TIN

By James F. Carlin, Jr.

Domestic survey data and tables were prepared by Elsie D. Isaac, statistical assistant, and the world production tables were prepared by Regina R. Coleman, international data coordinator.

In 1998, tin was not mined in the United States. Of the reported primary tin used domestically, 25 firms consumed about 97%. The major uses were as follows: cans and containers, 22%; electrical, 22%; transportation, 13%; construction, 11%; and other, 32%. The estimated value of primary metal consumed domestically was about $305 million. Industry stocks remained steady (tables 2 and 4).

About 16,100 metric tons of tin in purchased old and new scrap, including tin alloys, was recycled (table 5). Of this, about 7,710 tons was old scrap. Almost one-fifth of the tin consumed in the United States was produced at 5 detinning plants and 46 secondary nonferrous-metal-processing plants. Interest was widespread in the recycling of used tin cans, partly because of the rising fees and limited space of landfills. The recycling rate for steel cans was 56% in 1998, compared to 61% in 1997, 58% in 1996, 56% in 1995, 53% in 1994, and 15% in 1988. By yearend, 12,183 tons of pig tin had been sold from the National Defense Stockpile (NDS), leaving 83,607 tons in inventory.

World tin mine output decreased by 2% (tables 1 and 10). Industry observers believed that world supply and demand were in approximate equilibrium. The average Platt's Metals Week composite price of tin declined by 2%.

Of the 23 countries in which tin was mined, the top 6 accounted for about 90% of the world total of 206,000 tons. China was the largest producer (38% of the world total) and was followed by Indonesia (19%), Peru (13%), Brazil (9%), Bolivia (6%), and Australia (5%) (table 9).

World tin reserves, estimated to be 8 million tons, were considered to be adequate to meet the world's future tin requirements. Assuming that the world primary tin consumption will be about 200,000 tons per year, these reserves would last 38 years. Most tin reserves were in Asia and South America.

Legislation and Government Programs

The NDS continued to be managed by the U.S. Department of Defense, with day-to-day operations being guided by the Defense Logistics Agency (DLA). In 1998, the DLA sold 12,183 tons of pig tin from the stockpile. Of this total, 10,313 tons represented long-term sales contracts to RMT Corp. and Considar, Inc. (both of New York, NY). The DLA continued its monthly spot tin sales program under the same format as in recent years, with sales being held on the first Wednesday.

The following depots held the largest inventories of tin, in descending order: Hammond, IN; Anniston, AL; Point Pleasant, WV; and Baton Rouge, LA. At yearend, 83,607 tons of tin remained in the NDS.

Production

Mine.—For the fifth consecutive year, tin was not produced at any domestic mine. Before 1994, one or two small tin mines had operated for many years. A U.S. Geological Survey (USGS) canvass of mines confirmed that there was no domestic tin production in 1998.

Secondary.—The United States was believed by industry observers to be the world's largest producer of secondary tin. Tin metal recovered from new tinplate scrap and used tin cans was the only type of secondary tin available in the marketplace as free tin; most secondary tin was produced from the various scrapped alloys of tin and recycled in those same alloy industries. 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, which had been started in 1988 and funded by five domestic tinplate producers to advance the collection, preparation, and transportation of steel can scrap, was in its fifth full year of expanded activities under its new name, the Steel Recycling Institute (SRI). The SRI fostered the collection of all steel scrap (ranging from appliances to cars), not just steel cans. It continued to maintain its 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 announced that the recycling rates for steel, including tinplate, fell in 1998, after having risen for 10 consecutive years. The Institute attributed the decline to production cutbacks by the domestic steel industry in response to record increases in foreign steel imports. As domestic steel production slackened, it caused a drop in steel scrap demand and, thus, a scrap inventory buildup. Market value for steel scrap declined sharply throughout 1998—from $129 per ton in January to $71 per ton in December. Although many scrap dealers accepted and stored steel product scrap items, pending a market turnaround, these inventoried scrap items were not considered to be "recycled" until they had been shipped to a steel plant for remelting (Steel Recycling Institute, 1999).

Consumption

In 1998, domestic consumption of primary tin increased by 2%, and consumption of secondary tin rose by 4%. Domestic consumption data for tin were developed by the USGS from a voluntary survey of tin consumers. Of the 163 firms to which a survey form was sent, 138 responded, for an 85% response rate (table 3).

In 1998, aluminum accounted for 77% of the 139 billion metal cans shipped domestically; tinplated steel and tin-free steel accounted for 23%. In 1997, aluminum accounted for 76% of the 137 billion metal cans shipped domestically; tinplated steel and tin-free steel accounted for 24%. Aluminum held 100% of the beverage can market, and steel dominated in the food can and the "general line" can markets (Can Manufacturer's Institute, 1998, p. 3).

