,370	18,739
1925	2,779	15.3	11,176	22,350
1926	4,490	12.6	10,472	20,943
1927	...	...	...	...
1928	...	...	...	...
1929	2,900	9.5	6,400	16,150

Table 32 - PRODUCTION OF MOLYBDENITE IN CANADA, 1902-1944 (concluded)

Year	Ores milled	Ores and concentrates shipped or used		Total MoS_2 content of shipments
	Tons	Tons	Value (a)	Pounds
			$	
1930	...	...	...	...
1931	12	0.61	280	1,222
1932-1936	...	...	...	...
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

(a) Value as given by the operators 1902 to 1939; 1940-1944 value estimated using market or Government prices.
(b) Not known.
(c) Mines.

PITCHBLENDE - Pitchblende, the ore from which radium and uranium products are made, is mined in Canada only in the Great Bear district of the Northwest Territories.

A report prepared by the Bureau of Mines, Ottawa, states:

"Most of the world production of radium and uranium ores has come from the Belgian Congo, Canada, and the United States. The American material consists mainly of low-uranium carnotite, found mainly in Colorado and Utah, and now mined chiefly for its vanadium content, the present recovery of uranium and radium being small. Ores of the Belgian Congo are mainly a complex assemblage of secondary uranium minerals resulting from the weathering of original pitchblende. The remainder of the world production has come mostly from Czechoslovakia, Portugal, England, Australia, and Russia, but the deposits in most of these countries are small and low-grade and are of minor importance at present." (1941)

"E and M J Metal Markets", New York, quoted radium at $25 to $30 per Mg of radium content, depending on quantity; September, 1945.

SELENIUM

(Bureau of Mines, Ottawa)

Selenium is fairly widely distributed, but is not abundant in nature. It occurs in association with sulphur and frequently accompanies the sulphides of heavy metals in the form of selenides. In no case does it occur in quantity large enough to be mined for itself alone.

Commercial selenium is recovered in association with tellurium from the slime or residue produced in the refining of copper. In Canada it 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 in Canada 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 that at Montreal East 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.

Canadian production of selenium in 1944 was 298,592 pounds valued at $537,466, compared with 374,013 pounds valued at $654,523 in 1943. The maximum production of 495,365 pounds was reached in 1942. Quebec is the source of about 58 per cent of the total output of the metal, Ontario about 18 per cent, and Manitoba and Saskatchewan the remainder.

Exports of selenium and selenium salts in 1944 were 250,404 pounds valued at $445,768, compared with 211,530 pounds valued at $380,493 in 1943.

World production of selenium is believed to approximate 600 to 700 short tons a year, the United States and Canada being the principal sources of supply. Small quantities are produced by several countries, including Russia, Rhodesia, and Mexico.

A plant for the manufacture of selenium compounds was erected in 1944 at Montreal East by Canadian Copper Refiners, Limited.

Selenium is marketed as a black to steel-grey amorphous powder, but cakes and sticks are also obtainable. Among the other products marketed are ferro-selenium, sodium selenite, selenious acid, and selenium dioxide.

The greatest single development in the utilization of selenium since the commencement of war has been its use in electrical rectifiers that have 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. It is also being used to develop free machining qualities in stainless metal. Selenium is used as an ingredient of austenitic chromium steels. For this purpose it is supplied in bars of selenium-bearing stainless metal. The Battelle Institute has discovered that 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 August, 1938, the nominal price for selenium, black powdered, 99.5 per cent pure at New York has been $1.75 a pound. "Glass Industry" gives the following quotations for selenium salts in 1943: (1944 not available) barium selenite, $1.40 to $1.60 a pound, and sodium selenite, $1.50 to $1.65 a pound.

Table 33 - PRODUCTION OF SELENIUM IN CANADA, 1931-1944

Year	Pounds	$	Year	Pounds	$
1931 (x)	21,500	40,850	1938	358,929	622,742
1932	...	...	1939	150,771	266,714
1933	48,221	70,345	1940	179,860	343,533
1934	104,924	171,311	1941	406,930	777,236
1935	366,425	703,536	1942	495,369	951,108
1936	350,857	621,017	1943	374,013	654,523
1937	397,227	687,203	1944	298,592	537,466

(x) First commercial production in Canada.

Consumption of selenium in the manufacture of glass in Canada during 1943 was estimated at 1,687 pounds compared with 3,647 pounds in 1942.

General statistics on employment, etc., as relating to the production of both selenium and tellurium are included with those compiled for the Canadian non-ferrous smelting and refining industry.

