

TIN

By James F. Carlin, Jr.

There was no domestic mine production of tin in 1994. Twenty-five firms consumed about 86% of the primary tin used domestically. The major uses were as follows: cans and containers, 32%; electrical, 22%; transportation, 11%; construction, 10%; and other, 25%. The estimated value of primary metal consumed in 1994 was about \$270 million.

About 10,900 metric tons of purchased old and new tin scrap, including tin alloys, was recycled in 1994. Of this, about 6,900 tons was old scrap. About one-fifth of the tin consumed in the United States was produced from old scrap at detinning plants and 119 secondary nonferrous metal processing plants. There was continued interest in the recycling of used tin cans, largely owing to the rising costs and limited space of landfills. The recycling rate for steel cans was 53% in 1994, having risen from 40% in 1993 and 15% in 1988. In 1994, 11,360 tons of pig tin was sold from the National Defense Stockpile (NDS) leaving 136,559 tons in inventory at yearend, all of which was considered to be in excess.

World tin mine output in 1994 remained essentially the same as in the prior 2 years, the result of concerted producer efforts to restrict production. Nevertheless, there was an excess of tin on the world market for the 13th consecutive year. Excess stocks were believed to be about 35,000 tons at yearend.

The price of tin rose about 20% throughout the year. The price rise was attributed generally to increased consumption and some success by major tin producing countries in curtailing or leveling output.

Tin was mined in 28 countries in 1994, of which the top 5 accounted for about three-fourths of the world total of 183,000 tons. China was the largest producer with 27% of the world total, followed by Indonesia (19%), Brazil (15%), Bolivia (9%), and Peru (8%).

World tin reserves were estimated at 7 million tons and were considered adequate to meet the world's tin requirements in the near future. The bulk of these tin reserves were in Asia and South America.

Legislation and Government Programs

The NDS continued in its fifth year of being managed by the Department of Defense, with

day-to-day operations guided by the Defense Logistics Agency (DLA).

The DLA sold 11,360 metric tons of tin from the stockpile in 1994. The bulk of the sales, 5,740 tons, were handled through long-term sales contracts to firms such as Considar Corp. (New York, NY), American Iron and Metal Corp. (Quebec, Canada), and M. C. Canfield and Sons Co. (Union, NJ). Also, direct sales were held each day, with orders for lots of 5 tons or more being accepted daily between 1:30 P.M. and 3:30 P.M. at the price set by DLA for that day.

Production

Mine Production.—For the first time in many years, there was no domestic tin mine production. In recent years, the Cache Creek Mine, in the Tofty District near Manley Hot Springs, AK, was the only mine in the United States to produce significant amounts of tin concentrates. The tin was recovered as a byproduct of gold mining. The mine, owned by Shoreham Resources, Inc., Houston, TX, in prior years, was sold to Cassiterite Placers Inc., Fairbanks, AK, in 1994 and was in its fourth year of production. The tin output from the mine had amounted to only a small fraction of domestic tin requirements.

Smelter Production.—For several years, there has been no domestic primary tin smelter. Any domestic tin mine output has been shipped to foreign smelters.

Secondary Production.—The United States was believed to be the world's largest producer of secondary tin. Tin metal recovered from new tinplate scrap and from used tin cans was the only type of secondary tin available in the marketplace as free tin; other secondary tin was available in scrap materials as an alloying ingredient. Secondary tin from recycled fabricated parts was used in many kinds of products and was a major source of material, particularly for the solder, and the brass and bronze industries.

The former Steel Can Recycling Institute (SCRI) that had been funded by five domestic tinplate producers to advance the collection, preparation, and transportation of steel can scrap in 1988, was in its first full year of expanded activities under a new name, the Steel Recycling Institute (SRI). The SRI now fosters

the collection of all steel scrap (ranging from appliances to cars), not just steel cans. The SRI continued to maintain a program of having representatives in various regions of the United States work with municipalities, scrap dealers, and detinners to promote the recycling of tin cans.

The SRI made several announcements during 1994:

- a) In the 6 years of SRI's existence, the recycling rate for steel cans has more than tripled, from 15% in 1988 to 53% in 1994. More than 18 billion steel cans, weighing 1.55 million tons, were recycled in 1994.
- b) The SRI's goal is to achieve a 66% recycling rate for steel cans by the end of 1995.
- c) The average American uses 144 steel cans each year. If every American recycles at least 95 steel cans in 1995, the goal of a 66% steel can recycling rate will be achieved easily.
- d) Each year more than 30 billion steel cans are produced, packaging a variety of products from food and beverage, to paints, chemicals and personal care products.
- e) Nine out of 10 aerosol cans are made of steel and are recyclable when empty. More than 1,700 communities across the country currently recycle aerosol cans.
- f) More than 170 million Americans have convenient access to steel can recycling through curbside, drop-off, and buyback programs, as well as through magnetic separation at resource recovery facilities.

SRI continued to actively sponsor the recycling of aerosol steel cans. It particularly pointed out its success in Michigan where a Statewide environmental campaign, sponsored and supported by a coalition of Government, industry, academic, and environmental leaders was encouraging Michigan consumers to recycle empty aerosol cans with other steel cans.

SRI also announced progress in its efforts to encourage many iron foundries to utilize scrap steel cans as part of their raw material charge. Iron foundries are found in virtually all 50 States, and they depend on steel scrap for about

50% of their charge material. Over the past 2 years, a small but growing number of foundries have been experimenting with melting used steel cans. SRI stated that nine foundries, all east of the Mississippi River, were accepting used steel cans. The attraction to foundries of using steel cans scrap is its low cost, consistent composition, and relative cleanliness. The downside to this scrap source is that the tin on the can surface has often been perceived as an unacceptable contaminant that could cause loss of strength and embrittlement in cast iron products. Among the first iron foundries to experiment with used tin can usage has been the Waupaca Foundry, Waupaca, WI; the U.S. Foundry, Medley FL; and the Internet Corp., Lynchburg, VA.

One of the major domestic detinners, Proler International Corp., announced plans to expand capacity at its Coolidge, AZ, facility to recycle tin-bearing solutions from the electronics industry. Proler announced that the company had developed its own process to extract tin from solutions and sludges by adapting detinning technology used internally. Proler produced tin anodes from these solutions and sludges, which it sold back to the electronics industry. Proler felt the need to expand because demand for the service exceeded capacity at its existing plant. Arizona is the home of numerous electronics plants.

Consumption

Primary tin consumption remained about the same as in 1993 and other recent years. The demand pattern was similar to that of 1993.

Tinplated steel and tin-free steel accounted for 24% of the 139 billion cans shipped domestically; aluminum accounted for 76%. This compared with 1993 figures showing steel accounting for 26% of the 132 billion cans shipped domestically and aluminum accounting for 74%. Aluminum held an overwhelming advantage in the beverage can market, while steel dominated in the food can and the "general-line" markets.¹

Bev-Pak Inc., Des Plaines, IL, with production facilities in Monticello, IN, completed the transfer of all of its three beverage can production lines to aluminum, thereby eliminating its status as a steel or tinplate purchaser and as a major producer of steel cans. The company started in the late 1980's and immediately forged for itself a special niche as a producer of steel cans. Bev-Pak had claimed about 50% of the domestic steel beverage can market and a 2% share of the total U.S. beverage can market. The domestic beverage can market has been increasingly dominated by aluminum during the past 30

years. The firm attributed the switch in materials to recently lowered prices for aluminum can sheet and to the end of its contracts with Coca-Cola, Pepsi Cola, and 7-Up, which had desired steel cans for certain steel-producing Midwestern States. Industry sources felt the switch by Bev-Pak represented about a 1% slice of the 4-million-ton-per-year tin mill products market. Crown Cork & Seal Co., Philadelphia, PA, still operated two steel can production lines that could be switched between aluminum and steel feedstocks.

