Tin

By J. W. Pennington [1] and John B. Umhau [2]

THE PREDOMINANT factor in the world tin situation in 1957 was the International Tin Agreement. Actions sponsored by the Tin Council under the agreement included export controls restricting the flow of tin; the removal of 15,300 long tons of tin buffer stock from the market to regulate supply and demand; steps to maintain a floor price for tin at £730 per ton (91.25 cents a pound); and authorization to sell from the buffer stock at £780 per ton (97.50 cents a pound) to prevent excessive rise in prices.

Other outstanding features were the cessation of domestic tin smelting under Government sponsorship and the sale of the Longhorn tin smelter at Texas City, Tex., to Wah Chang Corp.

In the United States, despite declining tin consumption, tinplate production rose to a new peak and aluminum cans were introduced.

Elsewhere, the British and Canadian Governments announced plans to sell 5,500 long tons of tin from their stockpiles; shipments of Soviet tin entered European markets; and Australia began producing tinplate.

TABLE 1.—Salient statistics of tin in the United States, 1948–52 (average) and 1953–57

	1948–52 (average)	1953	1954	1955	1956	1957
United States:						
Production:						
From domestic mines [1] long tons	70.78	56.0	204.68	99.24	----------	----------
From domestic smelters [2] do	32,062	37,562	27,407	22,329	17,631	1,564
From secondary sources do	28,071	27,600	26,190	28,340	29,440	24,260
Imports for consumption:						
Metal do	60,211	74,570	65,599	64,815	62,590	56,183
Ore (tin content) do	31,575	35,973	22,140	20,112	16,688	94
Exports (domestic and foreign) do	587	203	822	1,107	[3] 890	1,531
Consumption:						
Primary do	56,085	53,959	54,427	59,828	60,470	54,429
Secondary do	30,764	31,681	28,464	30,655	29,854	28,078
Monthly price of Straits tin at New York:						
Highest cents per pound	135.00	121.50	101.00	110.00	113.75	103.00
Lowest do	90.33	78.25	84.25	85.75	92.88	87.13
Average do	108.57	95.77	91.81	94.73	101.26	96.17
World:						
Mine production long tons	173,800	189,700	189,400	190,700	192,300	191,500
Smelter production do	177,500	193,200	196,700	191,700	193,000	185,900

[1] Includes Alaska.
[2] Includes tin content of alloys made directly from ores.
[3] Revised figure.

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LEGISLATION AND GOVERNMENT PROGRAMS

The Export Control Act of 1949, extended to June 30, 1958, governed shipments of tin by destinations. Exports were under general license to the Free World.

The foreign assets control regulations of the United States Treasury Department prohibited the entry of Chinese tin. Tin of U. S. S. R. origin could enter the United States but required a permit (none was issued) on the presumption it might be of Chinese origin. Entrance of alloys that might include Chinese and/or Soviet tin also was prohibited.

A Defense Minerals Exploration Administration (DMEA) tin exploration contract with Keenan Properties, Lawrence County, S. Dak., for $48,931 (Government participation, 90 percent) continued in force. The contract had been made in 1951. Government participation in DMEA contracts for tin was reduced from 90 percent to 50 percent, effective October 22.

The real and personal property of the United States Tin Corp. was offered to the highest bidder at the United States Marshal's sale held at the mine office October 30, 1957. The sale was to satisfy a judgment in favor of the United States of America. No acceptable bid was submitted; therefore, the Government took possession of the property.

H. R. 2394, introduced January 10, would authorize a Federal purchase program for tin. The bill set a base price of $1.35 per pound for tin in concentrate from lode mines and $1.20 per pound for tin in concentrate from placer mines. Purchase was to be limited to 10,000 long tons of tin in concentrate or to receipts in a 10-year period, whichever was completed sooner; this concentrate was to have been produced in the United States, its Territories, or possessions.

DOMESTIC PRODUCTION

MINE OUTPUT

No tin ore or concentrate of marketable grade was produced in the United States in 1957. A small quantity of tin concentrate recovered from treating molybdenum ore during 1956 and 1957 was unsold.

A report was published[3] on the tin-producing potential of the placer deposits in the Tofty area of the Hot Springs district, Central Alaska.

SMELTER OUTPUT

Domestic tin-smelter production was 1,564 long tons, compared with 17,631 tons in 1956. The entire output came from the Government-owned Longhorn smelter at Texas City, Tex. Production comprised 948 tons of Three Star grade, 449 tons of Two Star grade B, and 167 tons of Two Star grade C. In addition, 14 tons of Three Star (remelts) was recast, the remnants of lots produced before January 1957, and previously shown in the statistics. Production of tin at the smelter, which began in 1942 under Government sponsorship, ceased January 31, 1957. The plant was sold to Wah Chang Corp., which took title and possession February 15, 1957. Wah Chang Corp. rehabilitated much of the plant and storage area, reducing tin-producing facilities and sub-leasing some buildings to

[3] Thomas, Bruce I., Tin-Bearing Placer Deposits Near Tofty, Hot Springs District, Central Alaska: Bureau of Mines Rept. of Investigations 5373, 1957, 56 pp.

other industries. During Government ownership the smelter had been managed by the Tin Processing Corp., a Delaware corporation, and a subsidiary of N. V. Billiton Maatshappij.

According to the 1958 Federal budget:[4]

Public Law 608, approved June 22, 1956, provided for operation of the tin smelter until January 31, 1957. It also authorizes and directs the Corporation (Federal Facilities Corp.) to take steps immediately to sell or lease the tin-producing facilities. Should no contract of sale or lease be affected by January 31, 1957, the tin smelter will be reported as excess property for transfer and disposal in accordance with the provisions of the Federal Property and Administration Services Act of 1949.

A report to the Congress on the liquidation of the Reconstruction Finance Corp. contains the following:[5]

After exhaustive negotiations, an agreement for the sale of the smelter was signed on January 3, 1957, with the Wah Chang Corp. The sale price was $1,350,000 with a 10-percent cash downpayment and the balance in annual installments over a period of 10 years. The purchaser also agreed to make additional payments up to $2 million contingent upon the volume of tin metal, tin alloys, and tungsten produced.

Effective June 30, 1957, responsibility for liquidating the remnants of the Government's tin program passed from the Secretary of the Treasury to the Administrator of General Services in accord with the provisions of Executive Order 10720 (July 11, 1957). At that time, the remaining assets of the tin program consisted primarily of $1,215,000 due on the purchase-money mortgage taken in the sale of the smelter.

TABLE 2.—Longhorn-tin smelter production 1942–57, in long tons

Year	Long tons	Year	Long tons
1942	15,696	1950	32,136
1943	20,727	1951	30,934
1944	30,619	1952	22,592
1945	40,591	1953	37,562
1946	43,468	1954	27,002
1947	33,292	1955	22,329
1948	36,678	1956	17,631
1949	36,053	1957	1,564

SECONDARY TIN[6]

Domestic recovery of secondary tin in 1957 decreased about 18 percent in quantity and 22 percent in value from 1956. Of the total tin recovered, copper-base scrap furnished 43 percent; lead base, 33 percent; tin-base, 10 percent; and tinplate scrap, the remainder. Only 15 percent was recovered as unalloyed tin, reclaimed mostly at detinning plants.

Treatment of tinplate clippings at detinning plants increased for the fifth successive year to a new high. Material treated totaled 649,000 long tons, compared with the previous peak of 630,000 tons in 1956. The average quantity of tin recovered per long ton of tinplate scrap treated was 11.45 pounds in 1957 against 11.93 pounds in 1956. The lower recovery (for the 11th consecutive year) continued to reflect treatment of a larger proportion of electrolytic tinplate carrying a thinner coating of tin.

[4] Bureau of the Budget, The Budget of the United States Government for the Fiscal Year Ending June 30, 1958: Jan. 16, 1957, p. 919.
[5] Department of the Treasury, Report to the Congress-Liquidation of Reconstruction Finance Corporation: Dec. 10, 1957, p. 13.
[6] The assistance of Archie J. McDermid and Edith E. den Hartog is acknowledged.