Silgan Container Corp. announced plans to acquire the canmaking operations of Campbell Soup Co. The deal was subject to regulatory approval. The acquisition followed strategy established by Silgan during the past decade in which the company has acquired captive canmaking operations throughout North America, significantly reshaping the metal food container manufacturing industry. In recent years, Silgan has become the dominant factor in the North American food can market. Campbell 3.4-billion-per-year canmaking capacity (about two-thirds of its total needs) will mean that Silgan, already with almost a 40% share, will have a 50% share of the domestic food can market, which totaled about 32 billion units in 1996. For Campbell, the sale of its canmaking operations was part of a strategy to become less vertically integrated. The canmaking operations were based at four of its food-processing factories. An exclusive long-term agreement, worth an estimated $200 million per year, between the two companies will maintain the supply of cans to Campbell. Silgan will be free to market excess cans made at the facilities to other customers. In 1996, 80% of Silgan's metal can sales were part of long-term supply agreements with customers, some of which, such as Nestle USA, Inc. (17% of sales) and Del Monte Foods Co. (12% of sales) developed from Silgan's acquisition of captive canmaking divisions in the past decade. Silgan was formed in 1987 by two former Continental Can Corp. executives to take over the canmaking operations at a food producer, Carnation Co. Silgan, Ball Corp., and Crown Cork and Seal Corp. were the three major independent food canmakers in North America, accounting for about 90% of the metal container sector of the food packaging market (Canmaker, 1998a).

Two new groups joined with the American Iron and Steel Institute (AISI) to form an alliance that will attempt to increase consumers' awareness of canned foods. The Can Manufacturer's Institute and the Canned Food Information Council will join forces with AISI in the Canned Food Alliance (CFA). The CFA is the successor to a $13 million program started by the Steel Packaging Council (SPC) in 1994; the SPC was an AISI Committee. The program used advertising, events, and other methods to encourage customers to purchase canned foods. Aluminum dominated the canned-beverage market, but steel controlled 95% of the canned food market. Tinplate represented about 4%, by weight, of the total domestic steel market. Tinplate used for food cans accounted for about 3% of the total domestic steel market. CFA indicated that its main competition came not from another material for packaging, but from fresh food. Before the program began in 1994, an independent study had predicted that the market for canned food would fall by 3% to 5% per year. Since then, the market, however, has actually been rising by 4% per year and sales of food for human consumption have increased by about 1.5%; the rest of the increase came from canned pet-food sales. Though per-capita consumption of canned fruits declined, purchases of canned tomatoes and vegetables increased significantly (New Steel, 1998a).

Prices

The Platt's Metals Week composite price for tin metal remained in a narrow range for the entire year. The average composite price for 1998 was 2% lower than that of 1997.

The London Metal Exchange (LME) remained the primary trading arena for tin. Tin was one of only six metals (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.

Officials at the LME announced plans to start a new index contract that would be based on all six metals traded on the LME. The contract would be a multimaturity index incorporating the first 3 months prices, by reference to each third Wednesday, and production value weighted. The index was to be launched at the 1000 level and would roll on the second Wednesday of each month. Officials believed that the proposed contract would offer risk diversification to investors, enhancement of yield or appreciation as part of a portfolio, and arbitrage opportunities for the trading community (Platt's Metals Week, 1998c).

Foreign Trade

Imports of refined tin, which supplied most domestic tin requirements, increased by about 8% in 1998. Imports of tin in all forms (ore and concentrate, metal, waste, and scrap) remained duty free (tables 7 and 8). In the United States, trading firms marketed most of the tin metal that they imported from a variety of countries and warehoused in this country until it was sold to customers. Foreign-owned firms tended to dominate the field. Most tin dealers were based in the New York area. Some tin was also marketed directly in the United States by large foreign producers that 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 largest tin producer, PT Tambang Timah.

Imports of tin from China more than doubled in 1998 as China replaced Brazil as the largest source of tin metal imports. Peru also registered a significant increase from its 1997 level of exports to the United States to rank as the second leading source of tin. Tin exports were small compared to imports (table 6).

World Review

One of the decisions at the September 1998 meeting of the Association of Tin Producing Countries (ATPC) in Rio de Janeiro, Brazil, was that Brazil would become the permanent host country. The headquarters were to be moved from Kuala

Lumpur, Malaysia, to Rio de Janeiro in 1999. The idea was raised and will be considered at the next meeting of tin-consuming countries being permitted to join the ATPC. Until now, only tin-producing countries have been allowed to be members, and membership has been declining in recent years. Thailand left the group in 1996 and Malaysia departed in 1997 after each country became a net tin importer. Australia and Indonesia have also left since 1996, the latter citing financial difficulties. In 1998, the ATPC comprised Bolivia, Brazil, China, the Democratic Republic of the Congo, and Nigeria (American Metal Market, 1998a).

Argentina.—Sunshine Mining and Refining Co. (USA) announced that it had completed its internal evaluation of the first half of its 1998 drilling program at the Pirquitas silver-tin mine in northwestern Argentina. Proven and probable ore reserves within the mineralized zone were estimated by the company to be 15 million tons with an average grade of 199 grams per ton silver and 0.31% tin, containing 3 million kilograms (96 million ounces) of silver and 47,000 tons of tin. The firm's feasibility study on the prospect was scheduled to be completed in late 1998 (Tin International, 1998d).

Australia.—RGC Corp. (formerly known as Renison Goldfields Consolidated Plc.), a major tin and mineral sands miner, announced it would merge with Westralian Sands Co. The merger would create the world's second largest mineral sands group, with total assets of more than $700 million and annual sales of $450 million. The merged entity would be run by Westralian's chairman. RGC's 56% stake in Goldfields Ltd. would be excluded from the merger and sold off, the proceeds reverting to RGC shareholders only. Both boards and Hanson Plc., which is a 39% shareholder in RGC and will end up with a 24% interest in the new entity, approved the deal. RGC management said it would seek to sell its nonmineral sands assets, including its wholly owned Renison Bell tin mine on Tasmania and its 75% stake in PT Koba Tin in Indonesia. RGC would then be completely out of tin mining (Tin International, 1998b).