U.S. Can Corp., Oak Brook, IL, completed purchase of Baltimore, MD—based Steeltin Can Corp. and two affiliated firms. Steeltin is a regional producer of containers for the specialty food and paint markets.

In the spring, Weirton Steel Corp., Weirton, WV, one of the largest domestic tinplate producers and therefore one of the largest domestic tin consumers, suffered major fire damage to its No. 9 tandem cold-rolling mill. The cold-rolling mill, one of the key process units preparatory to the steel coil entering the tin mill, had an annual capacity of about 900,000 tons. Weirton moved as much light-gauge sheet production as possible to two other tandem mills. The outage continued into the fall, with Weirton having partial success arranging interim tolling arrangements with other tinplate producers to meet its customers' needs. About 40% of Weirton's shipments is tin mill products. Of all domestic tinplate producers, Weirton's total steel output has the heaviest weighting toward tinplate products.

One of the domestic tinplate producers, Wheeling-Pittsburgh Steel Corp. Wheeling, WV, announced plans to construct a new joint-venture tinplate mill in Belmont County, OH. Construction was set to begin in early 1995, with completion planned for late 1996. The tin mill is a joint venture of Wheeling-Pittsburgh Steel Corp., Dong Yang Tinplate Industries Co. Ltd., South Korea, and Nittetsu Shoji Inc., Los Angeles, CA. Wheeling-Pittsburgh and the United Steelworkers of America reportedly reached an agreement in principle concerning all employment issues for the \$80 million mill. The mill is expected to use about 500 tons of tin per year. It would be the first tinplating facility constructed in the United States since the early 1960's, and would replace Wheeling's current 50-year-old tin mill. Upon announcement of the project, the State of Ohio became active in assisting the venture, obtaining a 10-year tax abatement for the mill and working with the county in seeking government grants for equipment and employee training. Tinplate represents about 9% of Wheeling's output. (See tables 2, 3, and 4).

The American Iron & Steel Institute's (AISI)

Steel Packaging Council, formerly the market development arm of AISI's Tin Mill Products Committee, commenced a 5-year, \$12.5 million program to promote the nutritional value and convenience of canned foods. The Council expressed concern that over the past 10 years, while the domestic population has been growing, canned food shipments have been flat. The intent was to help forge a modern image for canned food and thereby boost tin mill shipments to can makers.

Prices

The price of tin metal, as published in Platt's Metals Week, generally rose throughout the year, with the sharpest increases coming in the final 2 months. The price at yearend was about 20% higher than at the beginning of the year. Analysts believed the strong price action in 1994 was due to improved world demand and to some select successes by large tin producing countries in restricting their output or exports.

The London Metal Exchange (LME) remained the primary trading arena for tin. Tin was one of only six metals (along with aluminum, copper, lead, nickel, and zinc) to be traded on the LME. The Kuala Lumpur Commodities Exchange in Malaysia continued as an active tin trading forum.

Foreign Trade

The marketing of tin metal in the United States was performed mostly through trading firms, which imported the tin from a variety of countries and warehoused it in this country until they sold it to customers. Foreign-owned trading firms tended to dominate the field. Most tin dealers were based in the New York, NY, area. Some tin also was marketed directly in the United States by large foreign producers who maintained sales offices here and sold their tin metal, usually on a 1-year contract basis, only to the largest users. Perhaps foremost among these direct-sale operations was Indo-Metal Corp., which served as the exclusive North American sales outlet for tin metal produced by Indonesia's Government-owned tin production organization, P.T. Tambang Timah.

For the third consecutive year, Brazil was the major source of U.S. tin metal imports. Bolivia ranked second, followed by Indonesia, China, and Malaysia. Imports, which supply the majority of domestic tin requirements, remained about the same as in 1993.

Imports of tin in all forms (ore and concentrate, metal, waste, and scrap) remained free of U.S. duty. (See tables 5, 6, and 7.)

World Review

At the Association of Tin Producing Countries' (ATPC) Annual Meeting of Ministers in Bangkok, Thailand, on September 19 and 20, several important events occurred:

- a) It was agreed in principle that Brazil, the world's third largest tin producer, would become an ATPC member. Brazil's inclusion in the ATPC would increase the share of tin supply under the aegis of the producer group from 66% to 82% of the world total.
- b) China, the world's largest tin producer, pledged to hold its 1995 export quotas at 1994 levels.
- c) The ATPC decided to extend the Supply Rationalization Scheme (SRS) into 1995, with a 7.55% cutback from 1994's SRS. Total permissible export tonnages for ATPC members in 1995 are:

Australia	7,800 tons
Bolivia	16,600 tons
China	20,000 tons
Indonesia	30,000 tons
Malaysia	8,200 tons
Nigeria	1,900 tons
Thailand	4,500 tons
Zaire	1,100 tons
- d) The ATPC estimated current tin excess stocks to be on the order of 40,000 tons. It expected member country stocks to reduce by about 5,000 tons by yearend. The ultimate goal remained to reduce stocks below 25,000 tons.

Australia.—Renison Consolidated Goldfields Ltd. remained the major tin producer in the country. Renison operates the Renison Bell tin mine at Zeehan, Tasmania. In recent years, the company has achieved considerable cost reduction at Renison Bell. Productivity reportedly has increased 40% over the past 3 years.

Reportedly the Renison Bell tin mine now ranks among the lowest cost third of all world tin producers. Exploration of the mine's Rendeep section, started in recent years, has been an important facet for the mine. The Rendeep area, which is about 600 to 800 meters below the surface at the northern end of the mine, has been shown to contain significant reserves of high grade tin ore, sufficient to extend mine life by at least 6 years.

Exploration to date of the Rendeep resource has delineated a probable reserve of 3.3 million tons grading 1.96% tin with additional resources of 3 million tons at 1.5%. Metallurgical testwork has indicated higher recovery from Rendeep ore than from existing

reserves. The firm is investing \$30 million to sink a new hoisting shaft which would permit lower cost hoisting of Rendeep ore as well as that from the lower levels of current reserves. This should enable the mine to expand production to over 9,000 tons per year of tin-in-concentrate.

Bolivia.—The first steps toward the privatization of Bolivia's Government-owned COMIBOL mining organization began to take place. A delegation of Bolivian Government mining officials was due to be dispatched to London, England, to solicit interest among antimony, lead, tin, and zinc circles. On offer are exploration and mineral rights, mining operations, smelters, refineries, infrastructure, and equipment. To facilitate the process, COMIBOL would be reorganized into a company exclusively involved with the administration of lease and joint-venture contracts with the private sector for the nonprivatized assets. In order to make the offerings more attractive, the Ministry of Mines announced that all debts and most environmental liabilities would be assumed by the Government.

A number of pollution control measures have already been implemented at the smelters. For example, in 1993, the German firm Stolberg conducted a feasibility study into reducing pollution at the Vinto tin smelter. The project for environmental control now has financing from the German Government for about \$6 million.

A process of rationalization has been undertaken over the past 3 years that eases the move to privatization. Only three COMIBOL tin mines are now operating: Huanuni, Caracoles, and Colquiri. All money-losing operations have been closed. Also, COMIBOL had reduced its work force from 28,000 in 1984 to 1,500 in 1994.

As a result of the planned privatization, tin, lead, and zinc production are expected to grow significantly. Tin output in 1993 and 1994 was in the 16,000 to 19,000 ton range. Of that amount, an estimated 4,000 tons was toll-smelted for the San Rafael tin mine in Peru. Output for 1995 was anticipated to rise to 20,000 tons, of which 10,000 tons would be toll smelted for San Rafael.