TABLE 3.—Secondary tin recovered in the United States, 1948–52 (average) and 1953–57, in long tons

Year	Tin recovered at detinning plants			Tin recovered from all sources			
	As metal	In chemicals	Total	As metal	In alloys and chemicals	Total	
						Long tons	Value
1948–52 (average)	2,974	410	3,384	3,209	24,862	28,071	$68,628,020
1953	2,650	450	3,100	2,850	24,750	27,600	59,212,676
1954	2,660	530	3,190	2,930	23,260	26,190	53,863,091
1955	2,580	620	3,200	2,970	25,370	28,340	60,140,288
1956	2,700	690	3,390	3,260	26,180	29,440	66,776,900
1957	2,840	500	3,340	3,540	20,720	24,260	52,266,470

TABLE 4.—Tin recovered from scrap processed in the United States, by kind of scrap and form of recovery, 1956–57, in long tons

Kind of scrap	1956	1957	Form of recovery	1956	1957
New scrap:			As metal:		
Tinplate	3,350	3,310	At detinning plants	2,975	3,100
Tin-base	1,630	1,260	At other plants	285	440
Lead-base	4,130	2,800			
Copper-base	2,700	2,150			
Total	11,810	9,520	Total	3,260	3,540
Old scrap:					
Tin cans	40	30	In solder	6,260	5,170
Tin-base	1,590	1,110	In tin babbitt	625	280
Lead-base	6,340	5,200	In chemical compounds	745	560
Copper-base	9,660	8,400	In lead-base alloys	4,870	3,480
			In brass and bronze	13,680	11,230
Total	17,630	14,740	Total	26,180	20,720
Grand total	29,440	24,260	Grand total	29,440	24,260

TABLE 5.—Secondary tin recovered from scrap processed at detinning plants in the United States, 1956–57

	1956	1957
Scrap treated:		
Clean tinplate clippings, long tons	629,097	648,343
Old tin-coated containers, do.	6,045	4,056
Total, do.	635,142	652,399
Tin recovered:		
From new tinplate clippings, do.	3,350	3,310
From old tin-coated containers, do.	40	30
Total, do.	3,390	3,340
Form of recovery:		
As metal, do.	2,700	2,840
In compounds, do.	690	500
Total [1], do.	3,390	3,340
Weight of tin compounds produced, do.	1,125	1,020
Average quantity of tin recovered per long ton of clean tinplate scrap used, pounds	11.93	11.45
Average quantity of tin recovered per long ton of old tin-coated containers used, pounds	15.47	15.50
Average delivered cost of clean tinplate scrap, per long ton	$44.20	$39.20
Average delivered cost of old tin-coated containers, do.	$44.37	$42.41

[1] Recovery from tinplate clippings and old containers only. In addition, detinners recovered 325 tons from these sources in 1956, and 315 tons of tin as metal and in compounds from tin-base scrap and residues in 1957.

TABLE 6.—Stocks and consumption of new and old tin scrap in the United States in 1957, gross weight in long tons

Class of consumer and type of scrap	Stocks, beginning of year [1]	Receipts	Consumption			Stocks, end of year
			New scrap	Old scrap	Total	
Smelters and refiners:						
Block-tin pipe, scrap, and foil	20	532	----	529	529	23
No. 1 pewter	19	57	----	53	53	23
High-tin babbitt	63	709	----	629	629	143
Drosses and residues	478	1,986	2,009	----	2,009	455
Total	580	3,284	2,009	1,211	3,220	644
Foundries and other manufacturers:						
Block-tin pipe, scrap, and foil	2	20	----	13	13	9
High-tin babbitt	1	3	----	3	3	1
Drosses and residues	1	----	----	----	----	1
Total	4	23	----	16	16	11
Grand total:						
Block-tin pipe, scrap, and foil	22	552	----	542	542	32
No. 1 pewter	19	57	----	53	53	23
High-tin babbitt	64	712	----	632	632	144
Drosses and residues	479	1,986	2,009	----	2,009	456
Total	584	3,307	2,009	1,227	3,236	655

[1] Revised figures.

CONSUMPTION BY USES

Total tin consumption in the United States declined 9 percent in 1957. Five items—tinplate, solder, bronze and brass, babbitt, and tinning—supplied 91 percent of the tin used in 1957, virtually unchanged from 1956 and 1955. Consumption of tin in tinplate (the leading use of primary, which took almost 60 percent of the annual totals for 1952–57) dropped 2,700 tons from 1956. Consumption increased 9 percent for electrolytic but decreased 36 percent for hot-dipped. In 1957, 74 percent of the tin used to make tinplate was for electrolytic and 26 percent for hot-dipped; use of solder ranked second, consuming 1,680 tons less; bronze, the largest use of secondary tin, decreased 2,285 tons; babbitt declined 285 tons, mainly in primary tin; and the quantity used in tinning was 430 tons smaller. Tin used for white metal (highest since 1941) advanced 7 percent; the tonnage going into britannia metal increased the most.

Tinplate production reached an alltime high of 5.7 million short tons. Of the total output, electrolytic furnished 87 percent compared with 81 percent in 1956, and the hot-dipped type only 13 percent compared with 19 percent in 1956. Hot-dipped-tinplate production was the smallest since 1909.

The United States, the leading producer and consumer of tinplate, required about 50 percent of the world consumption of tin for tinplate. Of the nearly 90 percent of tinplate consumed in making cans, about 60 percent was used for food packing and 40 percent for nonfood products. During 1957 one company began processing tinplate directly from coils weighing up to 7½ tons in can plants.

The manufacture of aluminum cans for motor oil, grated cheese, and meat began in 1957. It was stated in the 1957 annual report of the Continental Can Co., Inc., however, that aluminum was not

TABLE 7.—Consumption of primary and secondary tin in the United States, 1948–52 (average) and 1953–57, in long tons

	1948–52 (average)	1953	1954	1955	1956	1957
Stocks on hand Jan. 1 [1]	26,011	23,105	24,525	23,326	27,757	28,446
Net receipts during year:						
Primary	57,370	57,969	52,673	64,544	62,099	59,215
Secondary	2,918	2,582	2,351	2,191	2,185	2,868
Terne	673	604	[2] 226			
Scrap	28,952	29,754	28,601	30,262	28,999	26,758
Total receipts	89,913	90,909	83,851	96,997	93,283	88,841
Available	115,924	114,014	108,376	120,323	121,040	117,287
Stocks on hand Dec. 31 [1]	25,483	24,525	23,326	27,757	28,446	32,030
Total processed during year	90,441	89,489	85,050	92,566	92,594	85,257
Intercompany transactions in scrap	2,399	2,566	2,159	2,083	2,270	2,750
Tin consumed in manufactured products	[3] 88,042	[3] 86,923	82,891	90,483	90,324	82,507
Primary	56,085	53,959	54,427	59,828	60,470	54,429
Secondary	30,764	31,681	28,464	30,655	29,854	28,078

[1] Stocks shown exclude tin in transit or in other warehouses on Jan. 1, as follows: 1953, 525 tons; 1954, 240 tons; 1955, 1,340 tons; 1956, 2,005 tons; 1957, 1,815 tons; and 1958, 1,310 tons.
[2] January–June only, earlier reported as tin content of terne metal consumed in terneplate manufacturing. Beginning July 1954 reported as tin consumed in making terne metal.
[3] Includes tin losses in manufacturing.

considered a substitute for tinplate, but rather a means of extending the metal-container line of products.

The Tin Industry (Research and Development) Board of Malaya has announced [7] the availability of a special fund of M$500,000 (U. S. $166,666) for use to refute publicity in favor of tin-less cans.

Receipts of tin for industrial consumption totaled 88,840 long tons (5 percent less than 1956), of which 67 percent was primary tin, unchanged from 1956 and 1955. "Straits" brand comprised 70 percent of the primary receipts in 1957 and 1956.

TABLE 8.—Tin content of tinplate produced in the United States, 1948–52 (average) and 1953–57

Year	Total tinplate (all forms)			Tinplate (hot-dipped)			Tinplate (electrolytic)			Tinplate waste-waste, strips, cobbles, etc.		
	Gross weight (short tons)	Tin content (long tons)[1]	Tin per short ton of plate (pounds)	Gross weight (short tons)	Tin content (long tons)	Tin per short ton of plate (pounds)	Gross weight (short tons)	Tin content (long tons)	Tin per short ton of plate (pounds)	Gross weight (short tons)	Tin content (long tons)	Tin per short ton of plate (pounds)
1948–52 (average)	4,277,244	30,868	16.2	1,641,312	19,263	26.3	2,437,551	10,412	9.6	198,381	1,192	13.6
1953	5,067,010	31,327	13.9	1,375,606	14,807	24.1	3,331,386	14,605	9.8	360,018	1,915	11.9
1954	5,017,227	33,026	14.7	1,339,611	15,906	26.6	3,526,982	16,115	10.2	[2] 150,634	[3] 1,005	------
1955	5,422,444	33,549	13.9	1,062,850	13,395	28.2	4,002,068	20,154	11.3	357,526	------	------
1956	5,689,061	34,761	13.7	1,006,196	13,041	29.0	4,305,774	21,720	11.3	377,091	------	------
1957	5,715,384	32,046	12.6	686,616	8,370	27.3	4,593,587	23,676	11.6	435,181	------	------

[1] Includes small tonnage of secondary pig tin and tin acquired in chemicals.
[2] Not reported during January-June 1954; figures shown are for period July-December only.
[3] For period January-June only; thereafter not separately reported but included in above figures on tinplate.

[7] Tin (London), August 1957, p. 177.

TABLE 9.—Consumption of tin in the United States, 1955–57, by finished products, in long tons of contained tin

Product	1955			1956			1957		
	Primary	Secondary [1]	Total	Primary	Secondary [1]	Total	Primary	Secondary [1]	Total
Tinplate	[2] 33,549		[2] 33,549	[2] 34,761		[2] 34,761	[2] 32,046		[2] 32,046
Terne metal	149	174	323	175	114	289	181	181	362
Solder	12,063	10,167	22,230	10,555	10,027	20,582	8,987	9,917	18,904
Babbitt	2,611	1,760	4,371	2,615	2,141	4,756	2,440	2,031	4,471
Bronze and brass	4,204	15,508	19,712	4,815	14,627	19,442	4,274	12,883	17,157
Collapsible tubes and foil	845	78	923	928	50	978	765	53	818
Tinning	2,568	45	2,613	2,525	52	2,577	2,091	53	2,144
Pipe and tubing	82	74	156	129	26	155	100	24	124
Type metal	175	1,312	1,487	164	1,347	1,511	85	1,464	1,549
Bar tin	1,439	140	1,579	1,317	115	1,432	1,070	162	1,232
Miscellaneous alloys	254	232	486	288	162	450	271	145	416
White metal	1,088	91	1,179	1,304	141	1,445	1,400	140	1,540
Chemicals including tin oxide	645	1,047	1,692	779	1,012	1,791	594	966	1,560
Miscellaneous	156	27	183	115	40	155	125	59	184
Total	59,828	30,655	90,483	60,470	29,854	90,324	54,429	28,078	82,507

[1] Includes 2,765 long tons of tin contained in imported tin-base alloys in 1955; 2,167 in 1956; and 3,100 in 1957.
[2] Includes small tonnage of secondary pig tin and tin acquired in chemicals.