Tin Australia NL (formerly Norminco Plc.) agreed to purchase the tin and other base metals assets of Great Northern Mining Co. in North Queensland. The assets comprised exploration and mining titles covering more than 2,500 square kilometers centered on the major part of the Herberton tin field in North Queensland in addition to the remaining plant and equipment at the Jumna mill site. The consideration for the sale was reported to be about the $1 million carrying cost of these assets and will be paid in equity in Tin Australia NL (Tin International, 1999).

Belgium.—Association of European Producers of Steel for Packaging (APEAL), the association of European tinplate producers, announced that the recovery and recycling rate of steel packaging in Europe grew by 7%, to 52%, in 1997. About 1.3 million tons of steel packaging were recycled in the European Union (EU) in 1997. About half of the steel packaging was recovered from municipal waste incineration plants by magnetic separation, and the remainder came from various curbside collection programs. Of the countries reporting to APEAL, Germany remained on top with a rate of 84%, and was followed by Austria (75%), Sweden (70%), the Netherlands (67%), Belgium (59%), France (46%), the United Kingdom (31%), and Spain (25%). Steel can recovery in the EU, however, still lagged behind Japan (80%) and the United States (61%) (Metal Bulletin, 1998h).

Bolivia.—The country's Government-owned tin smelting organization, Empressa Nacional de Fundiciones (ENAF), announced that after more than a year of unsuccessful attempts to sell its assets as part of a privatization move, it was trying a new approach. Company officials stated that Paribas, the French investment bank, was managing the privatization effort, which could take the form of an outright sale, a leasing contract, or a joint venture. ENAF allowed the possibility that the Vinto tin smelter could be sold separately from the several mines also being offered—the Huanuni (tin), the Colquiri (tin-zinc), the San José (lead-silver), and the Cerro Rico de Potosí (silver). In 1998, refined tin output at Vinto was 11,102 tons compared with 16,853 tons in 1997. The smelter had a capacity of 30,000 tons per year of refined tin. Huanuni had proven and probable reserves of 3.7 million tons of tin ore grading 2.6% tin, as well as 8.1 million tons of prospective and potential reserves. Production there had been running at a rate of 2,400 tons per year of tin content. At Colquiri, proven and probable reserves were estimated to be 12.5 million tons of ore grading 0.8% tin and 4.7% zinc (Metal Bulletin, 1998a).

Brazil.—The country's largest tin producer, the Paranapanema Group, announced that it had decided to scale back a planned $100 million to $150 million hard-rock tin mining project because of low tin prices. Paranapanema's Pitinga alluvial tin mine in the western Amazon region was producing about 10,000 tons per year of tin-in-concentrate, more than 70% of the firm's total tin output. Alluvial mining at Pitinga, however, was rapidly exhausting the mine's near-surface tin reserves, which prompted the firm to plan a deeper hard-rock mining project there. The firm projected that by the time the hard-rock project will be operational in 2002, the mine's alluvial output will have declined considerably. Although Paranapanema originally planned a 23,000-ton-per-year hard-rock project at the mine, it now planned for only a 12,000-ton-per-year operation. Officials noted that because tin ore at Pitinga is mixed with columbium and tantalum ore, the project would include plans to produce 500 tons per year of tantalum oxide and 4,000 tons per year of columbium products (American Metal Market, 1998c).

China.—The country's major tin producer, Yunnan Tin Corp., announced plans to increase 1998 production by 2,000 tons from that of 1997, to about 25,000 tons per year. Yunnan officials claimed current capacity to be 30,000 tons per year (Platt's Metals Week, 1998a).

An older tin mill that had been physically transported to China from Japan began operation as a Japanese-Taiwanese joint venture. The tin mill had been moved from the Keihin Works of NKK Corp., west of Tokyo, to the Chinese city of Fuzhou in Fujian Province. The joint venture was the first foreign-owned company in China's steel industry involving no Chinese ownership. The joint venture, Fujian Sino-Japan Metal Corp., was launched in December 1995 with capital of $42 million. NKK and six Japanese trading companies owned 65% of the project, and Taiwan's Tung Ho Steel Enterprise

Corp. owned the remaining 35%. The plant employed 250 people and was expected to produce 150,000 tons per year of tinplate.

The Government reported that the country produced 67,700 tons of tin ingot in 1997, compared with 71,500 tons in 1996. The decline stemmed from the closure of most of the country's small producers owing to the low tin price. The two biggest smelters, Yunnan Tin and Luizhou Tin Corp., maintained output at the same level as in 1996. In 1997 exports reached 30,000 tons of tin ingots. China's production of tinplate increased by 200,000 tons in 1997, accounting for 1,300 tons of new domestic tin ingot demand. China's domestic tin consumption remained about the same as in 1996. China had imported 18,500 tons of tin products in 1996 (Metal Bulletin, 1998b).