Brazil.—The country's major tin producer, Paranapanema SA, embarked on a program to reduce its output of tin concentrates by about 50% in 1994, so as to be consistent with objectives set by the ATPC at its meeting in October 1993. Paranapanema was expecting to produce about 7,000 tons of tin-in-concentrate, down from 13,000 tons in 1993. In worldwide terms, this reduction represents about 4% of primary tin output. In addition to its directly

owned assets, including the high grade Pitinga Mine, the company also holds a 52% stake in Empresa Brasileira de Estanho SA (EBESA) which holds the mining rights for the Bom Futuro tin mine in the Amazon region. Output at Bom Futuro was believed to have remained rather steady in 1994 at about 11,000 tons of tin-in-concentrate.

Mineracaõ Taboca, a wholly owned subsidiary of Paranapanema, won a bid to develop a tin mine in the State of Saõ Paulo. Mineracaõ Taboca agreed to pay \$1.1 million for the project plus royalties equivalent to 15% of the value of the ore extracted from the mine. The firm will pay \$150,000 to conclude studies on the site, which is estimated to contain some 5,000 tons of tin ore reserves at an average grade of 1.5%. These studies were expected to be concluded by early 1995, and if favorable, mine development could start in late 1995. While of modest size, the deposit is considered to be of strategic interest since it is only 483 kilometers (300 miles) from the city of Saõ Paulo, where the large Mamore tin smelter is located.

Cesbra, Brazil's second largest tin smelter, and Minsur, the parent organization of the San Raphael tin mine in Peru, terminated its long-term tolling contract. Under this contract 8,000 to 11,000 tons of tin concentrates were smelted each year at Cesbra's tin smelter near Rio de Janeiro. The loss of this contract was expected to affect Cesbra seriously. As a result, Cesbra was forced to layoff over 100 workers at the Volta Redonda tin smelter, thereby reducing the work force to only 160. The tolling contract had been in effect since 1991. Reportedly, Minsur had sought major reductions in treatment charges, which Cesbra was unwilling to meet. Minsur's mine output is now being shipped to tin smelters in Bolivia, Malaysia, Russia, and Thailand. The loss means Cesbra's smelter output is now only 200 tons per month of tin metal, all from Brazilian concentrates. This represented about one-fifth of the smelters' installed capacity of 1,000 tons per month. Cesbra exported 60% of its output, with the balance sold to a domestic steelmaker or to local tin solder producers.

SNA Minerios a Metais Ltda., a small tin smelter, shut down after a shortage of tin ore had reduced its smelting operations to just 20% of the facility's 500-ton annual capacity. As part of the closure, SNA laid off about 50 workers and sold its 5.4% share in Ebasa, the tin consortium that buys two-thirds of the tin ore extracted from the Bom Futuro Mine in western Rondônia State. Paranapanema purchased 75% of SNA's Ebasa stake, with Companhia Estanifera do Brasil taking the remainder. SNA's management said operations would be

resumed only if it finds enough tin ore to smelt at 50% of the firm's installed capacity. Until the closure, SNA produced tin with a purity ranging from 99.95% to 99.98%, most of which was sold to consumers in Europe. SNA's tin concentrates had originated mostly from Mineracão Canopus which has a mine in northern Para State, and from its stake in Ebesa. Problems developed for SNA this past year when a drop in ore output at Mineracão Canopus and Bom Futuro caused a major reduction in the company's tin ore supply. Canopus, which itself smelted 1,200 tons of tin in 1991, reduced its own smelting output to a level of 480 tons per year starting in September 1993. The Bom Futuro Mine provided Ebesa with only 1,600 tons of tin-in-concentrate in the first 3 months of 1994. Ebesa had expected to receive 2,400 tons.

The São Paulo provincial government called for tenders to exploit tin deposits at a site in the south of the State. Initial surveys indicated about 5,000 tons of tin available in a combined cassiterite/wolframite deposit, grading up to 1.5% tin. There would need to be additional surveys, and it would be at least 2 years before a mine could start commercial production. A bid for the site was made by Mineracão Tobaca, a mining subsidiary of Paranapanema.

Burma.—The State-operated No. 2 Mining Enterprise (Myanmar) and Thailand's Roong Siam Mining Co. signed a production sharing contract (PSC) for offshore tin exploration and exploitation off the Gulf of Martaban and off the coast of Tenassarim. The contract block included the Heinze Basin, an area with known tin deposits. Since early 1990, Myanmar had signed three similar PSC's with three different Thai mining firms but none of these prior three efforts resulted in any tin production.

Canada.—Major steelmaker Stelco, Inc., was reportedly considering ending production of tinplate. If its considerations were actualized, Stelco's tinplate production could cease in 1995. Stelco had been moving away from tinplate production for some time. In 1994, it operated one tin mill at its Hamilton, ON, steel plant producing tinplate, Tin-Free-Steel (TFS), and blackplate. The company, formerly called Steel Company of Canada, has produced tinplate since the late 1940's and there are indications the firm may concentrate on alternative areas of business rather than spend considerable funds to upgrade its tin mill. Stelco's tinplate capacity is about 350,000 tons per year, but production has been only about 200,000 tons per year in recent years. This is despite the fact that Canada has not experienced as marked a shift away from steel beverage cans toward aluminum beverage cans as has the United States over the past 30 years. If Stelco

should cease tinplate production, Dofasco Inc., would remain as Canada's sole tinplate producer.

China.—China formally joined the ATPC for the first time in April, but its membership did not come into effect fully until June. Previously, China had an unofficial "observer" status in the ATPC. It has agreed to meet a 1994 export quota of 20,000 tons but in the first quarter alone it exported nearly 10,000 tons. Chinese officials reportedly blamed the excess shipments on a loss of control over exports after reforming the foreign trade system. They indicated that they have since issued new rules which will regulate exports and help to meet the requirements of the ATPC.

France.—One of the world's largest can makers and tinplate users, Carnaud-Metalbox (CMB), reported gains in many of its activities. The firm resulted from the merger, a few years ago, of two of the largest European can-makers: Metal Box (the United Kingdom) and Carnaud (France). About 80% of the firm's business is in Europe, but it employs 32,000 people in 173 plants in 34 countries. Annual sales are about \$4 billion. Recently, CMB acquired the Finnish metal packaging firm, Sohlberg. In recent years, CMB has made major investments in new can plants in Asia. Profits have reportedly been hampered over the past 2 years by recession in Germany and Spain.

Germany.—Germany's major tinplate producer, Rasselstein, joined several other large European tinplate producers in a joint-worldwide effort to promote the use of tinplate. The other tinplate producers are: Sollac (France), British Steel (UK), and Hoogovens (The Netherlands). The project was expected to be officially starting in early 1995 and would feature a Brussels-based marketing team comprising staff from all four firms.

Later in the year, Rasselstein announced that tinplate now controls 85% of the German can market, which the firm attributed partly to its timely introduction of the 2-piece can. The company further stated that European tinplate makers were on the leading edge of "lightweighting" their can stock to ward off competition from aluminum. In the conservation area, Rasselstein noted that the German tin can industry had achieved a 50% reduction in material consumption since 1970, reduced energy use by 70%, and had achieved a 48% recycling rate.

Metallgesellschaft announced the closure of its last tin smelter. The firm closed the Duisburg tin smelter, part of its Berzelius Stolberg and Hüttenwerke Templehof Division, due to low tin prices that caused the smelter to be unprofitable. The smelter produced high-grade tin-based solders in the form of bars,

sticks, foils, and wires. The smelter had the capacity to produce 10,000 tons of material yearly, although it recently produced at the rate of about 3,000 tons per year.

Indonesia.—The country maintained its position as the world's second largest tin producer from mine sources and the third largest producer of smelted tin metal. The country's main tin producer, Government-owned P.T. Tambang Timah announced plans to go public in 1995. Up to 20% of the firm's shares would be sold, and the funds generated would be used to upgrade the dredges and for a training program to improve the skills of its labor force. The organization produced an estimated 80% of Indonesia's tin output and exported almost 31,500 tons of tin in 1994. It sought to increase the tin production quota for 1995 to 36,000 tons. At current production levels, Timah estimated its commercial tin reserves would last more than 25 years.