TABLE 10.—Tinplate shipments by market classifications, 1948–52 (average) and 1953–57, in thousand short tons

American Iron and Steel Institute Annual Report on Shipments of Steel Products, by Market Classifications, AISI 16]

Market classifications	1948–52 (average)	1953	1954	1955	1956	1957
Sanitary cans:						
Hot dip	1,100	798	716	500	425	301
Electrolytic	1,125	1,446	1,530	1,978	2,070	2,070
Total	2,225	2,244	2,246	2,478	2,495	2,371
General-line cans:						
Hot dip	162	82	118	82	78	48
Electrolytic	851	1,280	1,424	1,606	1,691	1,773
Total	1,013	1,362	1,542	1,688	1,769	1,821
Closure-crown caps and others:						
Hot dip	17	12	6	8	4	3
Electrolytic	242	297	298	326	301	273
Total	259	309	304	334	305	276
Total cans and closures	3,497	3,915	4,092	4,500	4,569	4,468
Other uses:						
Hot dip	85	105	80	81	77	58
Electrolytic	91	137	164	251	237	230
Total	176	242	244	332	314	288
Export:						
Hot dip	390	321	387	430	366	240
Electrolytic	156	183	265	342	316	330
Total	546	504	652	772	682	570
Total:						
Hot dip	1,754	1,318	1,307	1,101	950	650
Electrolytic	2,465	3,343	3,681	4,503	4,615	4,676
Grand total	4,219	4,661	4,988	5,604	5,565	5,326

TABLE 11.—Consumer receipts of primary tin, by brands, 1948–52 (average) and 1953–57, in long tons

Year	Banka	English	Katanga	Longhorn	Straits	Others	Total
1948–52 (average)	3,604	(1)	5,605	15,580	24,978	7,603	57,370
1953	1,731	6,798	2,826	927	42,886	2,801	57,969
1954	1,216	4,727	5,112	255	38,784	2,579	52,673
1955	3,268	3,873	6,744	30	47,844	2,785	64,544
1956	7,190	3,373	6,341	----------	43,468	1,727	62,099
1957	6,897	3,726	3,154	----------	41,460	3,978	59,215

[1] Included with "Others," not separately reported.

STOCKS

Tinplate mills, holding nearly 85 percent of plant stocks of pig tin in the United States, increased inventories 4,390 long tons. Tin in process at tin mills on December 31, 1957, was the highest quantity recorded. At the end of the year, pig-tin stocks at other industrial plants declined to the lowest point recorded.

Tin was among the materials on which all Government stockpile objectives were reached.[8]

TABLE 12.—Industry tin stocks in the United States, Dec. 31, 1953–57, in long tons

	1953	1954	1955	1956	1957
At plants:					
Pig tin—virgin	13,680	12,162	16,205	16,290	20,126
In process [1]	10,845	11,164	11,552	12,156	11,904
Total	24,525	23,326	27,757	28,446	32,030
Other pig tin:					
In transit in United States	240	1,340	2,005	1,815	1,310
Jobbers-Importers	260	1,200	260	620	660
Afloat to United States	2,700	5,200	5,340	5,500	1,735
Total	3,200	7,740	7,605	7,935	3,705
Grand total industry	27,725	31,066	35,362	36,381	35,735

[1] Includes secondary pig tin (long tons) as follows: 1953, 326; 1954, 277; 1955, 246; 1956, 304; and 1957, 327.

PRICES

Tin prices in 1957 were sustained by purchase of excess tin supplies for the international buffer stock. Following a steady decline from the 1956 high of 113.75 cents on November 1, 1956, the highest price quoted in 1957 was $1.03 on January 31. The price moved steadily downward thereafter to 87.125 cents on November 22 and 25, 1957, the low for the year.

On the London market the cash price averaged £754.8 per long ton in 1957, compared with £787.7 in 1956. The highest price on the London Metal Exchange was £804 on January 23 and the lowest £730 on October 9, where it held virtually the rest of 1957 by buffer stock buying. The 3-months price which averaged £747.5 in 1957 (£774.4 in 1956) dropped from the high of £778.5 on March 25 to the low of £680.5 on November 22. A new feature of the London Metal Ex-

[8] Office of Defense Mobilization, Stockpile Report to the Congress, July to December 1957: Pp. 4–5.

change was selling Soviet tin in the United Kingdom and on the Continent.

On the Singapore market the monthly price of Straits tin ex-works was £731.5 for 1957, compared with £760.2 for 1956. The highest price for the year was £765.3 on March 26 and the lowest, £636, on November 25.

TABLE 13.—Monthly prices of Straits tin for prompt delivery in New York, 1956–57, in cents per pound [1]

Month	1956			1957		
	High	Low	Average	High	Low	Average
January	109.000	100.750	104.82	103.000	99.250	101.35
February	105.250	98.625	100.53	102.500	97.875	100.22
March	102.125	98.500	100.57	101.875	98.250	99.48
April	100.375	98.000	99.17	100.250	98.375	99.30
May	98.000	93.750	96.88	99.125	97.750	98.32
June	95.375	93.625	94.48	98.500	97.125	98.02
July	100.250	92.875	96.16	97.875	95.625	96.46
August	100.000	98.250	98.96	95.375	92.875	94.15
September	107.375	100.125	103.57	93.875	92.750	93.31
October	112.250	102.500	105.72	93.125	90.625	91.84
November	113.750	108.125	110.26	91.000	87.125	89.23
December	110.000	99.875	104.01	93.375	90.375	92.32
Total	113.750	92.875	101.26	103.000	87.125	96.17

[1] Compiled from quotations published in the American Metal Market.

FOREIGN TRADE [9]

The principal tin items in the foreign trade of the United States in 1957 were imports of metallic tin and 94-percent tin alloys and exports of tinplate and tin cans. Of less importance was the trade in tin scrap, including tin-alloy scrap, tinplate scrap, tinplate circles, cobbles, strip, scroll, etc. Significant quantities of tin ingot, miscellaneous tin manufactures, and tin compounds were exported. Tin contained in babbitt, solder, type metal, and bronze imported and exported is shown in the Lead and Copper chapters of this volume.

Imports of metallic tin declined in 1957 for the fifth successive year and fell 10 percent below 1956. This was the longest period of continuous downtrend recorded in metallic tin imports. Of the total imports, about 70 percent came from Malaya, the principal source; however, the quantity of tin received from Malaya was the smallest since 1951. The tin imported from Indonesia shown in table 16 is believed to have been smelted in the Netherlands.

Receipts of tin contained in concentrates were only 94 tons in 1957, the smallest since 1934. As there was no tin smelting in the United States after January, the concentrate was imported for other contained metals.

In addition, 4,800 long tons of alloys, with the chief value in tin was imported, mainly from Denmark in 94-percent tin alloys.

Exports of metallic tin (including ores and concentrates) in 1957 were 1,530 long tons (890 in 1956); Canada and the United Kingdom were the principal destinations. The gross weight of tin-alloy scrap

[9] Figures on imports and exports compiled by Mae B. Price and Elsie D. Jackson, Division of Foreign Activities, Bureau of Mines, from records of the U. S. Department of Commerce, Bureau of the Census.

exported (mostly to the United Kingdom) was 9,400 long tons in 1957, compared with 4,300 tons in 1956.

The principal tin-export item of the United States, as usual, was tinplate. Tinplate exports declined 4 percent in tonnage and only slightly in value, compared with 1956. Tinplate was exported to South America, Europe, Asia, North America, Africa, and Oceania,

TABLE 14.—Foreign trade of the United States in tin concentrate and tin, 1948–52 (average) and 1953–57

[Bureau of the Census]

Year	Imports				Exports			
	Concentrate (tin content)		Bars, blocks, pigs, grain, or granulated		Ingots, pigs, bars, etc.			
					Domestic		Foreign	
	Long tons	Value	Long tons	Value	Long tons	Value	Long tons	Value
1948–52 (average)	31,575	$69,051,733	60,211	$136,028,522	201	$455,665	386	$1,070,292
1953	35,973	82,713,269	74,570	175,950,269	128	297,695	75	141,901
1954	22,140	41,724,776	65,599	133,185,565	271	467,029	551	1,125,003
1955	20,112	[1] 36,773,366	64,815	131,605,569	254	503,892	853	1,748,367
1956	16,688	32,316,702	62,590	136,412,171	[2] 439	[2] 820,578	451	1,018,417
1957	94	118,416	56,183	121,310,541	1,112	1,526,091	419	919,162

[1] Owing to changes in tabulating procedures by the Bureau of the Census, data known to be not comparable with other years.
[2] Revised figure.