TANTALITE-COLUMBITE - 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 $(Fe,Mn)(Ta,Cb)_2O_6$. 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, August, 1945 were, per pound Ta_2O_5, $2 to $3 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 occurs native and as an essential constituent of several minerals, none of which has been found in commercial quantities. Tellurium-bearing minerals also occur in minute quantities in association with other metallic ores, and the element may be recovered from residues in the refining of copper or lead, and also when sulphuric acid is manufactured from certain varieties of pyrites. The potential recovery and production of tellurium are great, but the demand remains small so that the quantity of refined metal produced is small. Ores containing tellurium occur in British Columbia, Saskatchewan, Manitoba, Ontario, and Quebec.

The electrolytic copper refineries operating in Canada have plants for the recovery of tellurium from their sludges, and for the production of the refined metal. 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 the anode copper of Noranda Mines, Limited, Noranda, Quebec, and the blister copper of Hudson Bay Mining and Smelting Company, Flin Flon, Manitoba. There has been no recovery in Canada from the sludge of sulphuric acid chambers.

Canadian production of tellurium in 1944 was 10,661 pounds valued at $18,657, compared with 8,600 pounds valued at $15,050 in 1943 and 11,084 pounds valued at $17,735 in 1942. Exports of tellurium are not recorded separately.

World production is estimated at 150 short tons a year, or about double the pre-war figure, and Canada and the United States appear to be the main sources of supply.

Metallic tellurium, until a few years ago, was of little industrial importance. Formerly it was used to a small extent in some radio work and also in the photographic arts and for blackening art-silverware. Small quantities are used as a colouring agent in the ceramic industry. When alloyed with lead, the tensile strength and toughness of the lead is 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. The use of small quantities of tellurium as a substitute for tin in the lead used for sheathing electric wire cables is reported to improve the resistance of the cables to heat and corrosion. It has also been used for improving the machining qualities of certain steels. Very finely powdered tellurium is used as rubber-compounding material. Its presence is stated to shorten the time of curing and to greatly improve the resisting qualities of the product. A new use for tellurium is as a carbon stabilizer in cast iron in which case it is used in the form of a ferrotellurium.

A nominal price for tellurium of $1.75 per pound at New York has prevailed since 1938 and throughout 1944. (Bureau of Mines, Ottawa)

Table 34 - PRODUCTION OF TELLURIUM IN CANADA, 1934-1944

Year	Pounds	$	Year	Pounds	$
1934 (x)	5,130	25,599	1940	3,491	5,607
1935	16,425	32,850	1941	11,453	18,394
1936	35,591	62,997	1942	11,084	17,735
1937	41,490	71,777	1943	8,600	15,050
1938	48,237	82,967	1944	10,661	18,657
1939	2,940	4,769			

(x) First commercial production in Canada.

Table 35 - CONSUMPTION OF TELLURIUM IN STEEL AND WHITE METAL FOUNDRIES, 1940-1943

Year	Steel Foundries	White Metal Foundries
	(Pounds)	
1940	400	629
1941	185	492
1942	50	612
1943	135	453

THALLIUM - Thallium was produced commercially for the first time in Canada in 1944. The output totalling 128 pounds valued at $1,690 represented the metal contained in residues, produced by the 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 $12.50 per pound, nominal, September, 1945. The element has an atomic weight of 204 and has been used in alloys and glassmaking.

TIN

(Bureau of Mines, Ottawa)

Tin is widely distributed, but in only a few countries are the deposits sufficiently large for commercial development. Cassiterite (SnO_2) is the only important ore of tin and in the pure state it contains 78.6 per cent of the metal. Stannite, a sulphide of copper, iron, and tin, has little importance as an ore.

In British Columbia the small cassiterite content of the silver-lead-zinc ore of the Sullivan mine at Kimberley now being recovered from the zinc tailing is the source of Canada's production of tin. Stannite is present in the ore of the Snowflake property near Revelstoke, and cassiterite and stannite have been noted at several other places in the province. Cassiterite occurs also in many other places in Canada, but no commercial deposits have been found. In the unglaciated parts of Yukon, stream tin has been found in small quantities, but no serious attempt seems to have been made to test the gravels thoroughly for tin. During the past few years it has become apparent that the gold-bearing placers in many creeks in the Mayo district contain some crystalline cassiterite. Some evidence has been gathered showing the likelihood of there being from 200 to 300 tons of tin available as cassiterite in the placers of Dublin Gulch and Haggart Creek. In August, 1943, a lode source of this tin was found on the north side of Dublin Gulch assaying from 3/4 to 1 1/2 per cent tin across an approximate width of 3 feet.