The other major tin producer in Indonesia, P.T. Koba Tin, announced plans to increase tin concentrate production in 1996. Koba planned to place a new dredge into operation that would increase its capacity from 7,500 to 10,000 tons per year.

Malaysia.—Just a decade ago the world's dominant tin producer, Malaysia's tin industry activity continued to decline. Malaysian tin mine production in 1994 was about 40% lower than in 1993. Government officials indicated that 30 tin mining operations closed during the year, leaving only 76 operations active.

Netherlands.—Billiton Nederland BV announced that it had completed an agreement with the Cookson Group PLC (UK) to sell Billiton's tin/lead solder making subsidiary, Billiton Witmetaal, to Cookson. Witmetaal, with annual sales of about \$30 million, has facilities in Naarden (The Netherlands), Nuremburg (Germany), Antwerp (Belgium), and Paris (France). Witmetaal was to be merged into Cookson's Alpha-Fry Group, which Cookson formed in 1993 when it reorganized its solder operations by merging its Fry's Metals subsidiary (mostly a producer of industrial solders) with its Alpha Metals subsidiary (mostly a producer of electronic solders). Cookson announced that Witmetaal would be increasing its capacity from 7,000 tons of solder annually to 8,500 tons annually in 1995, of which 55% would be industrial solders and 45% would be electronic solders. Billiton had recently been sold by parent Royal Dutch Shell Corp. to Gencor (South Africa). Cookson, which is the world's major solder-maker, with several units in the United States, announced it would be focusing its marketing strategies upon Eastern Europe, and would be gearing up for the expected increase in demand for electronic

products from the Commonwealth of Independent States, the Czech Republic, and the Republic of Poland.

Hoogovens was the Netherlands' largest steel producer and one of the major tinplate suppliers in Europe. It also had a substantial detinning subsidiary, Hoogovens Scrap Processing (HSP). HSP operated six detinning plants in Belgium, Denmark, Germany, the Netherlands, and Switzerland.

The company had registered some setbacks recently and had been affected by what it viewed as a substantial increase in demand for tinplate scrap by Europe's steelmakers. At midyear, HSP was forced to close its 25,000-ton-per-year detinning plant in Strib, Denmark, because of stringent noise abatement laws. In 1993, its detinning plant in Burgdorf, Germany, was idled by a lack of feedstock. HSP attributed the shortage of scrap tinplate in its market to the growing practice of some European steelmakers, especially in Germany, of charging furnaces directly with scrap tinplate. HSP has a processing capacity of 200,000 tons of scrap tinplate yearly, but is currently processing only at the 135,000-ton-per-year level.

Peru.—This country continued its remarkable surge in tin mine production, which has carried it to fifth place among major world tin producing countries. Over the past 5 years, Peru has almost tripled its annual tin mine output. Peru's only tin producer is privately owned Mineras Sur (Minsur) SA. Minsur operates the San Raphael tin mine in the southern department of Puno. Presently, tin concentrates are exported for smelting, mostly to Bolivia and Brazil. But Minsur's wholly owned subsidiary, Finsur, was formulating plans early in 1994 to construct a 16,000-ton-per-year capacity smelter on the coast of Peru, at Pisco, 290 kilometers (180 miles) south of Lima. By midyear, it was reported that Minsur had signed a contract with Australia's Ausmelt Ltd. to utilize its technology in the new tin smelting plant. It was expected that the refinery would take 2 years to construct and would have an initial capacity of 30,000 tons annually of tin-in-concentrate. Late in the year it was announced that Minsur signed a contract with The Ministry of Mines and Energy, under which Minsur would receive \$35 million for the construction of the new tin smelter and expansion of mine capacity.

The San Rafael tin mine has operated since the 1950's. It is a large conventional underground mine high in the Andes at an altitude of some 5,000 meters. It is accessed via a ramp and uses trackless mining equipment. Proven and probable reserves reportedly are about 2 million tons grading 3.2% tin and

0.85% copper.

In view of Peru's substantial and increasing tin production, the question of its eventual membership in the ATPC has been raised. Peru's Minister of Energy and Mines recently stated that if it appeared that the country's increased tin output was affecting the world market, Government officials would work with Minsur to consider an ATPC membership.

Philippines.—The National Steel Corp. (NSC) of the Philippines announced that it expected to produce 156,000 tons of tinplate in 1994 compared with 106,000 tons in 1993. In 1992, the company had added a 150,000-ton-per-year tinplating line at its Illigan works. NSC also has two tinplating lines with a combined capacity of 150,000 tons annually at its older Manila plant. It stated that the weak Philippine economy and cheaper tinplate exports from countries such as the CIS have prevented NSC from producing at full capacity. The Manila plant also was affected in 1993 and 1994 by power shortages. Only one tinning line is used at the Manila plant; the 60,000-ton-per-year line is shut down temporarily. In 1994, NSC planned to produce 90,000 tons of tinplate on its newer line and 66,000 tons on the Manila line. Black plate is sourced from NSC's own mills, with supplements from Japan, Korea, and Taiwan. The firm exported about 25% of its tinplate to southeast Asia.

Portugal.—The country has experienced marked growth in its tin mine production in recent years. Production has almost tripled in the past 5 years. The source of Portugal's tin is the Neves Corvo copper-tin mine, which is owned by Sociedade Mineira de Neves Corvo S.A.R.L. Neves Corvo, in southern Portugal, is Europe's largest tin mine. Somincor has invested considerable funds in recent years at Neves Corvo, especially in improving tin concentrate grades. These improvements were associated with Somincor's long-term contract with the Zamora tin smelter in Spain, which has traditionally been a processor of high-grade tin concentrates. Somincor attributed the increase in 1994 tin mine output to these investments and also to the striking of a higher tin ore grade early in the year. Not all of Neves Corvo's tin concentrate output goes to Zamora; some also is shipped to the two large Malaysian tin smelters.

Russia.—Over the past 2 years, eight tin mines were forced to close in Russia, leaving the country with only four operating tin mines. To prevent the situation from worsening, the tin industry in Russia reportedly began discussions to forge stronger links and possibly even unite into a single financial/industrial group called Russia Tin. At one meeting of interested parties in Novosibirsk, the location of the country's largest tin smelter, mine officials were informed

that the smelter sought to increase cooperation with the tin mines. Smelter spokespeople stated that the smelter was no longer willing to rely mostly on treating imported concentrates. It was observed that the cost of domestic tin concentrates has often been more than that of imported concentrates and that inefficiencies, poor equipment, transport problems, and lack of investment have severely hindered most of the Russian tin mining industry. The meeting included managers from Deputatsky, Solnechny, the Khingalovo mining and enrichment complex, the Khrustalnenskaya tin mining company, and Kyztsvermet; these officials pointed to high taxes, high energy costs, and high freight costs as especially burdensome.

South Africa, Republic of.—ISCOR Ltd., the major steel producer and tinplate maker in the country reportedly began constructing a new tinplating line. Scheduled to open by mid-1995, the line would add a further 130,000 to 180,000 tons annually to capacity. Capacity had been 350,000 tons yearly. To achieve this, ISCOR was converting an existing tin-free steel line to tinplate production at a cost of \$10 million. ISCOR based its planning on reports of a 10%-plus increase in the domestic beverage can market by 1998-99, which would take demand in that sector to 315,000 tons of tinplate annually. The firm's aim was to obviate the need for tinplate imports and to cover all domestic demand itself with some left over to export.

