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TIN IN CANADA: OCCURRENCES AND USES

by

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INTRODUCTION

No economic deposits of tin have been found in Canada so far. Since 1941, a small output of tin, totalling 3,340 long tons including the 1951 output, has been recovered as a by-product in the treatment of the lead-zinc-silver ores of the Sullivan mine of The Consolidated Mining and Smelting Company of Canada Limited at Kimberley, British Columbia.

There are a limited number of widely distributed tin occurrences in Canada. Showings are found in Nova Scotia, Ontario, Manitoba, British Columbia, Yukon, and Northwest Territories, the most significant deposits being those in Yukon where tin is found in many of the placer gravels and where creeks and adjacent terrain provide an interesting field for more intensive exploration and prospecting. With the exception of some occurrences of stannite in British Columbia, tin occurs in Canada as the mineral cassiterite, SnO_2. In general, the cassiterite is found in pegmatite dykes, although in British Columbia it is found associated with other metallic minerals as in the Sullivan orebody.

Canadian consumption of tin has shown a marked increase since pre-war years, increasing from 2,600 long tons in 1939 to over 4,700 long tons in 1951. The expansion in the tinplate and tinning industry accounts for much of this increase. Tin finds its major uses in tin plating and in solders and Babbitt alloys.

NOVA SCOTIA

Tin was found at Tangier in 1868 in a sand composed of quartz and decomposed feldspar. Similar finds, all connected with drift material, have been reported from several other localities.

Cassiterite was discovered in 1906 in the New Ross area and considerable exploratory work has been carried out on the various showings.

The occurrences described below have been found in close proximity to the contact of the muscovite granite with the biotite granite or quartzites of the Goldenville formation.

Turner Tin Prospect[1]

This occurrence is about three miles from New Ross, Lunenburg county, at Mill Road, between Camp and Harris Lakes. The tin-bearing veins are found in a valley through which runs a tributary of the Gold River. Outcrops are plentiful in the vicinity of the stream, but to the north and south there is considerable drift.

The tin occurs in veins of greisen and quartz cutting muscovite granite. This light-coloured granite, with which the cassiterite-bearing pegmatite veins are associated, cuts a coarser-grained biotite granite.

The veins consist of a zone of granite which has been altered by hot solutions and gases to a dark green aggregate of quartz, chlorite, and white mica, and is cut by veins of quartz carrying small quantities of chalcopyrite, pyrite, fluorite, cassiterite, hematite, malachite, bornite, and several other minerals.

Four main veins, known as the Discovery, Elephant, Turner, and Elvan are listed. The principal development has been done on the Discovery vein on the north side of the mill stream. This has been open-cut for 210 feet. A vertical shaft, known as the No. 2 shaft, is reported sunk to a depth of 55 feet. Another vertical shaft, No. 1, 130 feet north of No. 2, is reported as being 35 feet deep. A pit exposes the vein 60 feet north of No. 1 shaft. No drifting was ever carried out.

During 1939 and 1940 sampling over the full length of the vein gave the following results:

No.	Location	Tin Per Cent		
		(a)	(b)	(c)
1.	Between No. 1 and No. 2 shafts	0.15	0.20	0.36
2.	Between No. 2 shaft and mill stream	.020	0.10	0.025
3.	Vein quartz at No. 2 shaft	0.10	--	--
4.	Dump at No. 2 shaft	0.15	--	--

(a) Prof. G. Vibert Douglas. (b) C. O. Campbell. (c) J.S. Scott.

The Elephant vein is on the south side of the mill stream and No. 3 vertical shaft is reported as 25 feet deep near the edge of the stream. An open cut extends for 40 feet on the vein. This vein consists of two and one-half feet of greisen with considerable quartz and a channel sample gave 0.08 per cent tin.

The Turner vein is more pegmatitic than the two veins already mentioned. A 65-foot trench exposes three feet of greisen and quartz striking 166° magnetic. A channel sample of this vein gave 0.08 per cent tin.

The Elvan vein is 10 feet wide and is exposed in three places, on both banks of the mill stream and at a pit 240 feet north of the bridge. This vein differs from the other three in that it is a quartz porphyry. Tiny veinlets, carrying cassiterite, fluorite, etc., cut through the porphyry. A channel sample across this vein gave 0.08 per cent tin.