The tin concentration plant of Consolidated Mining and Smelting Company at Kimberley commenced operation on March 1, 1941, and has been functioning very satisfactorily. The plant for the production of refined tin also at Kimberley was brought into commercial operation in April, 1942. The tin content of the ore is small and the recovery is proportionately small.

Production of tin in 1944 was 516,626 pounds valued at $299,643, compared with 776,937 pounds valued at $450,623 in 1943. Imports of tin in the form of blocks, pigs, tin foil, and collapsible tubes in 1944 were valued at $2,178,118, compared with $1,766,334 in 1943.

The tin produced at Kimberley and the small domestic recovery of secondary tin are far from sufficient to meet the Canadian requirements, which in peacetime amounted to about 3,000 tons a year and are now much larger. These requirements were formerly obtained mostly from smelters in the Straits Settlements. The position of the Allied countries in respect to tin became critical with the capture by Japan of these smelters and of the Malayan tin mines, and the civilian use of the metal has been greatly curtailed. The search for commercial deposits of tin in Canada was continued and some occurrences of possible economic interest were found by a Geological Survey party in the Yellowknife area, Northwest Territories. Elsewhere, the results were not encouraging.

The world smelter production of tin in 1939 (data for war years incomplete) was 175,500 long tons.

Because of changing conditions and the wide range in the market value of the metal, no definite statement can be made as to what constitutes payable ore. Under wartime conditions, however, provided the deposit is reasonably large, it is worthy of attention even though the grade of the material is lower than would ordinarily be regarded as suitable for commercial development. Most tin ores are too low in grade to be treated directly and accordingly must be concentrated. Concentrates are in most cases purchased on a 60 per cent tin basis and for each unit or fraction above or below 60 per cent the returning charge is reduced or increased. They are subject to penalties if they contain more than one per cent sulphur and 5 per cent iron. Antimony, arsenic, bismuth, copper, lead, and other impurities are not penalized. Consolidated Mining and Smelting Company is prepared to treat tin concentrate at its new smelter at Kimberley to the limit of its relatively small capacity.

The only other tin smelter on the North American Continent is at Texas City, Texas. This Government-sponsored smelter was built by Tin Processing Corporation of New York and had originally a capacity of 50,000 long tons of concentrate or 18,000 long tons of tin a year. Built to treat the portion of Bolivian ores made available to the United States (50,000 long tons of concentrate), it was ready for operation in April, 1942. Subsequent enlargements raised the capacity of the smelter to 90,000 long tons a year. In 1944 it was producing at the rate of 30,000 long tons of metal a year. Following its entry into the war, the United States took over all the supplies of the metal in that country and specific allocation of tin was taken over by the Director of Priorities.

Tin is used chiefly in the manufacture of tin plate, mainly for use in the making of tin cans and of containers of all kinds. It is a necessary ingredient of solder and is a component part of most babbitt and other anti-friction metals, without which manufacturing and transportation would be impossible. Smaller quantities are used in foil, which in turn is used for wrapping food, tobacco, etc.; in terne-plate, pipe and tubing; type metal; bronze; galvanizing; and in bar tin.

The price of tin in New York was fixed in August, 1941, at 52 cents a pound and there has been no change since then.

Table 36 - PRODUCTION OF NEW TIN IN CANADA, 1941-1944

Year	Pounds	$
1941 (x)	64,744	33,667
1942	1,237,863	643,689
1943	776,937	450,623
1944	516,626	299,643

(x) First commercial production.

Table 37 - CONSUMPTION OF TIN IN CANADA BY INDUSTRIES, 1939-1943

	1939	1940	1941	1942	1943
			(short tons)		
Brass and bronze foundries	129	277	437	217	357
White metal foundries	1,640	2,087	3,141	1,530	1,106
Steel foundries (chiefly for tin plate) .	810	1,207	2,346	1,428	1,148
Iron foundries	52	84	224	49	88
Galvanizing plants	...	90	50	226	28
Jewellery and silverware plants	45	64	146	15	...
Electrical apparatus plants	34	43	56	6	42
Miscellaneous industries	77	16	36	30	10
TOTAL ACCOUNTED FOR	2,787	3,868	6,436	3,501	2,779

Production of secondary tin in Canadian plants in 1943 was estimated at 16,560 pounds compared with 64,511 pounds in 1942.