Thailand.—This country rated as one of the world's top tin producers during the 1980's, but reports continued to indicate declining tin mine production. One official stated that Thailand could even become a net tin importer in the next few years. Continuing industrialization of the country has boosted domestic tin demand. Over the last 10 years, the number of active tin mines in Thailand reportedly has declined from about 500 to less than 30. If net exports do actually decline, and Thailand becomes a net importer, the country could be obliged to give up its ATPC membership.

A speaker representing The Thailand Smelting and Refining Co., the major tin smelter in Thailand, at Metal Bulletin's 3rd International Tin Conference in Jakarta, Indonesia, offered a summary of recent developments in the Thai tin mining-smelting-consumption industries. For more than 100 years, Thai tin concentrates have been produced in the region of Phuket and along the western tin belt. Production reached a peak of 35,000 tons of tin-in-concentrate in 1980, with offshore dredges contributing over one-half of that total. The speaker enumerated four factors contributing to the current low production:

- a) Depressed tin price led to the closure of several tin mines .
- b) High-grade and easy-to-mine tin deposits are mostly depleted.
- c) The mining sector is losing out to the rising tourist industry in the competition for land.
- d) Environmental protection, partly to benefit tourism, is now an obstacle.

However, he illustrated the growing domestic tin consumption. The Thai canned food industry, especially, is increased rapidly, creating demand for local tinsplate. Thai solder consumption is growing 10% annually due to rapid growth in the domestic electronics industry.

Thailand's Council of Economic Ministers agreed to transform the money-losing Offshore Mining Organization (OMO) into a joint-venture company with private firms. The new venture would absorb \$8 million in assets and \$5 million in liabilities and 170 employees. The joint-venture firms would also be given OMO's four existing blocks of offshore tin mining concessions and would be obliged to continue offshore tin mining using OMO's dredger and equipment.

United Kingdom.—The South Crofty Mine, the last operating tin mine, launched a \$1.5 million share issue in an attempt to secure its immediate future during the summer. The British Government agreed to waive repayment of \$35 million in loans made to the mine since 1985 provided that the \$1.5 million share subscription was successful. South Crofty, in the Cornwall District, treated 180,000 tons of tin ore in 1993 to produce about 1,900 tons of tin-in-concentrate. All of the mine's tin concentrates were shipped to the Datuk Keramat Smelting Co. tin smelter in Malaysia. The mines' total identified reserves were 700,000 tons grading 1.48% tin, with further inferred reserves of 2.6 million tons grading 1.46% tin; working mine life was projected to be at least 10 years. The mine's Wheal Jane mill is considered one of the world's most efficient tin concentrators.

By the fall, new ownership had taken control of the South Crofty Mine. Bearing the new name South Crofty Holdings Ltd. (formerly known as Crew Natural Resources, based in Canada), the new owners sought to raise \$3 million from investors through a private placement to fund improvements and expand production at the mine. The new owners pointed out that the firm was now debt-free and anticipated breaking even once expansion was completed. Reportedly, while the South Crofty tin mine had cut costs sharply, it was still operating at a loss of about \$400 per ton, owing to the mining of lower grade ores and the

inability to increase throughput. Immediate reequipping would cost only about \$100,000, but if the firm wished to lower costs even more, one option would be to relocate the milling operation now at the Wheal Jane site; by moving it to South Crofty, the firm believed it could save about \$500,000 annually in tin-in-concentrate transport costs. About \$5 million reportedly would be needed for that option. The firm indicated that a decision would be needed in the next few years since the mine tailings dam at Wheal Jane would become obsolete in about 7 years; by then the firm must decide whether to move the mill or expand the dam. Other changes being considered at the Wheal Jane mill reportedly are removal of barren sand from the gravity circuit and the installation of a second multigravity separator to run in parallel with the existing one, thus improving throughput as well as recovery rates. South Crofty was also reportedly mulling the development of a toll-treating line for zinc ores and other ores.

South Crofty aimed to increase its mill recovery rates to the 87% to 90% level. The average grade of concentrates is now 58% tin, and metallurgical recoveries average 85%. At the mine, the Cook's Kitchen shaft is used for all ore and waste handling, material handling, and worker transport, while the Robinson shaft serves as an emergency exit. The mine is being developed by a combination of shaft and decline access, with two mining methods employed: shrinkage stoping and sublevel long-hole open stoping. During the period 1906-93, South Crofty treated 8.7 million tons of ore, recovering 68,000 tons of tin-in-concentrate. Current identified plus inferred reserves are estimates by management at 3.3 million tons, grading 1.5% tin, or about 50,000 tons of tin.

India's Solo Industries, which bought shares in the South Crofty public stock sale, started receiving South Crofty tin concentrates in the fall. Half of all Crofty production was slated to go to Solo's tin smelter near Bombay under a long-term contract; the remaining output would be divided between tin smelters in Malaysia and Indonesia.

Vietnam.—Domestic tin producers were reportedly demanding major Government relief from royalty and export taxes and threatened that all domestic tin mines might close unless such relief were granted. The Rare and Precious Minerals Corporation of the Vietnam Ministry of Heavy Industry indicated that domestic producers, including the Cao Bang Non-Ferrous Manufacturing Co., the Thai Nguyen Non-Ferrous Manufacturing Co., and the Nghe Tinh Non-Ferrous Manufacturing Co. have been losing substantial amounts of money in recent years due to low tin prices. Producers

sought a 50% reduction in the tin royalty tax and a 20% reduction in the export tax.

Vietnam has shown an increasing trend of tin mine output over the past 5 years. The country has seven major tin-producing areas and estimated reserves of 85,000 tons of contained metal.

Current Research

The USBM Rolla Research Center in Missouri investigated characteristics of recycled automotive oil filters, many of which are fabricated from tinsplate. Increasingly, over the past several years, used oil filters have become a steel scrap item used as an electric furnace scrap charge by steel mini-mills. TAMCO Steel Co., Rancho Cucamonga, CA, has been prominent in such scrap usage. USBM research showed that crushed and drained oil filters have a bulk density that is higher than many traditional scrap steel grades, a chemical analysis low in residual elements (except tin), and an overall yield of oil-filter scrap to cast steel of 76% to 85% depending on the method used to prepare the scrap.

The International Tin Research Institute (ITRI), based in Uxbridge, United Kingdom, the world's foremost laboratory for tin scientific research and new tin applications, completed a transformation in its structure late this year. The ITRI has now become privatized, with funding now supplied by several major tin producer firms rather than by the Association of Tin Producing Countries. The Institute is now called ITRI Ltd. Among the firms funding ITRI are Renison Goldfields Consolidated Ltd. of Australia; P.T. Timah and P.T. Koba Tin of Indonesia; Malaysia Mining Corp. of Malaysia; Minsur SA of Peru; and Somincor of Portugal. Disclosure of other participating producers, as well as membership by smelters and tin consumers, was to be made later. ITRI, in operation since the 1930's, is primarily a research organization that focuses its efforts on expanding the consumption of tin. Among the areas of current interest are lead-free, tin-rich solders; tin chemicals for fire retardants in polyvinyl chloride, plastics, and paper; and tin/zinc alloys for corrosion-resistant coatings.