Diamond drilling on these veins has been limited to two holes.

Mitchell Property (Lake Wallaback Tin Prospect)(1)

This occurrence is about four miles north of New Ross on the southeast bank of Grassy Brook which flows into the southern end of Lake Wallaback.

A small vertical shaft, about 15 or 20 feet deep, is sunk 175 feet from the south bank of the brook about one-quarter of a mile from where it enters Lake Wallaback. The pegmatite strikes 169° magnetic and dips east at 85°. One hundred and fifty feet southeast of this shaft, another pegmatite dyke, about six feet wide, is exposed by a small trench. Following down the bank of the brook, pegmatitic material is exposed for 200 feet over a width of 25 feet. Cassiterite not only occurs in the pegmatite, but also forms tiny veinlets running through the greisenized granite which flanks the pegmatitic material. A sample of greisenized granite taken from the dump beside the shaft gave 1.1 per cent tin.

Lake Ramsay(1)

An occurrence of tin is reported from an outcrop at the southern end of Lake Ramsay, about two and one-half miles west of New Ross.

ONTARIO

Tin-bearing pegmatites occur north of Gogama in the Sudbury Mining Division and cassiterite mineralization occurs east of Linklater Lakes in the District of Thunder Bay.

Tin has also been reported associated with the platinum metals of the Vermillion mine, Denison township, Algoma district. The occurrence is of purely mineralogical interest.

Redore Mining Company Limited(2)

A group of claims centering around the boundaries of Wigle, Middleboro, Whalen, and Carter townships in the Sudbury Mining Division, 16 miles north of Gogama on the Canadian National Railway, contains numerous tin-bearing pegmatites. The dykes which vary in width from 100 to 400 feet have been traced for a distance of one and three-quarter miles. In 1940, the property was owned by the Redore Mining Company Limited which carried out a certain amount of surface exploration.

From samples taken from the pegmatites, analyses as high as 2.5 per cent tin, 17.5 per cent beryllium oxide, and 2.4 per cent tantalum-columbium oxide are reported. There is no record of any systematic sampling of the deposit to indicate its economic possibilities.

Linklater Lake(3)

A deposit of tin near the east end of Linklater Lake, 20 miles northeast of Armstrong on the Canadian National Railway in the District of Thunder Bay, was examined by San Antonio Gold Mines Limited in 1948.

The cassiterite mineralization is found in narrow, discontinuous, felsite dykes occurring in a zone 1,500 feet long by 50 feet wide. This zone was subjected to stripping and trenching operations. A series of 18 intermittent cross-trenches, up to 50 feet in length, were made and channel sampling was carried out across the dykes carrying visible cassiterite mineralization. The best channel sample was 1.83 per cent tin across a width of six inches. The overall results did not indicate sufficient tin to make commercial operation of the deposit possible. E.O. Chisholm states that the deposit has many of the characteristics of other tin deposits in the world which occur at or near the contact of acidic granite rocks. Careful prospecting along the whole zone of the granite-sediments contact and southwards to the greenstone might disclose other deposits more favourable to economic development.

MANITOBA

Occurrences of tin in Manitoba are found in several widely separated localities.(4) One of these is found on the shore of Red Sucker Lake in Island Lake Mining Division, while in the southeastern part of the province there are a number of showings.

Red Sucker Lake(5)

This property comprises 18 claims on the north shore of Red Sucker Lake midway between God's Lake and Island Lake in Island Lake Mining Division. It is accessible by tractor road to God's Lake and thence to Ilford on the Hudson Bay Railway.

Cassiterite is found in narrow banks in dykes of albite aplite. The mineralization is typical of pegmatitic deposits. In 1943, God's Lake Gold Mines Limited (N.P.L.) took on option on the property and carried out extensive drilling of the tin occurrences and prospected the surrounding area. The results, however, did not indicate tin in sufficient amount to warrant commercial development.

Rush Lake Property[6]

The mining claims of this property lie near the centre of a belt of sediments and lavas, in the Rush Lake area in the Lac du Bonnet Mining Division. The greater number of claims are overlain by altered sediments with their bedding planes striking approximately east and west and dipping steeply to the south. The sediments have been intruded by numerous pegmatite dykes, which vary in width from a few feet to around 80 feet. Numerous local concentrations of cassiterite are found within these intrusions.