Table 38 - IMPORTS INTO CANADA AND EXPORTS OF TIN AND TIN PRODUCTS, 1943 and 1944

Item	1943		1944	
	Pounds	$	Pounds	$
IMPORTS				
Tin in blocks, pigs or bars	2,631,100	1,504,438	2,682,300	1,767,779
Tinfoil	829,394	106,174	1,625,265	217,978
Collapsible tubes	...	155,722	...	192,361
Tin bichloride and tin crystals	11,054	5,031	10,139	4,807
Oxide of tin and copper	142,986	30,274	168,462	38,954
Phosphor tin and phosphor bronze in blocks, bars, plates, etc.	708,624	321,408	735,419	361,916
Tin plate food containers	...	258,084	...	244,780
Tin plate containers, n.o.p.	...	84,721	...	116,370
Sheets, tin and lead coated	20,230,500	877,446	35,589,700	1,582,839
Manufactures of tin plate painted, etc., manufactures of tin, n.o.p.	...	498,633	...	426,833
Kitchen or dairy holloware of iron or steel coated with tin	...	82,892	...	75,757
Arseniate, biarseniate and stannate of soda	83,329	18,712	86,475	24,488
Tin plate scrap	2,354,000	21,285	...	...
Tin plate, n.o.p.	64,485,400	3,679,160	44,332,300	2,496,682
EXPORTS				
Tinware	...	10,236	...	66,500
Tin plate scrap	26,799,600	135,557	31,914,500	145,824

TITANIUM - All known occurrences of titanium in Canada of possible economic interest are in Quebec and Ontario. Ilmenite or titanic iron ($FeTiO_3$), in commercial quantities and containing from 18 to 25 per cent of titanium is found at St. Urbain in Charlevoix county, and at Ivry in Terrebonne county, Quebec. Rutile (TiO_2), which usually contains 54 to 59 per cent titanium, is found mixed with the ilmenite in parts of one of the St. Urbain occurrences and in sufficient quantities to make it of possible importance for the rutile alone, this being the only known workable deposit of rutile in Canada. Titaniferous magnetite (magnetite containing 3 to 15 per cent titanium) deposits occur on the Saguenay River, near Lake St. John, and at Bay of Seven Islands, both in Quebec, and on the shores of Seine Bay and Bad Vermilion Lake in Western Ontario.

The Canadian output of ilmenite is shipped annually from the St. Urbain deposits, part of it to Niagara Falls, New York, presumably for use in the manufacture of ferrotitanium, and part of it to plants of the General Electric Company in the United States. No shipments from the Ivry deposits have been reported for several years.

The production of titanium ore (ilmenite) in 1944 was 33,973 tons valued at $165,195, compared with 69,437 tons valued at $308,290 in 1943. Imports of titanium, which are in form of the oxide, are not recorded separately.

The world production of titanium ore is estimated at about 300,000 tons of ilmenite and 9,000 tons of rutile. India is the principal producer of ilmenite, the other important producers being Norway, Malaya, Portugal, Australia, United States, and Canada. The principal producers of rutile are Brazil, New South Wales (Australia), and the United States.

The United States became virtually self-sufficient in supplies of ilmenite with the completion of the plan to exploit the Adirondack titaniferous iron ores. This deposit, known as the MacIntyre Development, is at Newcomb, Essex county, in northeastern New York State. Development of the property was started in 1941 by the Titanium Division of the National Lead Company, and the property was put into production in August, 1948. The program of operations called for a daily mine output of 5,500 long tons of ore analysing 16 per cent TiO_2, from which were to be produced 800 long tons of ilmenite concentrate containing about 48 per cent TiO_2. Titanium ore is also produced in the United States in Arkansas, Carolina, Florida, and Virginia. The ilmenite concentrates shipped run from 42 to 54 per cent TiO_2, and rutile concentrates from 92 to 95 per cent TiO_2.

Commercial uses for titanium in recent years have continued to increase independently of the trend of general business. Ilmenite continues to be used chiefly in the manufacture of white pigment, and it is used to a smaller extent for making ferro-alloys. In metallurgy, titanium is not only an effective deoxidizer and cleansing agent, but also an alloying element. By addition of titanium, chrome-nickel steels are made more resistant to corrosion and chrome-molybdenum steels become easier to weld. In aluminium and sundry non-ferrous alloys, titanium refines the grain and otherwise contributes to better structure. A variety of carbontitanium alloys are now available. Titanium-treated rails are said to be superior to those treated with silicon. In other industries titanium compounds have many different uses. Rutile is used chiefly in welding-rod coatings, in steel manufacture, and in the ceramic industry.