TABLE 15.—Tin concentrate (tin content) imported for consumption in the United States, 1956–57, by countries

[Bureau of the Census]

Country	1956		1957	
	Long tons	Value	Long tons	Value
North America:				
Canada	221	$430,898		
Mexico	156	205,975	9	$11,921
Total	377	636,873	9	11,921
South America:				
Argentina			[1]	384
Bolivia	8,533	15,652,803	11	5,839
Total	8,533	15,652,803	11	6,223
Europe: United Kingdom	25	36,730		
Asia:				
Indonesia	3,548	7,451,014		
Thailand	3,144	6,351,200	40	20,345
Vietnam, Laos, Cambodia	16	27,488		
Total	6,708	13,829,702	40	20,345
Africa:				
Belgian Congo	969	1,988,234		
Nigeria			34	79,927
Total	969	1,988,234	34	79,927
Oceania: Australia	76	172,360		
Grand total	16,688	32,316,702	94	118,416

[1] Less than 1 ton.

TABLE 16.—Tin [1] imported for consumption in the United States, 1956–57, by countries

[Bureau of the Census]

Country	1956		1957	
	Long tons	Value	Long tons	Value
South America: Bolivia	333	$706,722	214	$407,929
Europe:				
Belgium-Luxembourg	6,275	14,081,583	3,730	8,133,880
Germany, West	439	862,618	263	561,574
Netherlands	7,109	15,965,499	6,712	14,459,675
Portugal	90	191,659	20	43,008
United Kingdom	4,700	10,333,014	4,913	10,406,539
Total	18,613	41,434,373	15,638	33,604,676
Asia:				
Indonesia	925	2,147,107	1,330	3,103,641
Malaya	42,479	91,551,930	39,001	84,194,295
Total	43,404	93,699,037	40,331	87,297,936
Africa: Belgian Congo	240	572,039	----------	----------
Grand total	62,590	136,412,171	56,183	121,310,541

[1] Bars, blocks, pigs, grain, or granulated.

in that order. Electrolytic tinplate exports were 270,350 long tons valued at $60 million. Exports of hot-dipped tinplate totaled 187,100 long tons valued at $44 million. Exports of short ternes were 1,870 long tons in 1957 (2,240 in 1956).

According to the American Iron and Steel Institute, producers in 1957 shipped for export 570,000 short tons (682,000 in 1956) of tinplate; 330,000 tons was electrolytic (316,400 in 1956) and 240,000, hot-dipped (365,600 in 1956).

Tinplate scrap exported was 3,630 long tons in 1957 (3,380 in 1956), mostly to Japan through the customs district of Hawaii. Tinplate-scrap imports, mainly from Canada, were 31,400 long tons, compared with 29,200 in 1956.

TABLE 17.—Foreign trade of the United States in tinplate, taggers tin, and terneplate in various forms, 1948–52 (average) and 1953–57, in long tons

[Bureau of the Census]

Year	Tinplate, taggers tin, and terneplate		Tinplate circles, strips, cobbles, etc. (exports)	Terneplate clippings and scrap (exports)	Tinplate scrap	
	Imports	Exports			Imports	Exports
1948–52 (average)	3,781	[1] 540,716	7,237	159	43,747	988
1953	374	459,639	11,445	----------	37,582	5,195
1954	127	635,969	11,831	----------	29,214	944
1955	40	747,682	14,798	----------	28,721	144
1956	586	[2] 648,517	21,858	10	29,137	3,377
1957	40	625,641	19,531	----------	31,431	3,628

[1] Owing to changes in classifications, data for 1948–51 not strictly comparable with other years.
[2] Revised figure.

TABLE 18.—Foreign trade of the United States in miscellaneous tin, tin manufactures, and tin compounds, 1948–52 (average) and 1953–57

[Bureau of the Census]

Year	Miscellaneous tin and manufactures						Tin compounds	
	Imports			Exports				
	Tinfoil, tin powder, flitters, metallics, tin and tinplate manufactures, n. s. p. f. (value)	Dross, skimmings, scrap, residues, and tin alloys, n. s. p. f.		Tin cans, finished or unfinished		Tin scrap and other tin-bearing material, except tinplate scrap (value)	Imports (pounds)	Exports (pounds)
		Pounds	Value	Long tons	Value			
1948–52 (average)	$267,600	6,010,737	$4,516,630	34,256	$12,562,546	[1] $1,857,798	38,258	[2]
1953	605,609	15,924,059	11,894,770	29,841	12,916,664	2,418,061	5,115	183,328
1954	[3] 784,511	13,165,707	9,358,184	23,878	11,022,214	3,340,533	2,703	342,146
1955	[3] 558,964	13,702,355	[3] 10,383,046	26,490	11,516,846	2,440,829	11,350	311,005
1956	[3] 604,531	11,364,288	[3] 9,429,600	30,502	13,245,030	[4] 2,323,865	22,576	375,021
1957	560,676	11,382,988	9,488,004	30,166	14,308,916	3,911,036	21,809	489,227

[1] Owing to changes in classifications, data for 1948–51 not strictly comparable to later years.
[2] Not separately classified 1948; 1949: 41,004 pounds; 1950: 122,716 pounds; 1951: 136,179 pounds; 1952: 73,131 pounds.
[3] Owing to changes in tabulating procedures by the Bureau of the Census, data known to be not comparable with years before 1954.
[4] Revised figure.

WORLD REVIEW

INTERNATIONAL TIN AGREEMENT

Tin control was exercised under the International Tin Agreement for the first full year in 1957. Producing countries contributed to the buffer stock, tin prices (under which the buffer stock manager operates) were revised, buffer stocks of tin were accumulated, percentages and votes of participating countries were reallocated, and export controls were established. By March 15 all the first contributions to the buffer stock were made in money and totaled £9.6 million—the equivalent of 15,000 tons of tin at £640 a ton. The International Tin Council held five meetings. Thailand formally deposited its instrument of ratification of the International Tin Agreement on March 18, 1957.

At the first meeting of the year, in March, the floor price of tin was raised from £640 per long ton (80 cents a pound) to £730 (91¼ cents a pound). The ceiling price of £880 (110 cents a pound) was left unchanged.

Under the agreement, if the price is at or above the ceiling, the buffer-stock manager must offer any tin that he has for sale. When the price is at or below the floor price, he must buy tin, if he has

money. The range between the floor and ceiling continues divided into three sections: In the lower range—£730 (91¼ cents a pound) to £780 (97½ cents a pound)—the manager may buy tin; in the top range—£830 (103¾ cents a pound) to £880 (110 cents a pound)—he may sell; and in the middle range—£780 (97½ cents a pound) to £830 (103¾ cents a pound)—he abstains from selling or buying unless the Council decides otherwise.

At the June meeting in Brussels, Canada gave the Council 6 months' notice of its impending disposition of about 3,000 long tons of non-commercial stocks of tin (when the price reached £830 per ton).

At a July meeting in London the instrument of ratification of the International Tin Agreement by the Government of Austria was deposited and welcomed. The United Kingdom stated that the 2,500 tons of stock referred to at the December 1956 meeting would be sold over a period of time at prices (about £748–£750 per ton) that would not depress the market. Consumers' votes were reallocated on the basis of net imports and consumption for the 3 years, 1954–56. No tin was held in the buffer stock on March 31. The meeting was adjourned until October 23; no decision was reached on reallocation of producers' percentages. At the meeting, continued in London on October 23, new percentages and votes of the participating countries were approved.

At an October meeting cash and forward tin held by the buffer stock on June 30, 1957, was announced as equivalent to 3,915 long tons.

On September 30 the buffer stock was 4,315 tons, and the stock rose to 10,000 long tons of tin by November 21. The Tin Council issued a communique November 27 stating that the chairman had informed contributing producing governments that the second contribution of 5,000 tons to the buffer stock was due. Delegates of producing countries unanimously recommended that their governments make prompt payment of the total in cash at £730 per long ton, which they later agreed to pay by December 6.

Control of tin exports from the participating countries was decided at a December meeting. During the first control period—December 15, 1957, to March 14, 1958, inclusive—the total permissible export quantity was fixed at 27,000 long tons of tin. This was about 28½ percent below the total production rate in the 12 months ended September 30, 1957. To prevent a sharp price rise from this action, the buffer-stock manager was permitted to operate on the market, should the price reach the middle range. Consideration was also given to the third contribution of 5,000 tons, which would be due

when the buffer stock held 15,000 tons of metal. This was called up December 30, 1957, and most of it had been paid in cash in advance of the due date. On December 31, 1957, the buffer stock stood at 15,300 tons.

The International Tin Council assumed publication of tin statistics in April when the Tin Study Group ceased these activities on March 31, 1957.

TABLE 19.—International Tin Agreement voting power of consuming countries

Country	At first meeting	At second, third, fourth, and fifth meetings	At sixth and seventh meetings	At eighth meeting
Australia	39	32	29	29
Austria			13	13
Belgium	32	38	38	38
Canada	105	77	71	71
Denmark	22	79	85	86
Ecuador	5	5	5	(1)
France	159	165	167	168
India	78	75	74	75
Israel		7	7	7
Italy		56	58	58
Netherlands	102	52	53	53
Spain	19	14	13	13
Turkey		20	17	17
United Kingdom	439	380	370	372
Total	1,000	1,000	1,000	1,000

[1] Withdrew in November 1957.

TABLE 20.—International Tin Agreement export control—percentages, votes, and permissible export amount—first control period, Dec. 15, 1957, to Mar. 31, 1958

Producing country	Percentage [1]	Votes allocated [1]	Permissible export amount [2] (long tons)
Belgian Congo and Ruanda-Urundi	8.95	92	2,416
Bolivia	20.43	203	5,516
Indonesia	20.43	203	5,516
Malaya	37.50	369	10,125
Nigeria	5.34	57	1,442
Thailand	7.35	76	1,985
Total	100.00	1,000	27,000

[1] Established at October 1957 meeting.
[2] Fixed at December 1957 and January 1958 meetings.