France.—Usinor Group, a steelmaker, ranked among the largest steel producers in the world. Its flat-rolled steel subsidiary, Sollac, ranked as the world's largest producer of steel for beverage cans and the second-largest producer of steel for packaging. With an average annual production rate of about 1.1 million tons of steel for packaging, the human and pet foods sectors represented Sollac's main market, with 47% of the total production. General line cans represented 23% of output; beverage cans, 16%; aerosol cans, 5%; and closures, crown corks, and caps, 9%. Sollac had three manufacturing sites producing steel for packaging—two in northern France (Florange and Mardyk) and one in western France (Basse Indre). In 1997, the Basse Indre plant made 400,000 tons of tin-free steel and tinplate, the Florange site produced 400,000 tons of tinplate, and the Mardyk site produced 300,000 tons of tinplate (Canmaker, 1998b).

Indonesia.—Timah, one of the world's major tin producers, fashioned a new restructuring plan, whereby it would become a holding company, with its subsidiaries focusing on mining and smelting and exploration activities. This would allow the firm to diversify into a multicommodity mining company. In 1997, the company's tin-in-concentrate production increased by 5% compared with that of the prior year, to 44,000 tons, with 21 dredges producing 21,000 tons and its inland mines contributing 23,000 tons. In 1997, refined tin production increased by 6%, to 43,000 tons. Timah completed the reconstruction of the "Kandur I" dredge; this dredge was acquired from Malaysia in used condition and was rebuilt at a savings of 50% compared with the cost of building a similar dredge from scratch. The dredge was commissioned in summer 1998 (CRU Tin Monitor, 1998c).

RGC (Australia) announced 1997 results for its Indonesian subsidiary, Koba. Koba's mine output increased by 17%, to 10,400 tons, and, its smelter, in its second full year of production, produced 10,000 tons of refined tin, an increase of 18% compared with 1996 production. The smelter began toll-smelting of third-party material to ensure full capacity utilization (CRU Tin Monitor, 1998b).

The Ministry of Mines and Energy announced that Indonesia would no longer be a member of the ATPC after August 1998. The Ministry observed that Indonesia had not been complying with the restricted tin output guidelines of the ATPC's Supply Rationalization Scheme for several years (Platt's Metals Week, 1998b).

Japan.—NKK, the country's second largest steel producer, announced the startup of production of a laminated steel sheet for a new type of two-piece beverage can. To produce the coils of sheet, NKK spent $54 million to install a laminated-sheet facility and to modify the No. 2 tin-free steel line and other equipment at its Fukuyama Works. The tin-free line has a capacity of 15,000 tons per month. The laminated-sheet facility coats both sides of the tin-free sheet with a polyester film. The line processed sheet up to 1,240 millimeters (48.8 inches) wide. NKK stated that the laminated film preserved the flavor of beverages and was also an environmentally friendly product because neither lubricants nor cooling agents were used in the forming process. The coils of sheet were shipped to Toyo Seikan Kaisha Ltd., Japan's largest canmaker, to make a product it called "The Toyo Ultimate Can;" this new product competes with traditional tin cans (New Steel, 1998b).

Malaysia.—The Government's announced 14% to 18% increase in the country's tin-in-concentrate production for 1998 was achieved. The increase was due largely to the issuance by the Government of 15 new tin mining licences in 1998 in a bid to revive dormant mines in the States of Perak and Selangor. About half of those mines were operating by yearend. Each reactivated mine can reportedly produce 200 to 300 tons per year of tin-in-concentrate; when fully operational, they could raise Malaysia's output by about 4,000 tons per year (Platt's Metals Week, 1998d).

Despite the long decline in its domestic mine production, especially since the Tin Crisis of 1985, Malaysia has remained the leading center for tin smelting in the world. In 1998, Malaysia Smelting Corp. in Penang had a capacity of 60,000 tons per year of tin concentrate.

The National Mineral Development Policy was considered to be close to implementation, which should help revitalize the country's tin industry by encouraging the exploitation of hard-rock nonalluvial tin deposits and offshore areas. The Government and the country's tin mining industry have already undertaken projects to rejuvenate the tin sector, including considering joint ventures with projects in Africa, Australia, Canada, Indonesia, Laos, Mongolia, Vietnam, and the former Soviet bloc countries (Metal Bulletin, 1998d).

Tin trading volumes on the Kuala Lumpur Tin Market (KLTM) declined markedly as a result of the closure of the Escoy Ltd. tin smelter in Penang early in 1998. Already-low trading volumes of 70 to 100 tons per day fell to around 60 to 70 tons per day. The KLTM was a physical market. Much of the tin metal in the region was priced via the KLTM with six companies represented on the trading floor. Attempts were made to get tin from other countries, including Indonesia, to trade on the KLTM (Metal Bulletin, 1998c).

Morocco.—A new $1 million high technology solder plant was established in Casablanca by a Moroccan-Portugese consortium. The plant, Techno Soudres, was established by the Moroccan Afriquia Group and the Electro Portugal Co. It was expected to employ a staff of 50 people and to produce about 2,000 tons per year of solder, destined mostly for Europe (Tin International, 1998a).