During 1942, Dr. J.D. Bateman, of the Geological Survey of Canada, carried out an intensive exploration on the Odd claim of this group, about one mile north of Rush Lake in township 17, Range 16E. There are several cassiterite occurrences on this and associated claims. With the exception of a cassiterite-bearing aplite dyke, the cassiterite is in pegmatites, which in this district are noted for the erratic distribution of any contained valuable minerals. The work, undertaken by the Department of Mines and Resources, was confined to the tin-bearing aplite dyke and consisted of channel-sampling the exposed length of the dyke for 320 feet and carrying out 2,200 feet of diamond drilling.

The results of sampling indicated that the length of 320 feet contains 0.35 per cent tin over a width of 4.7 feet. This gives approximately 125 tons of tin-bearing material per vertical foot.

The nine diamond drill holes put down indicated that the depth of tin-bearing material did not extend to more than 100 feet. This would yield approximately 12,500 tons of dyke rock carring some 40 tons of tin.

Crocodile Claim

This occurrence which is in Township 17, Range 16E is not of economic interest. Assays of samples taken across the upper and lower tin-bearing dykes gave 0.08 and 0.15 per cent tin respectively.

Shatford-Bernic Lakes Deposits[7]

Tin was first discovered in 1924 in an outcrop of pegmatite on Tin Island, a small island in Shatford Lake. The rocks of the area are made up largely of altered volcanics intruded by granite and numerous pegmatite dykes. Cassiterite occurs in a few of the pegmatites either in coarse, or fine-grained phases that form pockets either irregularly distributed throughout the whole body or confined to the hanging-wall side of flat-dipping bodies. Sampling of these tin-bearing pegmatites has not revealed any deposits of economic importance.

BRITISH COLUMBIA

The known occurrences of tin in British Columbia are found associated with base metal deposits and in this respect differ from the pegmatitic deposits of Manitoba. The two most significant occurrences are those of the Snowflake group and the Sullivan Mine.

The Snowflake Group[8]

This property lies on the east fork of Silver Creek, six miles north of Albert Canyon on the Canadian Pacific Railway in the Revelstoke Mining Division. The veins are quartz-filled fissures conforming to the stratification of the enclosing carbonaceous slates striking northwest and dipping 40° to 60° northeast. The ore minerals are galena, zinc-blende, stannite, scheelite, wolframite and a little chalcopyrite. The property was first opened up in 1922 and has been subsequently developed by adit tunnels and cross-cutting. In 1929 discoveries in the lower levels revealed the presence of stannite (sulphostannite of copper, iron and zinc). The Snowflake Mining Company Limited operated the property as a silver-lead-zinc mine up to the end of 1930, when all work was discontinued. During the early years of the war considerable interest was aroused in the property owing to the tin and tungsten present in the Snowflake vein. Investigation of the vein indicated that the Snowflake-Regal upper shoot contains about 10,000 tons of one per cent tin ore as stannite. Drilling by the Federal Government in 1942 did not verify the extension of this tin-bearing vein into the adjoining Regal Silver property. The occurrence is not considered as an important source of tin.

Sullivan Mine

The lead-zinc ore of the Sullivan Mine of The Consolidated Mining and Smelting Company of Canada Limited, Kimberley, contains an extremely small amount of tin-bearing mineral. About 90 per cent of this tin-bearing mineral is in the form of cassiterite, the

balance being tin sulphides. The cassiterite occurs in very small crystals having a maximum size of about 75 microns. The first indication of the presence of tin was noted shortly after the commencement of operations at the Sullivan concentrator. The use of a pilot table was employed to provide a visual control of the various stages of flotation, including the final tailing. A fine streak of a whitish mineral on the concentrate zone of the table was identified as cassiterite. The discovery was considered primarily of academic interest only, but from time to time the possibilities of recovering the tin were investigated. When the situation in the Far East in 1940 began to threaten supplies of tin from Malaya and the Netherlands East Indies, serious consideration was given to recovery of tin from the Sullivan ore. On March 1, 1941, a concentration plant commenced operation and eleven months later the production of refined tin by electric smelting was begun.