WORLD MINE PRODUCTION

World mine production of tin decreased 800 long tons in 1957. Six countries operating under the International Tin Agreement as producers, representing 80 percent of the total, decreased their output 2 percent. Among these, the tin fields of Malaya supplied 31 percent of the world total; Bolivia and Indonesia each, 15 percent; Belgian Congo and Thailand each, 7 percent; and Nigeria, 5 percent.

TABLE 21.—World mine production of tin (content of ore), by countries, 1948–52 (average), and 1953–57, in long tons [1]

[Compiled by Augusta W. Jann and Berenice B. Mitchell]

Country	1948–52 (average)	1953	1954	1955	1956	1957
North America:						
Canada	238	287	149	220	338	275
Mexico	352	476	349	605	500	473
United States	71	56	205	99		
Total	661	819	703	924	838	748
South America:						
Argentina	261	154	95	89	85	181
Bolivia (exports)	33,551	34,825	28,824	27,921	26,843	27,794
Brazil	223	209	167	146	[2] 180	[2] 180
Peru [3]	54				2	
Total	34,089	35,188	29,086	28,156	27,110	28,155
Europe:						
Czechoslovakia [4]	200	200	200	200	200	200
France	122	493	525	450	433	[2] 450
Germany, East	200	563	669	669	660	[2] 670
Portugal	[5] 852	1,367	1,283	1,445	1,169	1,144
Spain	615	1,241	1,020	822	550	[2] 489
U. S. S. R. [4]	8,000	9,400	9,800	10,300	11,800	13,000
United Kingdom	963	1,103	940	1,034	1,044	1,028
Total [2]	11,000	14,400	14,400	14,900	15,900	17,000
Asia:						
Burma	1,490	1,400	950	1,130	1,050	[2] 860
China [3]	6,800	9,600	10,000	11,500	13,000	14,500
Indonesia	31,524	33,822	35,861	33,368	30,053	27,723
Japan	340	737	715	896	926	941
Laos	73	264	110	253	254	525
Malaya	54,253	56,254	60,690	61,244	62,295	59,293
Thailand	8,280	10,126	9,776	11,023	12,481	13,531
Total [2]	102,800	112,200	118,100	119,400	120,100	117,400
Africa:						
Belgian Congo [6]	13,645	15,293	15,084	15,028	14,764	14,264
British Somaliland						5
French Cameroon	80	86	82	85	85	74
French West Africa	50	99	73	47	56	54
Morocco: Southern Zone	6	9	5	14	5	8
Mozambique	3					
Nigeria	8,633	8,228	7,926	8,158	9,067	9,534
Rhodesia and Nyasaland, Federation of:						
Northern Rhodesia	5	7	1			
Southern Rhodesia	62	30	14	208	329	350
South-West Africa	103	210	412	357	475	636
Swaziland	31	36	34	27	29	24
Tanganyika (exports)	83	47	37	41	15	[2] 13
Uganda (exports)	148	92	83	68	33	40
Union of South Africa	653	1,360	1,315	1,283	1,442	1,464
Total	23,502	25,497	25,066	25,316	26,300	26,466
Oceania: Australia	1,759	1,553	2,075	2,017	2,078	[2] 1,751
World total (estimate)	173,800	189,700	189,400	190,700	192,300	191,500

[1] This table incorporates a number of revisions of data published in previous Tin chapters. Data do not add to totals shown, owing to rounding where estimated figures are included in the detail.
[2] Estimated by authors of the chapter and in a few instances from the Statistical Bulletin of the International Tin Council, London, England.
[3] Minor constituent of other base-metal ores.
[4] Estimate, according to the 44th annual issue of Metal Statistics (Metallgesellschaft) through 1956.
[5] Excluding mixed concentrates.
[6] Including Ruanda-Urundi.

WORLD SMELTER PRODUCTION

World smelter production of tin in 1957 decreased 4 percent. Government smelting activities at Texas City, Tex., ceased January 31, 1957. Bolivian concentrate, formerly smelted in the United States, was shifted to the United Kingdom, where output reached the highest point since 1942. The smelters in Malaya (the most important sources of metallic tin in the world) decreased their output 3 percent but supplied 38 percent of the total in 1957 and 1956.

TABLE 22.—World smelter production of tin, by countries, 1948–52 (average) and 1953–57, in long tons [1]

[Compiled by Augusta W. Jann and Berenice B. Mitchell]

Country	1948–52 (average)	1953	1954	1955	1956	1957
North America:						
Canada	238					
Mexico	267	209	224	357	218	[2] 210
United States	32,062	37,562	27,407	22,329	17,631	1,564
Total	32,567	37,771	27,631	22,686	17,849	1,774
South America:						
Argentina	227	130	60	99	96	[2] 104
Bolivia (exports)	240	174	196	107	421	216
Brazil	142	553	1,850	1,184	[2] 1,200	[2] 1,400
Peru [3]	54				1	3
Total	663	857	2,106	1,390	1,718	1,723
Europe:						
Belgium	9,584	9,039	11,377	10,432	9,716	9,714
Germany:						
East	245	480	600	605	[2] 600	[2] 600
West	411	694		280	[2] 660	[2] 864
Netherlands	21,113	26,950	28,442	26,566	28,197	29,230
Portugal	272	471	664	1,018	1,127	982
Spain	736	823	676	608	576	[2] 714
U.S.S.R. [4]	8,000	9,400	9,800	10,300	11,800	13,000
United Kingdom [5]	29,011	28,860	27,475	27,241	26,434	34,174
Total [2]	69,400	76,700	79,000	77,100	79,100	89,300
Asia:						
China [2]	6,400	9,000	9,400	11,500	13,000	14,500
Indonesia	222	644	1,351	1,572	[2] 1,500	[2] 600
Japan	389	805	813	1,030	1,105	1,259
Laos	7					
Malaya	61,987	62,410	71,166	70,632	73,263	71,289
Thailand	4					
Total [2]	69,000	72,900	82,700	84,700	88,900	87,600
Africa:						
Belgian Congo	3,227	2,715	2,459	3,034	2,772	2,651
Morocco: Southern Zone	3		8	8	[2] 12	[2] 8
Rhodesia and Nyasaland, Federation of:						
Southern Rhodesia	76	27	19	22	12	253
Union of South Africa	731	828	752	779	756	823
Total	4,037	3,570	3,238	3,843	3,552	3,735
Oceania: Australia	1,803	1,443	2,063	2,004	1,850	1,806
World total (estimate)	177,500	193,200	196,700	191,700	193,000	185,900

[1] This table incorporates a number of revisions of data published in previous Tin chapters. Data do not add to totals shown owing to rounding where estimated figures are included in the detail.
[2] Estimated by authors of the chapter and in a few instances from Statistical Bulletin of the International Tin Council, London, England.
[3] Tin content of dross.
[4] Estimate, according to the 44th annual issue of Metal Statistics (Metallgesellschaft) through 1956.
[5] Includes production from imported scrap and residues refined on toll.

Next in rank were United Kingdom, Netherlands, China, U.S.S.R., and Belgium. These 6 countries furnished 92 percent of the world tin in 1957.

REVIEW BY COUNTRIES

South America

Bolivia.—Tin in concentrate and ore exported from Bolivia was 27,800 long tons valued at $57,377,000, a 4-percent increase in quantity, but a 3-percent decline in value compared with 1956. Shipments were greatly accelerated in December. Of the 1957 exports, 90 percent was treated in England, and the remainder mostly in Germany, Netherlands, Brazil, and Argentina. Some was smelted locally.

The permissible quota established December 15 by the International Tin Council reduced exports 31 percent beginning January 1, 1958. The Bolivian Government allocated the export quota 81 percent to the "nationalized mines," 8 percent to the "medium miners," and 11 percent to the "small miners."

The contribution due the buffer stock from Bolivia under the International Tin Agreement was the equivalent of 5,484 long tons of tin amounting to £3,693,630. Several firms, including Consolidated Tin Smelters, Ltd., Williams, Harvey & Co., Ltd., and Capper Pass & Son, Ltd., made joint loans to help the Bolivian Government participate in this phase of the tin agreement. The loan is interest-bearing and is secured on the stock of cash and tin under control of the buffer pool. The loan is being recovered on behalf of the lenders in regular installments by deduction from the proceeds of tin ore bought from Bolivia by one of the participating companies.

Krupps of Germany made melting tests on Bolivian tin ores. Tests with the Waelz volatilization procedure appeared encouraging, making a high-grade dust from low-grade concentrates. Placer Development, Ltd., approached the government for permission to erect a tin concentrator which would treat the dumps at Catavi.[10]

TABLE 23.—Tin production in Bolivia by nationalized mines, 1953–57, in long tons of contained tin

Mine	1953 [1]	1954 [1]	1955 [2]	1956 [2]	1957
Carocoles	789	447	351	340	561
Catavi	10,707	8,588	7,381	8,109	7,620
Chorolque	981	844	890	561	1,737
Colavi	330	218	191	171	[3]
Colquechaca			51	60	[4] 80
Colquiri	4,618	4,240	4,775	4,440	4,083
Hunanuni	5,236	4,308	3,637	3,431	2,874
Japo	28	65	47	63	[4] 70
Monserrat	14	4			
Morococala	219	168	185	194	949
Ocuri			29		
Oploca-Santa Ana	659	657	707	526	[5]
San Jose	1,741	1,787	1,644	1,502	1,352
Santa Fe	608	379	405	441	[6]
Tasna	1,192	664	810	693	[5]
Unificada	2,683	2,300	1,937	1,897	1,774
Viloco	214	94	75	81	92
Others	89	13		125	[4] 101
Total	30,108	24,776	23,115	22,634	21,293

[1] Ministerio de Minas y Petroleo, La Paz, International Tin Study Group, 1956 Statistical Yearbook, p. 92.
[2] U. S. Embassy, La Paz, Bolivia, from data furnished by Corporacion Minera de Bolivia.
[3] Included with Unificada. [4] Estimated. [5] Included with Chorolque. [6] Included with Morococala.