Pakistan.—A local textiles manufacturer announced plans to

install a 100,000-ton-per-year electrolytic tinning line near Karachi. Siddiqsons Tinplate Ltd. planned to start commercial operations at Winder, about 90 kilometers from Karachi, in mid-1999. The total project was estimated to cost about $35 million, which would be financed 60% as debt and 40% as equity. Among the equity participants would be major tinplate producer Sollac and major trader Mitsubishi Corp. (Japan). Each would invest $1 million for a 7% stake. Siddiqsons estimated that Pakistan consumed about 150,000 tons per year of tinplate. The new plant would be Pakistan's first tinplate line (Metal Bulletin, 1998g).

Peru.—Minsur S.A., the country's only tin producer, announced plans to expand its mining capacity. This followed an expansion in mid-1996 that took ore mining capacity from 1,000 tons per day to 1,500 tons per day. Minsur planned to increase the treatment capacity at its San Rafael tin mine from the existing 1,500 tons per day to 2,500 tons per day within 2 years. Minsur's mining operations involved extracting mineral rock that contained about 6% tin. The concentrate produced had a 50% tin content. In 1998, Minsur produced almost 26,000 tons of tin-in-concentrate (CRU Tin Monitor, 1998a).

Minsur also announced that it was proceeding with the second stage of its Pisco tin smelter project. This stage will include the addition of oxygen enrichment at the smelter, which used the new Ausmelt Pty. Ltd. technology. The priority will be to supply as much tin-in-concentrate to the Pisco smelter as possible and to export only the surplus. In recent years, Minsur has toll-smelted much of its tin mine output at the Vinto smelter (Bolivia), the Thailand Smelting and Refining Co. Ltd. (Thaisarco) smelter (Thailand), and the Malaysia Smelting smelter (Malaysia). About 60% of Minsur's refined tin went to the United States, 30% to Europe, and 10% to South America.

Russia.—Novosibirsk Tin Works, the country's biggest tin producer, announced that it planned to restart smelting on a tolling basis later in 1998 after completing a cost-cutting program. Of the plant's production in 1996, 48% was external tolling and 23% was domestic tolling, but it stopped tolling in 1997. Spare capacity was converted to process polymetallic waste and secondary raw materials; for example, the plant produced 1,000 tons of lead in 1997. The tin that Novosibirsk produced was sold in Russia; the Magnitogorsk Metallurgical Combine (MMK), which made tinplate, was the most significant customer. Novosibirsk's top priority was to cut energy costs, and to that end, it purchased a generator from The ABB Group that was to be operational by yearend. Officials believed that the new generator could cut the plant's electric power cost by half. The smelter would also start recovering other metals from secondary raw materials to be shipped mainly from abroad (Metal Bulletin, 1998f).

MMK, reportedly the largest producer of iron and steel in the countries of the Commonwealth of Independent States, planned to install a new cold rolling mill in 2001. MMK had a tinplate capacity of 500,000 tons per year. A cold-rolling mill was a critical component in the processing stages before the tin mill (Tin International, 1998c).

Slovakia.—VSZ Holding a.s., one of the largest steelmakers in Central Europe, was set to form a joint venture contract with the U.S. Steel Group. The parties intended to own and operate jointly a tinplate production plant in Slovakia. Initially, operations would begin with VSZ's existing facilities, which included a 140,000-ton-per-year tinning line, a continuous annealing line, and a temper mill at it's integrated steel complex in Kosice, eastern Slovakia. The expansion would involve adding a new 200,000-ton-per-year continuous annealing line. The decision to form the partnership would enable U.S. Steel to serve a new customer base in Central Europe, including a growing number of American can companies drawn to the region by growing demand (CRU Tin Monitor, 1998d).

United Kingdom.—The South Crofty, the country's last operating tin mine, closed early in the year. Tin mining in Cornwall dated back to Roman times, and South Crofty was the last of several active tin mines in that region in the past decade to close. Officials at the mine had submitted a proposal for a $10 million financial aid plan to the Department for Trade and Industry. The Government, however, rejected the financial aid proposal. The Canada-based owner of the mine, Crew Resources Ltd., which had acquired control in 1994, made the decision in 1996 to close the mine by late 1997. Crew cited low tin prices combined with the strength in the British currency, the pound sterling (Platt's Metals Week, 1998e).

Zimbabwe.—The Zimbabwe Mining Development Corp. (ZMDC) and a local investor contemplated the re-opening of the Kamativi tin mine, which had been Africa's largest tin mine before it closed. Allied Mining Investments Ltd. was close to completing a draft option financial agreement with ZMDC to revive operations. The mine, which produced about 860 tons of tin content in its last year, suspended operations in 1994, throwing 700 workers out of work (CRU Tin Monitor, 1998e).

Current Research

The International Tin Research Institute (ITRI), based in Uxbridge, United Kingdom, the largest laboratory for tin scientific research and new tin applications, completed its fourth full year under a new structure. It is now privatized, with funding supplied by several major tin producer and user firms rather than by the ATPC as had been the case in earlier years. The ITRI continued to focus its research efforts in several areas that would take advantage of tin's relative nontoxicity compared with other metals—lead-free solders, inorganic tin compounds as a replacement for antimony in flame-retardant chemicals, and tin shotgun pellets.