One area that the ITRI has been focusing on in recent years has been in developing tin foil bottle capsules to replace lead foil. Protective top capsules are used for many wine and spirits bottles, which are applied as a printed closure around the cork or stopper area. This top capsule has a decorative and promotional function, but it also acts as extra protection for the cork against mold growth, and an extra barrier to oxygen ingress which could affect

contents. In addition, it presents a tamper-evident seal, which is now considered critical in many forms of packaging, especially pharmaceuticals, in view of the well-publicized criminal tampering cases of the past decade. The total worldwide consumption of such capsules is estimated at 8 billion units per year and they have utilized three main foil materials: lead/tin, aluminum, and PVC. The lead-based foil material has been the traditional material used for premium quality wines and spirits, with an estimated 2 billion units consumed in 1991. The lead capsule material consists of a thin foil of lead (about 95% to 98% by weight) coated on each side by a very thin layer of roll-bonded tin, which is to prevent contact between the lead and the bottle contents (as well as human fingers). In recent years, there has been increasing concern about possible contamination of wine by this lead capsule. This could be caused by corrosion promoted by direct contact with wine that has seeped through the cork. This could deposit lead salts around the lip of the bottle. Studies have concluded that the main lead contamination occurs when the wine is poured out of the bottle, after the capsule and cork are removed. Also, the disposal of the capsule adds another toxic heavy metal into the waste stream. The European Union banned lead capsules effective January 1, 1993. The great majority of these capsules were manufactured in Europe and used throughout the world. ITRI reported that the U.S. Food and Drug Administration has issued a proposal to ban the use of lead capsules. California, which reportedly produce over 80% of American wines, banned their use on January 1, 1992, and on any imported products March 31, 1993.

ITRI responded to the capsule challenge, believing a product based on tin was feasible for several reasons:

- a) Tin foil has a similar soft feel to the touch and conveys a luxury or premium image, enhanced by its amenability to high quality printing.
- b) The material could be used in existing capsule-forming and bottling equipment.
- c) It can easily be removed manually from the bottle by tearing, without risk of cuts to the fingers.
- d) It is nontoxic, and the waste material is also recyclable.

The ITRI reports that in the last 3 years, most of the major capsule producers have introduced tin capsules as a direct substitute for lead in the premium wine and spirits markets, which are now enjoying high growth in many parts of the world. ITRI continued research on reducing the weight of the tin capsule to make

it more cost competitive with alternative materials. The weight of commercial tin capsules has been reduced now to 4.5 grams, compared with a figure of 10 grams for the original lead-based capsule. It is estimated that 5,000 tons of tin annually is now being used in this application worldwide.

The ITRI reported favorable developments on its work on a new noncyanide based electrolyte called "Stanzec." Its work involves an alloy of tin and zinc that could replace toxic cadmium as an environmentally friendly anti-corrosion coating on steel. "Stanzec" now has been patented for rack or barrel plating, and the plating process has been licensed to a major plating company. The process is currently being scaled up for commercialization in the United States. Reports indicate that tests on the 75% tin-25% zinc alloy coating have shown it to be markedly superior to zinc, cadmium, and zinc-nickel; and, unlike these other coatings, tin-zinc can be used without a chromate passivation film. Reportedly, some leading Japanese car makers have made tin-zinc plating a standard specification for certain car components. The alloy also was expected to fill applications in the aerospace and construction industries. ITRI also was attempting to develop a high-speed tin-zinc plating electrolyte for the continuous plating of steel strip.

In Japan, it was announced that lead-free solder for printed circuit boards, claimed to be the first of its kind in the world, had been developed jointly by Mitsui Mining and Smelting Co., Harima Chemicals Inc. (Osaka), and the Welding Research Institute of Osaka University. Researchers claim the newly developed lead-free solder is similar to the widely used tin-lead eutectic solder, which melts at 183°C, in a variety of standards such as tensile strength, elongation, and other mechanical and electrical properties. Researchers stated that the new solder was available in two varieties: one is a tin-silver type with a melting point of 210°C, and the other is a tin-zinc type with a melting point of 190°C. A spokesperson indicated that further studies will be conducted to apply the technology to producing lead-free flux-cored wire solder and solder paste.

In the United Kingdom, it was reported that the Hirst Research Center of GEC-Marconi Ltd., Wembley, performed developmental studies toward a new low temperature diffusion soldering process in which tin is used for joining carat gold jewelry. Diffusion soldering is a hybrid of diffusion bonding and soldering. The principle of the process is to run a minute volume of solder into a joint between components that are pressed together and to solidify the solder by conversion to high

melting point phases through isothermal reaction with the substrates. Thereafter, the joint will not remelt unless heated to the temperature at which the high melting point phases melt. Tin was found to be suitable to make diffusion soldered joints between components of pure gold. The studies evaluated tin as a diffusion solder for joining items of 18 carat gold alloys representative of alloys widely used in the fabrication of jewelry. Joints can be made by heating to 450°C, which is substantially lower than the temperature needed for brazing of jewelry using conventional carat filler alloys. The resulting joints were found to be color matched and have mechanical properties that are likely to be adequate for jeweler applications.

It was reported that a stainless steel coated with a terne alloy was successfully utilized in a unique construction application. The roof of the new main terminal at Pittsburgh (PA) International Airport was designed and constructed with AISI type 304 stainless steel coated on each side with 20 micrometers of a terne alloy. Arching, 24 meter radius barrel roofs cover the three-story building. Terne, comprised of 80% to 85% lead, and the balance tin, was used as early as the 11th century on church roofs in Europe; but terne-coated stainless steel was introduced only in the 1960's according to the Nickel Development Institute, Toronto, Canada. In the Pittsburgh airport, stainless steel provides corrosion resistance and structural integrity in case of fire. The terne coating weathers to a uniform, warm gray after 2 years of exposure. The precise shade depends on the sulfur content of the atmosphere. Terne also enhances corrosion resistance because it is anodic to stainless steel.

A team of professors and researchers at the Ames Laboratory, Ames, IA, began collaboration on development of a new lead-free alloy for use in strong, high-performance solder pastes, thereby eliminating a substantial source of a known environmental toxin. The composition of the lead-free alloy is tin-silver-copper, elements not commonly naturally found with lead. The researchers reported that silver and copper were not oxidation- or corrosion-sensitive and were not derived from lead ores. They also produce very hard intermetallic phases that would reinforce the tin to make a much stronger solder than the tin-lead combination. The team was reportedly leaning toward a powder form of the new solder composition that is made up of particles less than 25 microns in diameter. When these powder particles are blended with a fluxing agent that help clean the alloy and improve flux characteristics, they create a smooth, fluid-like behavior that is critical for convenient and

accurate handling of solder paste; that is considered very important to paste manufacturers and users who want to disperse it or screen print onto a circuit board. The team observed that principal potential uses for the lead-free solder paste would be applications in the electronics and automobile industries. For years, electronics firms have been concerned about solder strength because many failures occur after temperatures rise. This is especially typical under the hoods of automobiles, where there are many electronic components and where temperatures can easily reach 150°C (302°F). Lead solder melts at 183°C (361°F). The team's lead-free solder melts at 216°C (421°F), making possible solder connections that retain greater strength at equipment operating temperatures. The team also asserts their solder resists thermo-mechanical fatigue, a problem in which components grow when they get hot, and shrink when they cool back down. The solder joint is in the middle and gets flexed, and tin-lead solder is often not strong enough to resist that. The Ames team claims its solder, at about \$4 per pound is at or near the bottom of the price scale for all lead-free solders on the market.

In Utica, NY, Indium Corporation of America introduced a new lead-free solder, Indalloy 227. The solder took 3 years to develop and was introduced commercially after 18 months of testing. Its composition is 77.2% tin, 20% indium, and 2.8% silver. The company claims this solder is the first direct replacement for traditional 67% tin-33% lead solder, with similar melting and reflow characteristics. The firm acknowledged the new solder was more costly than the traditional ore, but still felt that possible emerging legislation against lead (including even the possible imposition of a tax in some applications) would make Indalloy 227 a success.

Outlook

Domestic demand for primary tin is

expected to grow slowly in the next few years, at a rate of perhaps 1% per year. However, new applications, especially those in which tin is substituted for toxic materials, could double that rate by the late 1990's.

As long as the price of tin remains historically low, there appears to be little incentive to explore or develop domestic tin reserves. Thus, it seems likely that domestic requirements for primary tin will continue to be met by imports and Government stockpile sales.

¹Can Manufacturers Institute. Metal Can Shipment Report 1994. Washington, DC, 1994, pp 1-4.