The essential features of the concentration are given below. The tailing from the zinc flotation, amounting to from 6,000 to 6,200 tons of solids per day, is pumped to a 33-foot by 7.5-foot Dorr hydroseparator. The zinc tailings contain about 40 per cent iron, principally in the form of pyrrhotite and 1.2 pounds of tin per ton. The purpose of the hydroseparator is to provide a flotation feed of suitable density and to eliminate slimes from the circuit. The underflow from the hydroseparator, about 5,600 tons, is treated by flotation to remove the bulk of the iron sulphides. These iron concentrates amount to around 3,000 tons daily and have a grade of 50 per cent iron.

The flotation tailings, carrying about 0.2 per cent cassiterite, are subjected to a series of gravity treatments. They first pass over specially designed five-deck, automatic-discharge, rubber-mat blanket tables. These are arranged in two series, a rougher and a cleaner. The cleaner tailings are returned to the rougher blankets, while the cleaner concentrates pass to the primary Wilfley tables. The primary table tailings are passed over a 65-mesh screen, the overflow being returned to the rougher blankets and the underflow to the cleaner blankets. The middlings are treated in a specially designed magnetic separator to remove magnetic iron, and the non-magnetics pass to the retreatment tables. The tailings and middlings from the retreatment tables are pumped back to the primary tables. The concentrates from both the primary and retreatment tables are further magnetically cleaned and passed through a unit flotation cell to remove any final trace of sulphides. The final cassiterite concentrate has a grade of from 66 to 68 per cent tin and about 3 per cent iron. The overall recoveries are from 45 to 50 per cent with a ratio of concentration of over 2,000 to 1.

The cassiterite concentrate is dried, and then smelted in a three-phase, 400-kilowatt, five-ton capacity electric furnace. Smelter capacity is about 1,350 tons per year. About three to four months' operation is sufficient to handle a year's production of tin concentrates.

The metal has a purity of 99.20 to 99.70 per cent tin. An average analysis in 1942 was as follows:

Tin	99.20 to 99.70 per cent
Copper	.005
Lead	.260 to .70
Zinc	.005
Iron	.006
Aluminum	.005
Manganese	.005
Bismuth	.002
Cobalt	.004
Antimony	.010

YUKON AND NORTHWEST TERRITORIES[9]

Tin has been reported from a number of placer gravels in Yukon. The auriferous gravels of Bonanza and Hunker Creeks of the Klondike river occassionally yield irregularly shaped pebbles of cassiterite. More recently, cassiterite was reported in the gravels of numerous creeks in the Mayo District where it occurs as finely crystalline pebbles associated with tourmaline, quartz, and chlorite. Frequently, small grains of cassiterite are found in the sluice boxes of the gold placer operations. These pebbles and grains have been found in Dublin Gulch and in Haggart, Arizona and Clear creeks and are reported from a number of other streams in the area. In Dublin Gulch cobbles weighing several pounds, composed mainly of cassiterite and containing angular fragments of quartzite, have been found. This suggests that their source is a vein cutting the quartzite in the upper part of the gulch. A vein disclosing cassiterite crystals and cutting the granodiorite was located. Spectrographic analyses of numerous granite samples from outcrops in the area have indicated the presence of tin.

These occurrences of tin in the creek gravels are by no means localised, but cover a wide area. They lie in a region extending roughly northwesterly from longitude 131° and latitude 63° to longitude 138° and latitude 64° . Although this region is