In Phuket, Thailand, at Metal Bulletin's 5th International Tin Conference, delegates were told of developments leading to the possible use of more tin in solder to replace lead. The use of lead-free solders was expected to be driven by three factors—direct legislation, marketing, and technical considerations. Through these means, a potential increase in tin consumption of 26,000 tons per year has been estimated for the global solder market. Denmark has been the leader in Europe in phasing out lead in solder to reduce risk to users from exposure to lead. In Japan, Matsushita Corp. announced that four of its home electronics products will be lead free by

2001; Hitachi Ltd. intends to halve the lead it uses in electronics products by 2001; Toshiba Corp. and Sony Corp. were expected to follow suit. The change to lead-free solders would mean moving to a tin alloy solder containing more than 90% tin rather than the typical 63% in the tin-lead solder used for electronics. The lead-free solders are likely to consist of tin-silver, tin-copper, or tin-copper-bismuth, as well as tin-indium combinations. The move from lead to tin and higher-priced alloying components was expected to result in a 30% to 100% increase in the cost of the solder (Metal Bulletin, 1998i).

Multicore Solders Plc., a British-based firm, announced that it had signed a licensing agreement to procure and market a lead-free solder on the basis of a composition patented by the Ames Laboratory (Ames, IO). The new solder was reportedly an alloy of copper, silver, and tin. The agreement was the second licensing agreement signed by Ames for lead-free solder. The first was signed with Johnson Manufacturing Co. in May 1995 (JOM, 1998).

The International Copper Association (ICA) announced the development of the CuproBraze process for manufacturing automotive radiators, which reportedly will cut costs by at least 10%. According to the ICA, the major breakthrough was the manufacturing speed of the new process. It was reportedly 50% faster than comparable aluminum radiator production lines. Also, the difference in melting temperatures greatly reduced the scrap rate. With aluminum, the window for brazing was less than 40° C, and overshooting the correct temperature would result in total scrapping of the production run. With CuproBraze, the window was nearly 300° C, and the process was more forgiving. First-run rejects could be rebrazed, further reducing the scrap rate. If widely adapted, this new process would reduce the use of tin solder (67% tin and 33% lead). The braze used, however, contained about 5% tin (Advanced Materials and Processes, 1998b).

The U.S. Mint (Washington, DC) announced that it is considering several specific alloys for its proposed new dollar coin. Among the alloys being considered is the combination of 89% copper, 5% aluminum, 5% zinc, and 1% tin known as "Nordic gold," which is used in the Swedish 10-kroner coin. The Mint is conducting extensive tests to determine the suitability of the considered alloys, including such tests as exposure to human perspiration, mechanical wear and tear, and electrical testing. The Mint expected that the coin could be introduced in 2000, with about 100 million coins as the initial production target (American Metal Market, 1998b).

Nippon Steel Corp. (Tokyo, Japan) announced that it had developed an ultra-thin tinplate for lightweight steel beer cans that were successfully test marketed on Japan's southern island of Kyushu. About 72 million steel cans for low-malt beer using the new can stock from Nippon Steel were sold in Kyushu. The tinplate, as thin as 0.19 millimeter, which has excellent drawability, was an attempt by Japan's largest steelmaker to gain market share for tinplate in a competitive battle with aluminum. In 1997, steel's share in the beer can market in Japan diminished to less than 0.7%, or 70 million cans, compared with aluminum's 99.3% share, or 10.15 billion cans. Steel still held a market share of 56.6% (21.57 billion cans) against aluminum's 43.4% (16.56 billion cans) in the overall market for all types of beverage cans. The ultra-thin tinplate reduced the weight of a steel beverage can to less than 30 grams (American Metal Market, 1998d).

Leeman Laboratories Co. (Hudson, NH) developed a spectrometer that precisely analyzes tin-lead solders. The A30 Metal Alloy Analyzer provided precise analysis of tin and lead for applications such as electronic assemblies and plumbing systems that carry drinking water (Advanced Materials and Processes, 1999e).

Materials Resources International Co. (North Wales, PA) developed a new tin-containing alloy to enhance solderability. Designated "Solder Bond 500," the tin-silver-titanium alloy can be used for precoating metals, ceramics, carbides, graphite, diamonds, oxides, nitrides, and many composites. The alloy directly wetted materials in preparation for soldering without the need for fluxes or special atmospheres. The precoating alloy was applied directly to the joint surfaces as a molten metal layer. After it has solidified, "Solder Bond 500" produced metallurgically bonded layers with any conventional solder. It is easily applied in air at low temperatures by brushing, dipping, or other methods. Applications include joining of light metals, such as aluminum, magnesium, and titanium; electronic ceramic materials; and ceramic-to-metal assemblies (Advanced Materials and Processes, 1998a).

Advanced Ceramics Corp. (Cleveland, OH) developed a process in which small particles of ceramics, graphite, and metal were encapsulated within pure metallic coatings. Tin may be one of the coatings used, along with cobalt, copper, iron, nickel and zinc or a combination of these metals. Coated particles, of which the coatings comprise 20 to 40 volume percent, were said to be easily attainable. Any material that can be wetted by water and has a specific gravity of greater than 1 was said to be a candidate for the process. Advantages include low cost, short production cycles, high volume production capacity, and the ability to put thick coatings on a variety of particles (Advanced Materials and Processes, 1998d).