OTHER SOURCES OF INFORMATION

U.S. Bureau of Mines Publications

Tin Ch. in Annual Report, annual.

Tin Ch. in Mineral Commodity Summaries, Annual.

Tin Ch. in Mineral Facts and Problems, 1985 ed.

Other Sources

American Metal Market.

Bottle/Can Recycling Update.

Canadian Mining Journal.

Commodities Research Unit Tin Monitor.

Engineering and Mining Journal.

Focus on Tin.

Metal Bulletin. (London).

Metals Week.

Mining Journal. (London).

Modern Metals.

Recycling Magnet.

Resource Recycling.

Tin International.

Tin Roskill Information Services Ltd.

Wall Street Journal.

Washington Post.

TABLE 1
SALIENT TIN STATISTICS 1/

(Metric tons unless otherwise specified)

	1990	1991	1992	1993	1994
United States:					
Production:					
Mine	W	W	W	W	--
Secondary e/	17,200	13,100	13,700	12,000 r/	10,900
Exports 2/	658	970	1,890	2,600	2,560
Imports for consumption:					
Metal	33,800	29,100	27,300	33,700	32,400
Ore (tin content)	--	1	--	--	--
Consumption:					
Primary	36,800	35,100	35,000	34,600 r/	32,900
Secondary	8,400	9,670	10,100	11,900 r/	8,490
Stocks, yearend, U.S. industry	17,300	13,800	10,700	10,800 r/	10,400
Prices, average cents per pound:					
New York market	287.69	258.75	282.58	239.17	254.93
Metals Week composite	386.29	362.85	400.00	300.00	369.14
London	281.00	254.00	277.00	233.00	248.00
Kuala Lumpur	276.02	248.42	271.85	231.58	244.76
World: Production:					
Mine	221,000 r/	201,000 r/	182,000 r/	187,000 r/	183,000 e/
Smelter:					
Primary	223,000	190,000	184,000 r/	185,000 r/	190,000 e/
Secondary	18,000	13,200	8,820 r/	7,740 r/	7,450 e/
Undifferentiated	4,830	1,720	2,150 r/	1,310 r/	1,340 e/

e/ Estimated. r/ Revised. W Withheld to avoid disclosing company proprietary data; U.S. mine production for 1990-1993 was negligible.

1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to three significant digits.

2/ Excludes reexports.

TABLE 2
U.S. CONSUMPTION OF PRIMARY AND SECONDARY TIN 1/

(Metric tons)

	1993	1994
Stocks, Jan. 1 2/	8,560	9,530
Net receipts during year:		
Primary	37,700 r/	33,000
Secondary	3,280 r/	4,160
Scrap	8,770	4,930
Total receipts	49,700 r/	42,000
Total available	58,300 r/	51,600
Tin consumed in manufactured products:		
Primary	34,600 r/	32,900
Secondary	11,900 r/	8,490
Total	46,600 r/	41,400
Intercompany transactions in scrap		
Total processed	165	214
Stocks, Dec. 31 (total available less total processed)	11,600	9,940

r/ Revised.

1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to three significant digits; may not add to totals shown.

2/ Includes tin in transit in the United States.

TABLE 3
U.S. CONSUMPTION OF TIN, BY FINISHED PRODUCT 1/

(Metric tons of contained tin)

Product	1993			1994		
	Primary	Secondary	Total	Primary	Secondary	Total
Alloys (miscellaneous) 2/	W	W	W	W	W	W
Babbitt	486	337	823	350	277	627
Bar tin	946	W	946	855	W	855
Bronze and brass	1,490	1,600	3,090	1,160	1,920	3,080
Chemicals	6,450	W	6,450	5,740	W	5,740
Collapsible tubes and foil	W	W	W	W	W	W
Solder	11,000 r/	8,010 r/	19,000 r/	10,700	4,370	15,000
Tinning	1,250	W	1,250	1,230	W	1,230
Tinplate 3/	9,650 r/	W	9,650 r/	9,480	W	9,480
Tin powder	608	W	608	625	W	625
Type metal	W	W	W	W	W	W
White metal 4/	789	W	789	756	W	756
Other	1,940	1,990	3,930	2,070	1,920	3,990
Total	34,600 r/	11,900 r/	46,600 r/	32,900	8,490	41,400

r/ Revised. W Withheld to avoid disclosing company proprietary data; included with "Other."

1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to three significant digits; may not add to totals shown.

2/ Includes terne metal.

3/ Includes secondary pig tin and tin acquired in chemicals.

4/ Includes pewter, britannia metal, and jewelers' metal.

TABLE 4
U.S. INDUSTRY YEAREND TIN STOCKS 1/

(Metric tons)

	1993	1994
Plant raw materials:		
Pig tin:		
Virgin 2/	7,460 r/	6,650
Secondary	654	706
In process 3/	1,190	1,510
Total	9,300 r/	8,870
Additional pig tin:		
Jobbers-importers	679	373
Afloat to United States	802	1,110
Total	1,480	1,480
Grand total	10,800 r/	10,400

r/ Revised.

1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to three significant digits; may not add to totals shown.

2/ Includes tin in transit in the United States.

3/ Data represent scrap only, tin content.

TABLE 5
U.S. IMPORTS FOR CONSUMPTION OF MISCELLANEOUS TIN, TIN MANUFACTURES,
TINPLATE AND TERNEPLATE, AND TINPLATE SCRAP 1/

Year	Miscellaneous tin and tin manufactures								
	Tinfoil, tin powder, flitters, metallics, manufac- tures, n.s.p.f.		Dross, skimmings, scrap residues, tin alloys, n.s.p.f.		Tinplate and terneplate		Tin compounds		Tinplate scrap
	Value (thousands)	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
1993	\$5,300	8,280	\$25,000	237,000	\$161,000	431	\$3,150	12,600	\$1,420
1994	2,840	9,150	39,300	337,000	216,000	744	4,740	8,950	1,410

1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to three significant digits.

Source: Bureau of the Census.

TABLE 6
U.S. EXPORTS OF TIN, TINPLATE AND TERNEPLATE IN VARIOUS FORMS,
INGOTS, PIGS AND TIN SCRAP 1/

Year	Tinplate and terneplate		Ingots and pigs		Tin scrap and other tin bearing material except tinplate scrap 2/	
	Quantity (metric tons)	Value (thou- sands)	Quantity (metric tons)	Value (thou- sands)	Quantity (metric tons)	Value (thou- sands)
1993	201,000	\$120,000	2,600	\$11,400	92,600	\$63,200
1994	213,000	123,000	2,560	13,900	68,000	52,800

1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to three significant digits.

2/ Includes rods, profiles, wire, powders, flakes, tubes, and pipes.

Source: Bureau of the Census.

TABLE 7
U.S. IMPORTS FOR CONSUMPTION OF UNWROUGHT TIN METAL
BY COUNTRY 1/

Country	1993		1994	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Bolivia	8,030	\$41,100	7,260	\$38,600
Brazil	11,400	59,400 r/	9,990	50,900
Chile	714	3,150	667	3,510
China	4,200	22,400	3,230	16,500
Hong Kong	1,810	10,000	1,210	6,460
India	20	90	120	647
Indonesia	5,680	29,900	6,620	35,100
Japan	--	--	76	659
Korea, Republic of	--	--	100	535
Malaysia	846	4,660	1,390	8,220
Mexico	572	2,950	--	--
Netherlands	20	95	281	1,550
Russia	40	213	325	1,710
Singapore	220	1,100	142	836
United Kingdom	6	54	666	3,480
Other	163 r/	958 r/	334	1,850
Total	33,700	176,000 r/	32,400	171,000

r/ Revised.

1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to three significant digits; may not add to totals shown.

Source: Bureau of the Census.