[10] Mining World, Annual Catalog: Vol. 20, No. 5, Apr. 15, 1958, p. 124.

TABLE 24.—Tin exports from Bolivia by groups, 1952–57, in long tons of contained tin

[Departmento de Estadistica, Ministeno de Mines y Petroleo]

Group	1952	1953	1954	1955	1956	1957
Corporation Minera de Bolivia	24,846	30,108	24,776	23,417	22,478	22,032
Banco Minero:						
Medium mines	4,111	1,782	1,686	1,957	3,914	5,435
Small mines	2,745	2,761	2,166	2,440		
Oruro smelter (tin metal)	257	174	196	107	449	329
Total	31,959	34,825	28,824	27,921	26,841	27,796

Europe

France.—The only operative tin mine in France near Nosay north of Nantes, producing 450 tons (tin content) in 1957 was shut down in December. Deposits in this area were worked as early as Phoenician times. The latest period of mining activity began in December 1951 by the Société Nantaise des Minerais de l'Ouet (S. N. M. O.) and the Société J. Carnaud. Equipment for the mine was financed with Marshall Plan credits.

Tin consumption in France was about 11,200 long tons, compared with 10,400 in 1956. About 5,000 tons (4,360 in 1956) was used for tinplate.

Portugal.—From 1950 through 1957 Portugal was the leading producer of tin-in-concentrate in Europe.

The alluvial reserves are decreasing steadily; the vein deposits appear to have a long life ahead. Beralt Tin and Wolfram, Ltd., operated a test mill with a capacity of up to 100 tons of ore per day on the Argimela property 27 miles from Panasqueira. It also had the Vale De Ermeda mine under development, looking toward large-scale mining. The Portuguese-American Tin Co., which dredged for tin on the Macainhas River, became the Portuguese-American Tin Co. Division of the Yuba Consolidated Industries, Inc.

Additional electric furnaces were reported to have been added to the tin smelter at Mangualda-Gar, which had a rated daily capacity of about 1 ton.

United Kingdom.—Mine production of about 1,000 long tons of tin was derived principally from 690 long tons of black tin (65 percent) produced by Geevor Tin Mines, Ltd., and 730 tons, by South Crofty, Ltd. In addition, Hydraulic Tin, Ltd., began treating tailing for recovering cassiterite at Truro, Cornwall. Minerals Recovery, Ltd., stopped processing beach sands for tin recovery at its plant near Gwithian, Cornwall.

The United Kingdom ranked second as a world smelter of tin ore, as a consumer of pig tin, and as a producer of tinplate. Smelter production increased about 30 percent, owing mainly to treatment of a larger tonnage of Bolivian concentrate. Tinplate production gained for the 5th consecutive year and totaled 988,900 long tons, 15 percent more than 1956 and the largest on record. Of the 1957 output, 60 percent was hot-dipped, and 40 percent, electrolytic. About 44 percent of the tinplate, or 431,100 long tons was exported in 1957, the highest quantity since 1937. The principal foreign markets were Australia and Argentina.

Year-end stocks of tin-in-concentrates afloat to United Kingdom were 2,689 tons (3,893 at beginning of year). Metal afloat increased from 140 tons at the beginning to 2,680 tons at the end of 1957.

United Kingdom tin imports came principally from Malaya, Russia, Belgium, and Netherlands. Import controls on tin were removed on August 1, 1957. Exports of tin metal went mostly to the United States.

The large increase in stocks was the result of buffer-stock procurement.

TABLE 25.—United Kingdom tin consumption, 1953–57, primary and secondary refined tin, excluding tin scrap, in long tons [1]

Use	1953	1954	1955	1956	1957
Tinplate	8,911	9,896	9,847	10,100	11,093
Tinning:					
Copper wire	405	493	527	484	539
Steel wire	78	113	112	100	99
Other	796	856	802	831	726
Solder	1,879	2,345	2,877	2,765	1,910
Alloys:					
White metal	2,901	3,581	3,741	2,935	2,779
Bronze and gunmetal	2,001	2,076	2,508	2,721	2,396
Other	393	488	479	449	390
Wrought tin: [2]					
Foil and sheets	255	319	338	290	263
Collapsible tubes	306	384	422	341	352
Pipes, wire, and capsules	71	54	50	48	56
Chemicals [3]	766	959	1,033	1,048	1,082
Other uses [4]	120	148	137	120	102
Total	18,882	21,712	22,873	22,232	21,787

[1] British Bureau of Non-ferrous Metal Statistics, World Non-Ferrous Metal Statistics: Bull., December 1957, vol. 10, No. 12, Feb. 11, 1958, p. 55.
[2] Includes compo and "B" metal.
[3] Mainly tin oxide.
[4] Mainly powder.

TABLE 26.—Tin production, imports, exports, and stocks, United Kingdom, 1953–57, in long tons

[British Bureau of Non-ferrous Metal Statistics, World Non-ferrous Metal Statistics]

	1953	1954	1955	1956	1957
Production:					
Ores and concentrates (tin content)	1,103	940	1,034	1,044	1,028
Refined tin:					
Primary	28,860	27,475	27,241	26,434	34,174
Secondary	490	525	468	402	325
Imports:					
Ores and concentrates (tin content)	28,907	27,494	27,084	26,571	39,272
Refined tin	1,039	2,406	1,227	2,226	9,834
Exports of refined tin	13,759	8,118	8,456	7,264	7,330
Reexports of refined tin	685	457	472	1,107	273
Total exports and reexports	14,444	8,575	8,928	8,371	7,603
Stocks end of period:					
Ores and concentrates (tin content)	2,450	2,473	2,181	2,393	3,872
Refined tin:					
At consumers	1,478	1,514	1,377	1,516	1,587
Official warehouse	807	1,933	622	759	12,202
Other (smelters)	800	900	1,000	697	591
Total	3,085	4,347	2,999	2,972	14,380

Asia

Indonesia.—The tin output—27,723 long tons—was 8 percent less than in 1956 and the lowest since 1947. The islands of Bangka, Billiton, and Singkep furnished 62, 33, and 5 percent, respectively, of the total.

Exports of tin-in-concentrate were about 26,920 long tons; 25,500 tons went to the Netherlands and 1,420, to the United States. The tonnage to the United States was shipped in December for smelting at Texas City, Tex., by the Wah Chang Corp.

The mining concessions in Indonesia of Billiton Joint Mining Co. were due to expire in February 1958. Political disturbances in the latter part of 1957 in Indonesia had no reported effect on the tin-producing areas.

Malaya.—Mine production of tin in Malaya decreased 5 percent to 59,290 long tons in 1957. The rate of production was highest during the last quarter; miners apparently produced as much tin as they could in December before buffer-stock collections and reduced exports became effective.

Of the 1957 total, 57 percent came from European mines (mostly by dredges) and 41 percent from Asian mines (mostly by gravel pumps), including 2 percent from dulang washing. European mines supplied 6 percent less than 1956, the lowest since 1946. Asian mines decreased their output 4 percent, but their portion was the largest since 1931.

The 1957 export duty on tin in Malaya was £6.3 million, compared with £7 million in 1956. The duty furnished nearly 71 percent of the Federation's total customs revenue in 1957.

Dredges in operation (mainly in Perak and Selangor) numbered 78 at the beginning and 76 at the end of 1957; gravel-pump units dropped from 633 to 597. The total number of active tin mines in 1957 was 743, compared with 784 in 1956. On December 31, 1957, in tin mines, 36,585 laborers were employed, compared with 39,459 on December 31, 1956.

Malaya's permitted exports of tin under the International Tin Agreement were fixed at 10,125 long tons of tin metal (equivalent to 226,196 piculs of concentrates at 75.2 percent tin) for the first quota period, December 15, 1957, to March 31, 1958, and 8,625 tons of metal for the quarter ending June 30, 1958. On the basis of production for the 5 years 1953–57, permissible export quotas were apportioned 58.66 percent to European mines, 39.55 percent to Asian mines, and 1.79 percent to dulang washers. Production, deliveries, and export of tin concentrate after December 15 were permitted only on the authority of certificates of production issued by deputy controllers. The first buffer-stock-collection period of 1 year terminated October 14, and a total of £3,589,950 was collected at the rate of M$24 a picul (£47 per ton) of concentrates. The second collection period began December 15; and another January 1, 1958, at a lesser rate of M$12 a picul of concentrate. The amount collected will be repaid on the partial or complete liquidation of the buffer stock.