The situation with respect to titanium dioxide pigments has remained unchanged during 1944. All of Canada's requirements were imported from the United States and the expanding demand continued to be met.

The New York quotation for ilmenite remained at $28 to $30 per gross ton of 60 per cent TiO_2 f.o.b. Atlantic seaboard. The price for rutile 94 per cent TiO_2 remained at 8 to 10 cents per pound of concentrate. The price of ferro-carbontitanium f.o.b. plant remained at $142.50 a ton, and metallic titanium at $5 to $5.50 a pound throughout 1944. (Bureau of Mines, Ottawa)

Table 39 - PRODUCTION OF TITANIUM ORE IN CANADA (x), 1927-1944

Year	Short ton	$	Year	Short ton	$
1927	2,029	8,980	1936	2,566	18,318
1928	2,244	6,732	1937	4,229	26,432
1929	2,748	7,359	1938	207	1,449
1930	412	1,239	1939	3,694	21,267
1931	1,509	10,261	1940	4,535	24,510
1932	...	...	1941	12,651	49,110
1933	...	...	1942	10,031	50,906
1934	2,023	14,161	1943	69,437	308,290
1935	2,288	16,400	1944	33,973	165,195

(x) All from Quebec.

Table 40 - CONSUMPTION OF TITANIUM PIGMENTS IN CANADIAN PAINT INDUSTRY, 1937-1943

Year	Reduced Titanium Pigments (x)		Titanium White	
	Pounds	Cost at works	Pounds	Cost at works
		$		$
1937	3,748,341	362,869	1,299,857	193,107
1938	3,903,337	378,548	1,341,359	200,552
1939	5,088,234	494,914	1,855,288	275,103
1940	6,138,760	616,360	2,297,248	344,945
1941	8,971,865	1,004,591	3,076,490	560,621
1942	7,034,376	578,894	4,168,097	820,990
1943	9,558,617	769,909	4,436,382	811,086

(x) Containing titanium oxide.

Table 41 - CONSUMPTION OF FERROTITANIUM IN MANUFACTURE OF STEEL IN CANADA, 1939-1943

Year	Tons	$
1939	118	23,498
1940	118	24,233
1941	181	52,128
1942	439	66,555
1943	614	118,416

TUNGSTEN

(Bureau of Mines, Ottawa)

The supply of tungsten, which was critically short during 1943, is now in excess of the demand. Consequently, the output of Canadian concentrates ceased at the end of 1943, but stocks at the mines were shipped during 1944. In the first quarter of 1945 consumption increased for a special war use, but by the end of April orders were cancelled, and at the present rate of consumption Canada has nearly two years' supply of tungsten. Resumption of mining operations thus appears unlikely, but if an urgent demand again arises, Canada's requirements can be adequately supplied from the Emerald property in southern British Columbia.

Wolframite, (Fe, Mn)WO_4, is the principal ore of tungsten; the next in importance being scheelite ($CaWO_4$), a calcium tungstate. The former is a dark brown to black, heavy mineral, which contains 76.4 per cent 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 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.

Intensive prospecting in 1941 and 1942 by means of the ultra-violet lamp revealed several hundred occurrences of scheelite distributed in every province except Alberta, the majority as well as the largest deposits being in British Columbia. All, except three or four, of the deposits are small and in many of them the scheelite is associated with gold ores and was recovered as a by-product of gold mining operations.

In Nova Scotia, the production came from the Indian Path mine near Lunenburg on the south coast, and from the Moose River property 35 miles northeast of Halifax.

The production from Quebec was hand-picked ore from a number of gold mining operations.

In Ontario, over 90 per cent of the output came from Hollinger Consolidated Gold Mines, Timmins, and most of the remainder came from Little Long Lac and Kerr Addison gold mines. Fairly massive scheelite occurs in the Hollinger mine in zones or bodies in quartz close to the porphyry, from the surface down to the 5,150-foot level.

In British Columbia, which was the leading producer of scheelite, the chief source of output was Consolidated Mining and Smelting Company's Red Rose mine, south of Hazelton. The remainder of the production came from the Emerald deposit, 6 miles southeast of Salmo in southern British Columbia, and from several producers in the Bridge River area. The Emerald ore is rather finely disseminated, usually in impure limestone with garnetite, and occurs in several contact metamorphic zones, mainly between granite and argillite.