Research applications in the field of metal foams offered possible new applications for tin. A new powder metallurgy process for production of metal foams was first developed for aluminum foams and now has recently been extended to other metals and alloys, such as bronze, lead, steel, tin, and zinc. Metal foams are metallic cellular materials that have a high porosity fraction, typically ranging from 40 to 90 volume percent. Because of their high stiffness and low specific weight, cellular materials are applied in construction, packaging, insulation, noise and vibration damping, and filtering. They are considered by some to be a new class of engineering material. Metal foams can be fabricated in a variety of ways. Recently, a new powder method for fabricating metal foams was developed by the Fraunhofer Institute for Applied Materials Research in Bremen, Germany. This method allowed for direct net-shape fabrication of foamed parts with a homogeneous pore structure. Metallic foams fabricated by this approach exhibited a closed-cell microstructure with higher mechanical strength than open-cell foams. This type of microstructure was particularly appropriate for applications requiring reduced weight and energy-absorption capabilities (Advanced Materials and Processes, 1998c).

Outlook

Domestic demand for primary tin is expected to grow slowly in the next few years, at a rate of perhaps 1% per year. If, however, new applications, especially those in which tin would be substituted for toxic materials, find acceptance in the marketplace, then that rate could double by 2002.

World tin reserves appear to be adequate to meet the foreseeable demand. Secondary sources of tin seem likely to remain an important component of tin supply, especially in the United States. The U.S. Government stockpile appears likely to remain in a selling mode in coming years, remaining an important segment of domestic tin supply. Domestic tin needs, however, will probably continue to be met primarily through imports.

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TABLE 1
SALIENT TIN STATISTICS 1/

(Metric tons of contained tin, unless otherwise specified)

	1994	1995	1996	1997	1998
United States:					
Production:					
Secondary e/	11,700	11,600	11,600	12,400 r/	16,100
Exports, refined tin	2,560	2,790	3,670	4,660	5,020
Imports for consumption, refined tin	32,400	33,200	30,200	40,600	44,000
Consumption:					
Primary	33,700	35,200	36,500	36,200 r/	37,100
Secondary	8,530	10,800	8,180	8,250	8,620
Stocks, yearend, U.S. industry	10,400	11,700	10,900	11,200 r/	10,700
Prices, average cents per pound:					
New York market	254.93	294.54	288.10	264.45	261.38
Platt's Metals Week composite	369.14	415.61	412.43	381.49	373.26
London	248.00	282.00	279.00	256.00	251.00
Kuala Lumpur	244.76	277.50	275.19	252.24	246.06
World: Production:					
Mine	178,000	193,000 r/	206,000 r/	210,000 r/	206,000 e/
Smelter:					
Primary	197,000 r/	204,000 r/	211,000 r/	213,000 r/	205,000 e/
Secondary	19,000 r/	18,900 r/	16,700 r/	17,400 r/	20,300 e/
Undifferentiated	200	200	200	200	200 e/

e/ Estimated. r/ Revised. NA Not available.
1/ Data are rounded to three significant digits.

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

(Metric tons of contained tin)

	1997	1998
Stocks, January 1 2/	9,180 r/	9,390
Net receipts during year:		
Primary	39,000 r/	40,000
Secondary	2,360	2,490
Scrap	6,010 r/	6,240
Total receipts	47,300	48,700
Total available	56,500 r/	58,100
Tin consumed in manufactured products:		
Primary	36,200 r/	37,100
Secondary	8,250	8,620
Total	44,400 r/	45,700
Intercompany transactions in scrap	138	137
Total processed	44,600 r/	45,800
Stocks, December 31 (total available less total processed)	11,900	12,300

r/ Revised.
1/ Data are rounded 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	1997			1998		
	Primary	Secondary	Total	Primary	Secondary	Total
Alloys (miscellaneous) 2/	W	W	W	W	W	W
Babbitt	683	226	909	831	185	1,020
Bar tin	684 r/	W	684 r/	704	W	704
Bronze and brass	1,330	1,830	3,160	1,700	1,910	3,610
Chemicals	8,170	W	8,170	8,170	W	8,170
Collapsible tubes and foil	314	W	314	238	W	238
Solder	11,300	4,660	15,900	11,900	4,960	16,900
Tinning	1,210 r/	W	1,210 r/	1,100	W	1,100
Tinplate 3/	9,350	W	9,350	8,900	W	8,900
Tin powder	W	W	W	W	W	W
Type metal	W	W	W	W	W	W
White metal 4/	754	W	754	778	W	778
Other	2,440 r/	1,540	3,980 r/	2,700	1,560	4,260
Total	36,200 r/	8,250	44,400 r/	37,100	8,620	45,700

r/ Revised. W Withheld to avoid disclosing company proprietary data; included with "Other."
1/ Data are rounded 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)

	1997	1998
Plant raw materials:		
Pig tin:		
Virgin 2/	7,550 r/	7,700
Secondary	692	716
In process 3/	1,130	1,080
Total	9,370 r/	9,500
Additional pig tin:		
Jobbers-importers	1,370	804
Afloat to United States	488	425
Total	1,860	1,230
Grand total	11,200 r/	10,700

r/ Revised.
1/ Data are rounded 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. STOCKS, RECEIPTS, AND CONSUMPTION OF NEW AND OLD SCRAP AND TIN RECOVERED,
BY TYPE OF SCRAP 1/

(Metric tons)