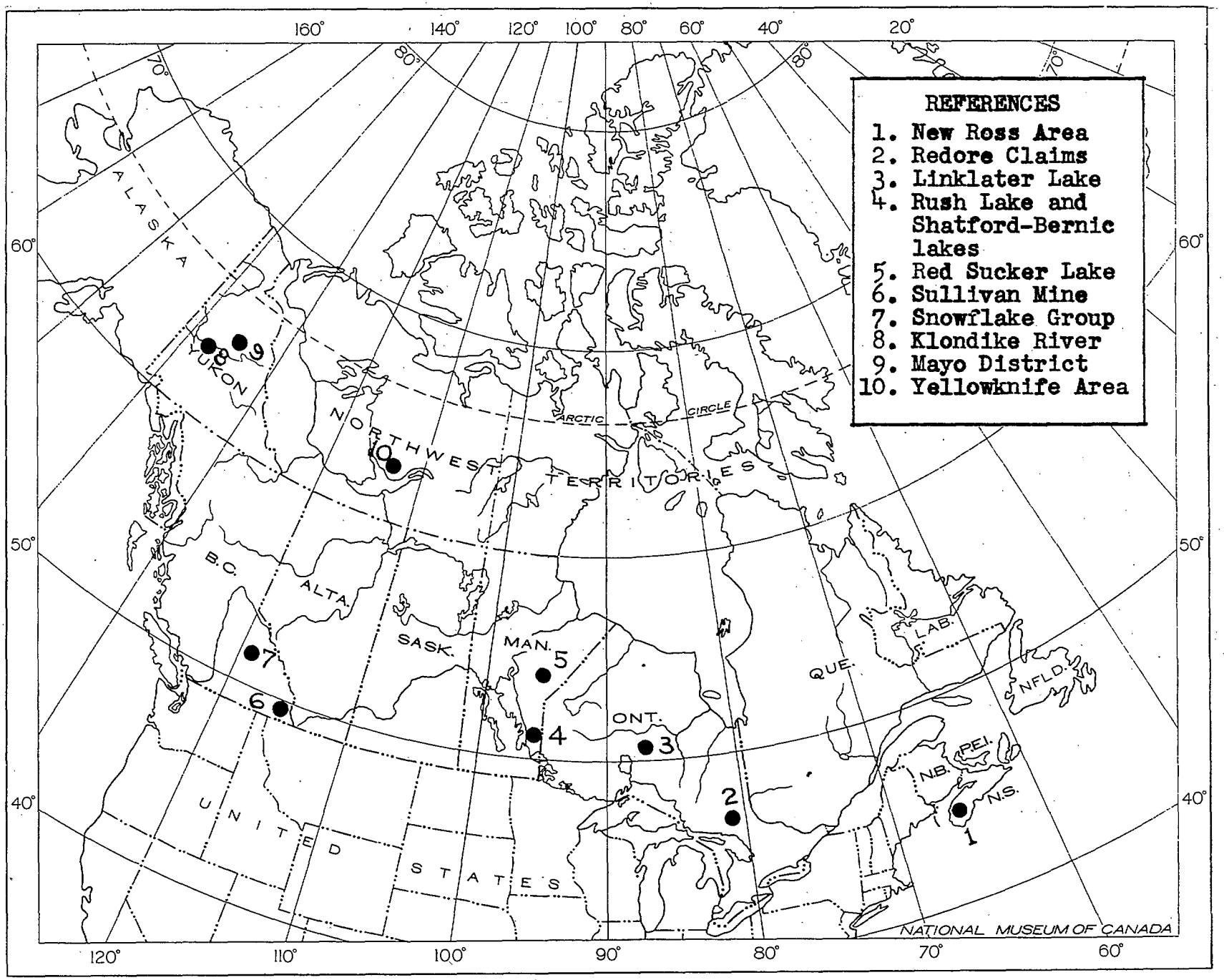
a continuation of the tin-bearing gravels of the Klondike, there is a decided difference in the appearance of the cassiterite. That of the Klondike is composed largely of well-rounded polished pebbles very sparsely dispersed in the gravel, while the cassiterite of the Mayo district resembles coagulated brown sugar and is usually rusted and a dirty brown in colour. The percentage of cassiterite in the creek gravels of the Mayo district is appreciably greater.

The occurrences of tin so far reported from the Northwest Territories are found in pegmatite deposits, but none are considered as economic sources of tin. The cassiterite is associated with tantalum, columbium, lithium, and beryllium minerals.

Cassiterite is found in the pegmatite dyke of the Peg Tantalum claims, one mile east of Ross Lake, in the Thompson Lake district, 75 miles northeast of Yellowknife.

Another occurrence is reported in the pegmatites of the Bore Group, Sproul Lake area, some 35 miles from Yellowknife.

Cassiterite is also found in pegmatite sills in the Buddy and Tan claims, Blatchford Lake area, 67 miles from Yellowknife.