In the Yukon, the output came from placer operations, and in the Northwest Territories it came mainly from Outpost Island in Great Slave Lake.

As noted, there was no production in 1944. Shipments consisted of concentrates on hand at mines and mills and comprised, in the main, the 1943 output from the Emerald property. The shipments amounted to 443.4 tons of high-grade and low-grade concentrates which contained 142.5 tons of WO_3 (114 tons of tungsten) valued at $245,780. They included 310 tons of low-grade concentrate (48 tons of WO_3) that was shipped to the United States for treatment.

Shipments in 1943 reached a record of 754 tons of concentrate (327 tons of tungsten) valued at $1,083,538, and from the start of the war to the end of 1944 they amounted to 1,510 tons of concentrate containing 742 tons of WO_3 (594 tons of tungsten) valued at $1,786,525. Most of this was 70 to 75 per cent WO_3 concentrate which was shipped to Atlas Steels, Limited, Welland, Ontario. The remainder consisted of low-grade (10 to 15 per cent WO_3) concentrate and was shipped to the United States for further treatment. All concentrates in stock at January 1, 1944, have now been shipped with the exception of about 33 tons of very low-grade material at the Val d'Or plant. Stocks at Welland and in storage at Niagara Falls at end of 1944 amounted to 515 tons of contained tungsten.

Consumption was about 232 tons of tungsten contained in scheelite and ferrotungsten, compared with 390 tons in 1943. No tungsten ore was imported in 1944.

In Nova Scotia, production of tungsten ore was discontinued late in 1942.

In Quebec, the output was shipped to the Val d'Or plant of the Quebec Department of Mines for treatment until November, 1943, when this service was discontinued.

In Ontario, the scheelite mill at the Hollinger mine entered production early in 1942 and was closed in September, 1943, during which period it produced about 275 tons of high-grade concentrate, which contained about 195 tons of WO_3. The ore averaged 0.37 per cent WO_3.

In British Columbia, production at the Red Rose property was started in January, 1942, and was discontinued in October, 1943, during which period 600 tons of high- (73.8 per cent) and low- (14 per cent) grade concentrates (344 tons of WO_3) were shipped, the average grade of the ore treated being 1.64 per cent WO_3).

The Emerald deposit was discovered early in 1942 and production from the 300-ton mill was started in July, 1943. The property, which was operated by a Crown company, was closed in October, 1943, as a result of the marked improvement in the tungsten situation. During the short period of operations high- (72 per cent) and low- (15 per cent) grade concentrates containing 137 tons of WO_3 were produced, the average grade of ore treated being 1.7 per cent WO_3. Estimates of reserves are 250,000 tons of 1.25 per cent WO_3 ore, apart from the ore in numerous minor bodies. The output from properties in the Bridge River area amounted to about 12 tons of WO_3.

The total output from the Yukon and the Northwest Territories amounted to about 21 tons of contained WO_3.

From 1939 to May, 1944, when shipments ceased, the Bureau of Mines, Ottawa, received about 210 tons of ore from about 60 producers across the Dominion for treatment. From this ore about 63 tons of concentrate which contained 40 tons of WO_3 was recovered and shipped.

Canada has no plants for the manufacture of ferrotungsten or other tungsten addition agents and the only company making tungsten steels is Atlas Steels, Welland, Ontario. Only scheelite is used by the company at present, and the high-grade (not less than 70 per cent WO_3) concentrate is added directly to the steel bath. This is possible because of the comparative ease with which the calcium forms a slag.

World production of tungsten ore and concentrate in 1939, on a basis of 60 per cent WO_3, was about 40,000 metric tons, and the principal producers were China, Burma, United States, Bolivia, Malaya, Spain, Portugal, Korea, Japanese-controlled areas in south China, Australia, Argentina, Brazil, and South Africa. China was the chief source of tungsten for 20 years prior to 1939, the record production being 16,257 metric tons of 60 per cent WO_3 in 1937. The ore mainly occurs as wolframite. Most of the mines in Kiangsi Province, where the largest deposits occur, are still under Chinese control. In Burma, the Mawchi tin-tungsten mine, 170 miles northeast of Rangoon, was the principal producer. Bolivia is the principal producer in South America. In Europe the most extensive tungsten deposits occur in Trasos-Montes in north-eastern Portugal.