The principal world source of tin metal continued to be the large plants of the Eastern Smelting Co., Ltd., on the island of Penang and the Straits Trading Co., Ltd., at Pulau Brani, Singapore, and Butter-

TABLE 27.—Federation of Malaya mine production of tin (content of ore), by methods of mining, 1952–57, in long tons [1]

Year	Dredges			Gravel pumps			Hydraulicking			Opencast			Underground			Small workings			Dulang washers	Total		
	European	Asian [2]	Total	European	Asian [2]	Total	European	Asian [2]	Total	European	Asian [2]	Total	European	Asian [2]	Total	European	Asian [2]	Total	Asian [2]	European	Asian [2]	Total
1952	29,587	-------	29,587	1,361	20,226	21,587	1,514	91	1,605	377	409	786	1,974	252	2,226	1	144	145	902	34,814	22,024	56,838
1953	28,638	-------	28,638	1,215	20,564	21,779	1,097	76	1,173	743	521	1,264	1,991	257	2,248	2	183	185	966	33,687	22,567	56,254
1954	31,669	-------	31,669	1,493	21,197	22,690	1,302	86	1,388	807	548	1,355	1,975	274	2,249	12	244	256	1,082	37,258	23,431	60,689
1955	31,048	-------	31,048	1,309	22,686	23,995	1,303	43	1,346	758	473	1,231	1,994	248	2,242	1	293	294	1,088	36,413	24,831	61,244
1956	30,705	-------	30,705	1,323	23,612	24,935	1,446	23	1,469	719	650	1,369	1,897	503	2,400	10	307	317	1,100	36,100	26,195	62,295
1957	28,116	-------	28,116	1,409	22,987	24,396	1,621	8	1,629	814	444	1,258	1,838	683	2,521	1	298	299	1,073	33,799	25,493	59,292

[1] Federation of Malaya, Department of Statistics, Monthly Statistical Bulletin: January 1958, p. 51.
[2] Includes Chinese only for 1952.

worth, Province Wellesley. In addition, a small quantity of metal was produced by a Chinese smelter for local consumption. Total smelter production in 1957 was 71,290 long tons (73,260 in 1956). Concentrates treated were derived mostly from Malaya and Thailand. Receipts from Thailand in 1957 reached a post-World War II high point.

Shipments to the United States declined nearly 5,000 tons; the flow was small in December. Exports to the United Kingdom more than trebled largely owing to buying for the buffer stock.

The smelter at Butterworth was strike-bound from January 10 to March 12; and, at the Penang smelter, a labor strike began as a "go slow" November 13 but was unsettled at the close of 1957, although a few men were reported as returning to work. It had been intended to transfer the bulk of the company smelting activity to the Butterworth smelter in Penang by the end of 1956 and eventually to close the obsolete Pulau Brani smelter. However, because of the labor strike at Butterworth, Straits Trading Co. resumed full production at Pulau Brani throughout 1957.

TABLE 28.—Tin-metal exports from Malaya in 1956–57 in long tons [1]

Destination	1956	1957	Destination	1956	1957
United States	41,083	36,117	Australia-New Zealand	887	1,483
Japan	6,889	6,745	South Africa	938	753
United Kingdom	1,984	6,531	Turkey	607	516
Republic of India	3,758	4,223	Germany, West	626	132
Argentina	118	2,813	Mexico	322	388
Italy	2,835	2,520	Other countries	3,755	2,694
France	3,578	2,202			
Netherlands	4,265	1,762	Total	73,275	70,599
Canada	1,630	1,720			

[1] Federation of Malaya, Department of Statistics, Monthly Statistical Bulletin: January 1958, p. 52.

TABLE 29.—Imports of tin-in-concentrate into Malaya in 1956 and 1957, in long tons

Country of origin	1956	1957	Country of origin	1956	1957
Burma	773	806	Other	42	126
Laos and Viet Nam	178	349			
Thailand	9,974	12,862	Total	10,967	14,143

Stocks of tin metal increased from 2,190 tons at the beginning to 2,830 at the end of 1957. Because of the labor strike at the smelter, tin-in-concentrates (including mine stocks) increased from 4,795 at the beginning to 6,960 at the end—the highest since 1939.

The Federation of Malaya attained independence within the British Commonwealth on August 31, 1957.

Thailand.—Thailand ranked sixth among the world tin-producing countries in 1957 as in 1956.

Aokim Tin, Ltd., off the island of Buhket, began producing early in 1957 by means of 2 deep grabs operating from a deep-sea grab dredge and capable of digging 120,000 cubic yards monthly. Values are below 60 to 70 feet of sea water. During the first 6 months of 1957 about 85 long tons of tin concentrate was produced.

The instrument of ratification by Thailand of the International Tin Agreement was deposited on March 18, 1957. A ministerial regulation specifying the responsibilities of tin mine operators and tin dealers regarding contributions to the tin buffer stock, in accordance with the agreement, was promulgated on March 1, 1957.

TABLE 30.—Exports of tin-in-concentrate from Thailand, 1956–57, in long tons

Country	1956	1957	Country	1956	1957
Belgium		42	Portugal		73
Brazil	615	292	United States	1,714	1
Chile	21				
Japan	191	243	Total	12,424	13,347
Malaya	9,883	12,696			

Africa

Belgian Congo.—Mine production of tin in Belgian Congo, including Ruanda-Urundi, was 14,264 long tons—a 3-percent decrease from 1956. December output increased to the highest for any month since December 1953. Smelting in Belgian Congo was about 5 percent below 1956. Exports of tin-in-concentrate, mostly to Belgium, totaling 12,370 long tons, reached a peak in December; lesser tonnages went to Brazil and United Kingdom. As usual, most of the tin metal exported in 1957 went to Belgium. However, the final destination of Belgian Congo tin was mainly the United States, either directly or via Belgium. Total stocks of tin in concentrates were 883 long tons at the end of the year.

Symétain Co., the principal producer, furnished over 25 percent of the tin output of Belgian Congo and Ruanda-Urundi since 1932. Production for 1957 was 5,420 long tons of cassiterite compared with 5,325 long tons in 1956. The deposits are in Maniema and extend over 400,000 hectares. Production came from 138 working places grouped in 23 camps. The company produced 4,000 tons of tin from 5,500 tons of concentrate recovered from 5 million cubic yards of ground. About 180 Europeans and 9,000 natives were employed.[11] Output per man-day increased from 0.87 cubic meters of ground excavated in 1932 to 1.66 in 1938 and 6.6 in 1957.

The Géomines Co. produced 3,745 tons of cassiterite concentrate (3,940 tons in 1956); 1,856 tons came from altered pegmatite and 1,889 tons, from unaltered pegmatite. A new crushing plant at washery No. 5 at Kitotolo reached its normal output in January 1957. A washery was installed and was expected to begin producing in January 1958. A new high-capacity crushing and washing plant was planned at the old Kahungwe open-cut mine at Manono, which has a substantial reserve of stony pegmatite-type ore. The reserve in the weathered and altered pegmatites is near exhaustion; the deposit has been mined for 40 years. In the unaltered pegmatite the reserve is estimated to exceed 100,000 tons of cassiterite.[12]

French Equatorial Africa.—The Société MINETAIN du Congo-Francais was formed on June 21, 1957, to exploit a tin deposit dis-

[11] International Tin Council, Notes on Tin: No. 5, July–August 1957, p. 63.
[12] International Tin Council, Notes on Tin (Source: Agence economique et financière No. 29-30, 1957: Report of Géomines—summarized), No. 8, November–December 1957, p. 125.

covered in 1956 in the northern part of the district of Madingou-Kayes, east of the lagoon M'Banie.[13] The deposit was reported to be "modest in size but excellent in tenor." It is not known whether the deposit is alluvial or vein. MINETAIN was expected to begin extracting the ore at the rate of 4 to 5 tons per month by the end of 1957.

Nigeria.—In 1957 Nigeria produced 13,151 long tons of tin ore (12,507 in 1956) averaging 72.5 percent tin. The entire tin-ore exports, totaling 13,577 tons (13,364 in 1956), went to the United Kingdom. About half the world supply of columbium was produced as a byproduct or coproduct of tin mining in Nigeria.

In the year ended March 31, 1957, Nigeria's largest tin producer—the Amalgamated Tin Mines of Nigeria, Ltd.—reported that 14 million cubic yards was treated by the company compared with 12.7 million in the preceding year. The value of the ground treated dropped from 0.75 pound to 0.62 pound of cassiterite per yard.

The output (in long tons) was obtained by the following methods:

	Cassiterite	*Columbite*
Gravel pumps	2,122	203
Dragline with washing plants	864	124
Dredge	188	33
Dumpers and jig plants	88	5
Elevators, hand paddocks, tribute, and contract	690	52
Mill tailings	216	138
	4,168	555

Rhodesia and Nyasaland, Federation of.—Tin production in Southern Rhodesia in 1957 remained virtually unchanged from 1956. Capacity of the plant of Kamativi Tin Mines, Ltd., (N. V. Billiton Maatschappij) at Bulawayo was increased late in 1957 from 600 to 1,000 tons of ore a day.

Oceania

Australia.—Mine production of tin in Australia was 1,750 long tons in 1957 or 16 percent below 1956. Smelter production was virtually unchanged. Imports of tin increased to meet expanded needs. Australia, one of the largest tinplate importers in the world, was supplied mostly by United Kingdom and the United States in 1957. Australia's first tinplate mill at Port Kembla, New South Wales, began producing August 5, 1957. Annual output was scheduled at 72,000 tons of hot-dipped tinplate. Production during December reached 4,250 tons. An electrolytic tinplate plant that is planned will make Australia self-sufficient in tinplate production by 1963.