TIN OCCURRENCES IN CANADA

CONSUMPTION AND USES

Tin occupies a significant position of importance in the world economy. In comparison with such metals as copper, lead, and zinc, the amount of tin used is relatively small. But its use in bearing metals alone makes it an essential factor in keeping the wheels of industry and transportation running smoothly. The food canning industry owes its phenomenal growth and development to the protective coating properties of tin.

The use of tin is almost always directly proportional to industrial growth. The continued expansion in Canada's manufacturing trade since the war is reflected in the increased use of tin, especially in such items as solders, babbitts, and tinplate. Although aluminum has replaced tin to a considerable extent in the manufacture of foil and collapsible tubes, the amount used in these items was relatively small; the decrease in the use of tin in these industries being more than counter-balanced by an increased demand in other uses of the metal.

TABLE 1*

Production, Trade, and Consumption

	Production		Imports		Consumption
Year	long tons	$	long tons	$	long tons
1939	--	--	2,601	2,833,089	2,600
1946	390	507,028	3,751	5,977,344	3,707
1947	319	517,794	3,961	6,677,436	3,628
1948	309	688,567	3,598	7,898,335	4,046
1949	276	633,047	3,676	7,861,709	4,318
1950	356	828,259	4,817	10,337,330	4,526
1951	154	493,050	6,135	19,576,828	4,731

* Dominion Bureau of Statistics, Ottawa.

TABLE 2*

Canadian Tin Consumption by Classes (long tons)

Year	Tin Plate and Tinning	Solder	Babbitt	Brass and Bronze	Foil and Collapsible Tubes	Miscellaneous	Total
1939	--	--	--	--	--	--	2,600**
1946	2,070	910	307	332	59	29	3,707
1947	2,096	941	211	274	53	45	3,628
1948	2,181	1,241	220	281	45	78	4,046
1949	2,823	966	247	195	31	56	4,318
1950	2,440	1,427	317	159	41	142	4,526
1951	2,678	1,203	421	310	32	87	4,731

* Dominion Bureau of Statistics, Ottawa.
** Apparent consumption.

TABLE 3*

Tin Plate in Canada (long tons)

Year	Production	Imports	Tin Used**
1946	131,779	43,495	2,070
1947	135,219	62,594	2,096
1948	140,226	43,604	2,181
1949	161,539	23,027	2,823
1950	211,636	1,487	2,440
1951	246,140	1,531	2,678

* International Tin Study Group, The Hague.
** Includes a small amount used in tinning.

Canada has become self-sufficient in tinplate. Production has risen from 19,000 long tons in 1937 to 246,140 tons in 1951, an output which has placed Canada in third place among the world producers of tinplate, the United States and the United Kingdom being first and second, respectively.

Two electrolytic tinplate plants were installed in Canada during 1948 and 1949. Electrolytic tinplate is made with a much lighter coating of tin than the hot-dipped plate, thus effecting an appreciable saving in tin. The use of this tinplate for food cans

is restricted at present to certain food packs, but advances in the development of protective lacquers is gradually extending the markets for electrolytic plate. In 1951 almost 47 per cent of the tinplate produced in Canada was electrolytic. It is of interest to note that in spite of the high proportion of electrolytic tinplate produced in 1951 the total tin used in both types of plate was 9.2 per cent greater than in the previous year.

The greater part of Canadian tin imports comes from Malaya, the tin from this source accounting for about 57 per cent of the tin imported during the past five years. The remainder comes from the tin smelters of the United States, the United Kingdom, Belgium, and the Netherlands. Tin is not mined in these countries, except for a very small production in the United Kingdom. The principal sources of the tin smelted in Europe and the United States are Bolivia, Nigeria, Belgian Congo, and Indonesia. These four countries, with Malaya and Thailand, account for over 90 per cent of the world's production of tin which in 1951 totalled 164,500 long tons; of this Malaya produced 57,167.

The smelter production of tin is confined largely to Malaya, the United States, the United Kingdom, and the Netherlands. Of a total production in 1951 of 166,000 long tons of tin metal, the above countries produced 65,914, 30,921, 27,650, and 20,977 long tons respectively. The balance is produced from a number of small smelters located in fifteen or more different countries.

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