In the United States, output in 1944 is estimated at 10,500 tons of 60 per cent WO_3, compared with the record of 12,045 tons in 1943. Most of the output came from Idaho, California, and Nevada. Approximately half the United States 1944 production came from the Bradley Mining Company's operations at Yellow Pine, near Stibnite, Idaho. The tungsten plant at Salt Lake City, operated by the U.S. Vanadium Corporation for the Metal Reserve Company, closed down in April, 1944. Most of the Canadian low-grade concentrate was shipped in the past to this plant for chemical treatment. Most of the ore mined in the United States is scheelite which occurs mainly in contact metamorphic deposits of tactite or skarn (garnet-epidote-diopside-calcite-quartz-complex) and is somewhat similar to the deposits in southern British Columbia.

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 are being used extensively in making armour plate, armour-piercing projectiles, and other military equipment. The use of tungsten in hard facing compounds is growing. 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, and accounts for about 2 per cent of the tungsten consumed. Tungsten carbide is widely used as an extra hard cutting tool and for projectiles. Pure tungsten is used in lamp filaments (about 1.5 per cent of the total tungsten consumption), in radio tubes, contact points, etc.

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 WO_3 for concentrate containing 70 per cent WO_3 (within specifications), delivered at Welland, Ontario. Since then the price has fluctuated downward and is unstable.

Table 42 - PRODUCTION (COMMERCIAL SHIPMENTS) OF CRUDE TUNGSTEN CONCENTRATES IN CANADA, 1912-1944

Year	Pounds	$	Average per cent WO_3
1912	28,000	(a)	72
1917	580	234	69.41
1918	27,000(c)	11,700	73.8
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

(a) Not recorded.
(b) Includes export of considerable low-grade material to U.S.A.
(c) Included 11 tons produced at Burnt Hill, N.B., with smaller shipments from Yukon, Nova Scotia and Manitoba.

Table 43 - TUNGSTEN CONSUMED IN SPECIFIED INDUSTRIES, 1938-1943

Year	Tungsten wire used in manufacture of Canadian electrical apparatus and supplies	Ferro-tungsten consumed in Canada in the manufacture of steel (x)		Tungsten metal consumed in Canada in the manufacture of steel and alloys (x)
	Value	Long tons	Value	Pounds
	$		$	
1938	50,594	30	69,806	...
1939	52,207	95	173,250	13,089
1940	62,175	336	829,859	15,474
1941	82,696	482	1,003,314	29,729
1942	129,265	577	1,440,141	36,882
1943	93,862	491	1,721,967	23,000

(x) Other than tungsten-chromium.

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. Vanadium was among the metals included in the inventory control provided by General Metals Order 1, May 1, 1941, issued by the United States Office of Production Management.

Data relating to possible imports of vanadium ores or vanadium compounds or alloys are not shown separately in Canadian trade reports. In 1943 there were 204 tons of ferrovanadium valued at $558,717 consumed in Canada in the manufacture of steel.

Vanadium ore was quoted September, 1945: 27 1/2 cents per pound contained V_2O_5, f.o.b. shipping point, by "E & M J Metal and Mineral Markets", New York.

ZIRCONIUM - The metal is not produced in Canada; zircon is the most common zirconium mineral and the Department of Mines and Resources, Ottawa, states that it, or cyrtolite, commonly occurs in greater or less amount in Canadian Precambrian pegmatites, also in the pegmatitic apatite-phlogopite deposits of the Grenville areas in Ontario and Quebec.

Zircon is used to a steadily growing extent in refractories, specialized porcelains and heat-resisting glass.

Zircon is recovered from the beach sands near Melbourne, Florida, by the Riz Mineral Company, as an accessory of titanium ore and from the gravels near Lincoln, California, as a by-product of gold dredging. Zirconium metal purifies, hardens, and strengthens steels and acts with aluminum to harden cupronickel. Metallic zirconium as powder or ductile metal is used in photoflash bulbs, radio tubes, ammunition primers and welding rods. In 1941 (January-September) there were 20,101 short tons of zirconium ore valued at $446,286 imported into the United States; of these 73 per cent came from Australia, 24 per cent from Brazil and 3 per cent from British India. Canadian consumption of ferrozirconium in the manufacture of steel totalled 51 short tons valued at $7,337 in 1943.

Zircon ore was quoted in September, 1945 by "E & M J Metal and Mineral Markets", New York: per ton f.o.b. Atlantic seaboard, minimum 55 per cent ZrO_2, $65 to $75 nominal. Zirconium alloy, 12 to 15 per cent Zr, 39 to 43 per cent Si, $102.50 to $107.50 per gross ton; 35 to 40 per cent Zr, 47 to 52 per cent Si, 14 to 16 cents per pound.