Tableland Tin Dredging, N. L., Mount Garnet, North Queensland, the leading tin producer, began dredging new ground in 1953; yields were erratic. Grade improved in late 1957, but mine production (544 tons of tin oxide) was 244 tons less than in 1956. Ravenshoe Tin Dredging, Ltd., began producing in the same district in September on financial credit guaranteed by the Queensland Government. An annual output of 600 tons was expected from this company. The Queensland Government operated its customs milling plant for tin ore at Irvinebank. The Northern Territory Department of Mines ore-processing plant at Maranboy was inactive. The Australian Government operated its tin dredge at Dorset, Tasmania.

[13] Arundale, Joseph C., American Counsul-Elisabethville, State Department Dispatch 12: Dec. 28, 1957.

A document on the tin resources of Australia, including a selected list of literature references was published.[14]

TECHNOLOGY

Four possible methods [15] of recovering tin and tungsten from the slags at the Longhorn tin smelter were developed on a laboratory scale by the Federal Bureau of Mines. From slags averaging 1 to 1½ percent tin and ½ to 1 percent tungstic oxide, a recovery of 90 percent of the tin and tungsten was indicated.

Results of research on the recovery of tin from metallurgical slimes were published.[16] Mixtures of hydrogen chloride and reducing gases such as hydrogen, carbon monoxide, hydrogen sulfide, ethane, propane, and butane were used to treat the slimes at elevated temperatures. Over 95 percent of the tin was volatilized as a chloride. Optimum conditions were found to consist of a mixture of 3 to 1 of hydrogen and hydrogen chloride gases at 475° C.

An analytical procedure was reported [17] for determining low concentrations of tin. The method was based on using flavonol, which produced a bright blue fluorescence with quadrivalent tin in 0.5 to 0.1 normal sulfuric acid solution. Although water solution was satisfactory for qualitative determinations, 33 percent dimethylformamide was preferred for quantitative analyses. Interfering ions included those of fluoride, phosphate, and zirconium.

A special aluminum-tin-bearing alloy, containing 21.1 percent tin, 1.83 percent copper, 0.15 percent silicon, 0.13 percent iron, and the remainder aluminum, provided encouraging results in evaluation tests.[18] The large proportions of tin in the bearing tested was believed to have prevented scoring of the shaft by allowing absorption of small abrasive particles.

When iron was exposed to molten tin three layers were formed—iron, tin, and $FeSn_2$.[19] Examination of these layers showed that the $FeSn_2$ layer was the hardest phase. In addition, the $FeSn_2$ was the most noble phase in acidified NaCl or dilute citric acid and in the same mediums, the corrosion rates of $FeSn_2$ were too low to be easily measurable. At low current densities, hydrogen overvoltage values for $FeSn_2$ were intermediate between values for iron and tin. The predicted corrosion behavior of tinplate was related to these properties.

When highly purified tin was dissolved in highly purified germanium, the tin, present as a solid solution, did not significantly alter the electrical characteristics of the germanium.[20] This verified the theory that impurities with the same number of valence electrons as germanium would be neutral; the impurities would act neither as donors nor as acceptors.

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[14] Commonwealth of Australia, Bureau of Mineral Resources, Geology and Geophysics, Geology and Mineral Economics Sections: Mineral Resources of Australia, Summary Report No. 38, Tin, Commonwealth Government Printer, Canberra, 1958, 59 pp.

[15] Kenworthy, H., Starliper, A. G., and Freeman, L. L., Recovery of Tin and Tungsten From Tin-Smelter Slags: Bureau of Mines Rept. of Investigations 5327, 1957, 12 pp.

[16] Kershner, K. K., and Cochran, A. A., Volatilization of Tin Chlorides From Slime: Bureau of Mines Rept. of Investigations 5298, 1957, 10 pp.

[17] Coyle, Charles F., and White, Charles E., Fluorometric Determination of Tin With Flavonol: Anal. Chem., vol. 29, No. 10, October 1957, pp. 1486–1488.

[18] Automobile Engineer (London), Aluminum-Tin Bearings: Vol. 47, No. 1, January 1957, p. 9.

[19] Covert, Roger A., and Uhlig, Herbert H., Chemical and Electrochemical Properties of $FeSn_2$: Jour. Electrochem. Soc., vol. 104, No. 9, September 1957, pp. 537–541.

[20] Iron Age, Dissolves Tin in Germanium: Vol. 180, No. 13, Sept. 26, 1957, pp. 140–141.

As part of a long-range program to study the atomic bonding in alloys, a liquid-tin solution calorimeter was designed and operated at the University of California.[21] The calorimeter permitted the determination of the heats of formation of alloy phases from the heats of solution of the alloys and of the pure component metals in liquid tin. Results indicated that the heats of formation of alloy phases may be determined with an average uncertainty of about ±50 calories per gram.

A study [22] of local corrosion of tin by dilute chloride solutions showed that special physical or chemical preparation of the metal surface or alloying additions to the metal did not prevent local corrosion indefinitely. Factors affecting corrosion were surface conditions, severity of attack, crevices, pH of solution, and electrical contact with a more noble metal. Local corrosion was prevented by adding sodium bicarbonate, carbonate, benzoate, chromate, phosphate, or silicate to the chloride solutions. Aluminum anodes provided cathodic protection.

Although acid sulfate and alkali stannate baths are widely used for electroplating tin industrially, pyrophosphate solutions offered advantages because of high solubility, nonpoisonous nature, stability, and low metal-ion concentration due to complex formation.[23] Good quality tin deposits over a wide range of experimental conditions are electroplated from the complex $Sn_2P_2O_4$ bath. The brightness of the deposits was increased by adding agents such as dextrin-gelatin.

Reports [24] were published describing new methods for the synthesis of tin-carbon bonds, typical organotin compounds, and addition products.

The effectiveness of a recently developed organotin compound, bis tri-n-butyl tin oxide, as a slime-control agent was demonstrated under actual operations in both newsprint and boxboard production.[25] Advantages of the new compound included less toxic effects, noncorrosive characteristics, efficiency in a wide range of pH conditions, and its ability to protect pulp and finished paper against mildew.

The manufacture of organotin compounds is growing as these chemicals strengthen their holds on current applications.[26] Uses include treating textiles, stabilizing rubber paints, polyvinyl chloride plastics, drugs, and biocides (fungicides, insecticides, herbicides). Researchers seeking new uses and new compounds found markets for organotins in veterinary medicine (anthelmintics), slime control, and catalysts for silicone polymerizations.

[21] Orr, Raymond L., Golberg, Alfred, and Hultgren, Ralph, Liquid Tin Solution Calorimeter for Measuring Heats of Formation of Alloys: Rev. Sci. Instr., vol. 28, No. 10, October 1957, pp. 767–773.

[22] Britton, S. C., and Michael, D. G., The Corrosion of Tin and Tinned Copper in Dilute Neutral Solutions: Jour. Appl. Chem., vol. 7, pt. 7, July 1957, pp. 349–356.

[23] Vaid, J., Rama Char, T. L., Tin Plating From the Pyrophosphate Bath: Jour. Electrochem. Soc., vol. 104, No. 5, May 1957, pp. 282–287.

[24] Van Der Kerk, G. J. M., Noltes, J. G., and Luijten, J. G. A., Investigations on Organo-Tin Compounds. VII. The Addition of Organo-Tin Hydrides to Oleofinic Double Bonds: Jour. Appl. Chem., vol. 7, pt. 7, July 1957, pp. 356–365.

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———. Investigations on Organo-Tin Compounds. IX. The Preparation of Some Dialkyltin Compound With Long-Chain Alkyl Groups: Jour. Appl. Chem., vol. 7, pt. 7, July 1957, pp. 369–374.

[25] Connolly, William J., A New Slime-Control Agent: Paper Trade Jour., vol. 141, No. 31, Aug. 5, 1957, pp. 46–47.

[26] Chemical Week, Organo-tins: The Little Slice With Big Hopes: Vol. 80, No. 27, July 6, 1957, pp. 50–51.

The Tin Research Institute celebrated its twenty-fifth anniversary demonstrating techniques that have been developed or used at the Institute.[27] The exhibits included the continuous casting of bronze rods, bearings made from an alloy of aluminum and tin bonded to thin steel strip shell, improved methods of applying tin coatings to resist corrosion of steel, electroplating tin-alloy coatings, and organotin compounds for use as fungicides, wood preservatives, and slime-control agents.

A review [28] of the industrial and engineering developments in tin since 1947 described research on solders, electrodeposition, compounds, bearings, tinplate, bronze, special alloys, physical properties of tin-containing materials, and miscellaneous applications. A detailed bibliography listed publications of the research projects.

A new chemical treatment called the Hinac Process,[29] a substitute for tin in its leading use as tinplate consisted of an inorganic coating chiefly with chromium compounds, which equaled tinplate in economy and performance. It worked well on both ferrous and nonferrous metals—anywhere a surface with good corrosion resistance and paint-bonding qualities was required.

[27] Chemistry and Industry, Twenty-Five Years of Tin Research: No. 31, Aug. 3, 1957, p. 1074.
[28] MacIntosh, Robert M., Materials of Construction: Tin and Its Alloys: Ind. Eng. Chem., vol. 49, No. 9, part II, September 1957, pp. 1653–1657.
[29] Iron Age, New Surface Treatment Substitutes for Tinplate: Vol. 179, No. 23, June 6, 1957, pp. 106–108.