TABLE 8
TIN: WORLD MINE PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons)

Country	1990	1991	1992	1993	1994 e/
Argentina	123	--	--	--	--
Australia 3/	7,380	5,700	6,610 r/	8,060 r/	6,400
Bolivia	17,200	16,800	16,500	18,600	16,200 4/
Brazil	39,100	29,300	27,500	26,500 r/	27,000
Burma 5/	596 r/	438 r/	649 r/	689 r/	750
Burundi e/	54	74	110	50	50
Cameroon e/	3	3	3	3	3
Canada	2,830	4,460	--	--	--
China e/	42,000	42,100	43,800 r/	49,100 r/	50,000
Czechoslovakia 6/	590	15	XX	XX	XX
Germany: Eastern states	1,810	118	--	--	--
Indonesia	30,200	30,100	29,400	29,000 e/	34,000
Kazakhstan e/	XX	XX	500	450 r/	400
Laos e/	300 r/ 4/	300	300	300	200
Malaysia	28,500	20,700	14,300	10,400	6,460 4/
Mexico	5	12	1	3 r/	3
Mongolia	320	250	190	150 e/	150
Namibia	900	11	11	4 r/	4
Niger	38	20	20 e/	20 e/	20
Nigeria 7/	192	217	186 e/	186 e/	180
Peru	5,130	6,560	9,680 r/	13,900 r/	14,000
Portugal	4,780 r/	8,330 r/	6,560 r/	10,100 r/	12,000
Russia e/	XX	XX	6,000	5,000	4,100
Rwanda e/	734 8/	730	500	400	50
South Africa, Republic of	1,140	1,040	582	450 r/ e/	-- 4/
Spain	27	12	7 r/	2 r/	--
Tanzania e/	15	6	5	5	5
Thailand	14,600	14,900	11,500	6,380 r/	4,000
Uganda e/	25	25	30 4/	30	30
U.S.S.R. e/ 9/	15,000	13,500	XX	XX	XX
United Kingdom	3,400	2,330	2,040 r/	2,230 r/	1,900
United States	W	W	W	W	--
Vietnam e/	850	800	3,400	3,500	4,000
Zaire	2,220	1,520	1,020	700 e/	700
Zambia	1	6	2	2 e/	2
Zimbabwe e/	1,120	1,060	950	800	800
Total	221,000 r/	201,000 r/	182,000 r/	187,000 r/	183,000

e/ Estimated. r/ Revised. W Witheld to avoid disclosing company proprietary data; not included in "Total." XX Not applicable.

1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to three significant digits; may not add to totals shown.

2/ Contained tin basis. Data derived in part from the Monthly Statistical Bulletin of the International Tin Council, London. Table includes data available through June 27, 1995.

3/ Excludes tin content of copper-tin and tin-tungsten concentrates.

4/ Reported figure.

5/ Includes content of tin-tungsten concentrate.

6/ Dissolved Dec. 31, 1992.

7/ Concentrate gross weight reported, estimated 62% Sn content.

8/ Concentrate gross weight reported, estimated 70% Sn content.

9/ Dissolved in Dec. 1991.

TABLE 9
TIN: WORLD SMELTER PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons)

Country	1990	1991	1992	1993	1994 e/
Argentina: e/					
Primary	180	240 3/	140	145	100
Secondary	100	100	100	100	100
Total	280	340	240	245	200
Australia:					
Primary	312	268	240 r/	222 r/	240
Secondary e/	200	300	360 r/	250	260
Total e/	512	568	600 r/	472 r/	500
Belgium: Secondary	6,060	4,430	5,260 e/	5,000 e/	5,000
Bolivia: Primary	12,600	14,700	14,400	14,500 r/	15,300
Brazil:					
Primary	37,600	25,800	27,000 r/	26,900 r/	30,000
Secondary e/	250	250	250	250	250
Total e/	37,800	26,000	27,300 r/	27,200 r/	30,300
Bulgaria: Primary and secondary	64	22	23 r/	20 e/	20
Burma: Primary	275	157	189	170 r/	200
Canada: Secondary e/	200	200	200	200	200
China: Primary e/	35,000	36,400	39,600	52,000 r/	53,000
Czech Republic: Primary and secondary e/	XX	XX	XX	115	115
Czechoslovakia: 4/ Primary	613	118	115	XX	XX
Denmark: Secondary e/	100	100	100	100	100
Germany: Primary and secondary	3,360	700	127 r/	179 r/	200
Greece: Secondary e/	700	200	200	200	150
India: Secondary e/	200	200	200	200	200
Indonesia: Primary	30,400	30,400	31,900	30,400 r/	31,100
Japan: Primary	816	716	821	804 r/	706 3/
Korea, Republic of: Primary e/	800	600	400	400	300
Malaysia: Primary	49,100	42,700	45,600	40,100 r/	42,000
Mexico: Primary	5,000	2,260	2,590 r/	1,640 r/	1,700
Netherlands:					
Primary	5,900	4,800	--	--	--
Secondary e/	200	200	200	-- r/	--
Total e/	6,100	5,000	200	-- r/	--
Nigeria: Primary	227	246	220	220 e/	200
Norway: Secondary e/	100	90	90	90	90
Portugal: Primary and secondary e/	1,400 3/	1,000	2,000	1,000	1,000
Russia: e/ 5/					
Primary	XX	XX	6,000	5,000	4,100
Secondary	XX	XX	1,500	1,000	800
Total	XX	XX	7,500	6,000	4,900
Singapore: Primary e/	2,500	600	--	--	--
South Africa, Republic of:					
Primary	1,140	1,040	592	452 r/	--
Secondary e/	70	70	60	45	--
Total e/	1,210	1,110	652	497 r/	--
Spain: e/					
Primary	600	600	600	500	700
Secondary	200	200	200	200	200
Total	800	800	800	700	900
Thailand: Primary	15,500	11,300	10,700	8,100 r/	8,100
U.S.S.R.: e/ 5/ 6/					
Primary	16,000	13,000	XX	XX	XX
Secondary	3,700	3,300	XX	XX	XX
Total	19,700	16,300	XX	XX	XX
United Kingdom:					
Primary	6,100 e/	1,660	--	--	--
Secondary	5,900 e/	3,580	100	100 e/	100
Total	12,000 e/	5,240	100	100 e/	100
United States: Secondary	W	W	W	W	W

See footnotes at end of table.

TABLE 9--Continued
TIN: WORLD SMELTER PRODUCTION, BY COUNTRY 1/

(Metric tons)

Country	1990	1991	1992	1993	
Vietnam: Primary e/	1,800	1,700	2,400	2,500	2,500
Zaire: Primary e/	90	70	50	20 r/	20
Zimbabwe: Primary	838	796	716	657	82 3/7/
Total primary	223,000	190,000	184,000 r/	185,000 r/	190,000
Total secondary	18,000	13,200	8,820 r/	7,740 r/	7,450
Total undifferentiated	4,830	1,720	2,150 r/	1,310 r/	1,340
Grand total	246,000	205,000	195,000 r/	194,000 r/	199,000

e/ Estimated. r/ Revised. W Withheld to avoid disclosing company proprietary data; not included in "Total." XX Not applicable.

1/ Previously published and 1994 data are rounded by the U.S. Bureau of Mines to three significant digits; may not add to totals shown.

2/ Data for 1990 are derived in part from UNCTAD. Wherever possible, total smelter output has been separated into primary (from ores and concentrates) and secondary (tin metal recovered from old scrap). This table reflects metal production at the first measurable stage of metal output. Table includes data available through June 27, 1995.

3/ Reported figure.

4/ Dissolved Dec. 31, 1992. All production in Czechoslovakia from 1990-92 came from the Czech Republic.

5/ All production in the U.S.S.R. from 1990-91 came from Russia.

6/ Dissolved in Dec. 1991.

7/ Kamativi mine closed in 1994.