DIRECTORY OF FIRMS IN THE MISCELLANEOUS METAL MINING INDUSTRY IN CANADA, 1944

(x) Active but not producing.

Name of Firm and Product	Head Office Address	Location of Mine or Plant
Aluminum -		
Aluminum Company of Canada Limited	1700 Sun Life Bldg., Montreal, Que.	Arvida, Que. Shawinigan Falls, Que. La Tuque, Que. Isle Maligne, Que. Beauharnois, Que.
Antimony -		
Consolidated Mining & Smelting Company of Canada Ltd.	215 St. James St., Montreal, Que.	Trail, B.C.
Beryl -		
Canadian Beryllium Mines & Alloys Ltd. (x)	room 401 .. 100 Adelaide St. W., Toronto, Ont.	Renfrew Co., Ont.
Bismuth -		
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.
Cadmium -		
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.
Chromite -		
Chrome Association	342 Notre Dame St., Black Lake, Que.	Black Lake, Que.
Chromore Ltd.	399 Notre Dame St., Thetford Mines, Que.	Coleraine Twp., Que.
Chromite Ltd.	404 Notre Dame St. W., Montreal, Que.	Cleveland Twp., Que.
Metivier, Willis B.	Black Lake, Que.	Coleraine Twp., Que.
Paré, Orel	Black Lake, Que.	Coleraine Twp., Que.
Wartime Metals Corp. (Chromeraine Project)	637 Craig St. W., Montreal, Que.	Coleraine Twp., Que.
Iron Ore -		
Goyette, A. E. (x)	4295 St. Hubert St., Montreal, Que.	Arthabaska Co., Que.
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.
Titan Steel Corp.	80 St. Peter St., Quebec	Moisie Bay, Que.
Algoma Ore Properties Ltd.	Cornwall Bldg., Sault Ste. Marie, Ont.	Algoma dist., Ont.
Michipicoten Iron Mines Ltd. (x)	25 King St. W., Toronto, Ont.	Algoma dist., Ont.
Rebair Gold Mines Ltd. (x)	9 Adelaide St. E., Toronto, Ont.	Atikokan, Ont.
Sarpedon Iron Mines Ltd. (x)	1101 Federal Bldg., Toronto, Ont.	Rainy River dist., 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.
Indium -		
Consolidated Mining & Smelting Company of Canada Ltd.	215 St. James St., Montreal, Que.	Trail, B.C.
Lithium Ore -		
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.
Sherritt Gordon Mines Ltd. (x)	25 King St. W., Toronto, Ont.	Crowduck Bay, Man. East Braintree, Man.
Magnesium -		
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.

DIRECTORY OF FIRMS IN THE MISCELLANEOUS METAL MINING INDUSTRY IN CANADA, 1944 (Concl)

Name of Firm and Product	Head Office Address	Location of Mine or Plant
Mercury -		
Bralorne Mines Ltd.	555 Burrard St., Vancouver, B.C.	Omineca District, B.C.
Consolidated Mining & Smelting Company of Canada Ltd.	215 St. James St., Montreal, Que.	Pinchi Lake, B.C.
Molybdenite -		
Indian Molybdenum Ltd.	Bourlamaque, Que.	Preissac Twp., Que.
Quyon Molybdenite Co. Ltd.	Quyon, Que.	Quyon, Que.
Wartime Metals Corp. (LaCorne Project)	637 Craig St. W., Montreal, Que.	Abitibi Co., Que.
Selenium-Tellurium -		
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.
Thallium -		
Hudson Bay Mining & Smelting Co. Ltd.	500 Royal Bank Bldg., Winnipeg, Man.	Flin Flon, Man.
Tin -		
Consolidated Mining & Smelting Company of Canada Ltd.	215 St. James St., Montreal, Que.	Trail, B.C.
Titanium Ore -		
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.
Simack Ulmenite Co. Ltd.	c/o C. N. Knowles & Co., 360 St. James St. W., Montreal, Que.	Romaine River Dist. Que.
Tungsten Concentrates -		
B.C. War Metals Research Board (a)	University of British Columbia, Vancouver, B.C.	Vancouver, B.C.
Hollinger Cons. Gold Mines Ltd.	Timmins, Ont.	Timmins, Ont.
Wartime Metals Corp. (Emerald Tungsten Project)	637 Craig St. W., Montreal, Que.	Salmon, B.C.

(a) treated alluvial material from Yukon.