	Gross weight of scrap								
	Stocks,		Consumption			Stocks,	Tin recovered e/ 2/		
Type of scrap	January 1	Receipts	New	Old	Total	December 31	New	Old	Total
1997:									
Copper-base scrap	6,010	128,000	26,700	101,000	128,000	5,800	1,160	3,680	4,840
Brass mills 3/	--	47,300	47,300	--	47,300	--	1,010	--	1,010
Foundries and other plants	2,660	16,500	7,170	10,100	17,300	1,880	333	368	701
Total tin from copper-base scrap	XX	XX	XX	XX	XX	XX	2,510	4,040	6,550
Lead-base scrap	31,200	1,360,000 r/	77,500 r/	1,290,000	1,370,000	23,100	2,030 r/	3,750	5,780 r/
Tin-base scrap 4/	W	34	W	41	W	W	(5/)	39	39
Grand total r/	XX	XX	XX	XX	XX	XX	4,540 r/	7,830	12,400 r/
1998:									
Copper-base scrap	5,800	124,000	26,700	96,900	124,000	6,340	1,170	3,540	4,710
Brass mills 3/	--	47,000	47,000	--	47,000	--	987	--	987
Foundries and other plants	1,880	15,000	5,840	8,840	14,700	2,200	275	344	619
Total tin from copper-base scrap	XX	XX	XX	XX	XX	XX	2,440	3,880	6,320
Lead-base scrap	23,100	1,400,000	65,600	1,340,000	1,400,000	25,400	1,720	3,830	5,550
Tin-base scrap 4/	W	W	W	W	W	W	4,280	(5/)	4,280
Grand total	XX	XX	XX	XX	XX	XX	8,440	7,710	16,100

e/ Estimated. r/ Revised. W Withheld to avoid disclosing company proprietary data. XX Not applicable.
1/ Data are rounded to three significant digits; may not add to totals shown.
2/ Tin recovered from new and old copper-base scrap, brass mills, and foundries.
3/ Brass-mill stocks include home scrap, and purchased-scrap consumption is assumed to be equal to receipts; therefore, line does not balance.
4/ Includes tinplate and other scrap recovered at detinning plants.
5/ Withheld to avoid disclosing company proprietary data; not included in "Total" and "Grand total."

TABLE 6
U.S. EXPORTS OF TIN IN VARIOUS FORMS 1/

	Tinplate and terneplate		Ingots and pigs		Tin scrap and other tin bearing material except tinplate scrap 2/	
Year	Quantity (metric tons, gross weight)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Quantity (metric tons, gross weight)	Value (thousands)
1997	349,000	$206,000	4,660	$27,400	34,500	$45,900
1998	262,000	162,000	5,020	29,200	36,100	51,200

1/ Data are rounded 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 TIN IN VARIOUS FORMS 1/

	Miscellaneous 2/	Dross, skimmings, scrap, residues, tin alloys, n.s.p.f.		Tinplate and terneplate		Tin compounds		Tinplate scrap	
Year	Value (thousands)	Quantity (metric tons, gross weight)	Value (thousands)	Quantity (metric tons, gross weight)	Value (thousands)	Quantity (metric tons, gross weight)	Value (thousands)	Quantity (metric tons, gross weight)	Value (thousands)
1997	$5,890	4,110	$14,600	261,000	$166,000	389	$3,210	34,300	$5,120
1998	6,760	4,600	4,590	291,000	186,000	482	3,610	72,100	6,380

1/ Data are rounded to three significant digits.
2/ Includes tinfoil, tin powder, flitters, metallics, manufactures, n.s.p.f.

Source: Bureau of the Census.

TABLE 8
U.S. IMPORTS FOR CONSUMPTION OF UNWROUGHT TIN METAL,
BY COUNTRY 1/

Country	1997 Quantity (metric tons)	1997 Value (thousands)	1998 Quantity (metric tons)	1998 Value (thousands)
Australia	500	$2,600	516	$2,690
Belgium	160	979	324	1,880
Bolivia	6,680	38,600	5,160	28,700
Brazil	8,610	47,800	4,710	26,400
Canada	144	920	190	1,150
Chile	464	2,730	894	4,970
China	4,710	26,900	9,870	54,700
Hong Kong	258	1,530	840	4,600
India	1,720	9,940	359	2,010
Indonesia	7,610	43,000	7,880	43,800
Malaysia	1,640	9,720	1,870	10,200
Netherlands	200	1,090	20	111
Peru	6,610	34,600	8,650	47,400
Russia	480	2,810	--	--
Singapore	120	666	822	4,510
Thailand	600	3,240	540	2,760
United Kingdom	20	118	790	4,680
Other	68	397	544	3,030
Total	40,600	228,000	44,000	244,000

1/ Data are rounded to three significant digits; may not add to totals shown.

Source: Bureau of the Census.

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

(Metric tons)

Country	1994	1995	1996	1997	1998 e/
Australia	7,495	8,656	8,828	10,169	10,204 3/
Bolivia	16,169	14,419	14,802	12,898 r/	11,305 3/
Brazil	16,619	17,317	19,617	18,291 r/	18,300
Burma 4/	814	747	459	335 r/	240
Burundi	--	15	25	(5/) e/	23
Cameroon e/	2	2	1	1	1
China e/	54,100	61,900	69,600	67,500 r/	79,000
Indonesia	30,610	38,378	38,500 e/	47,000 e/	40,000
Kazakhstan e/	24	15	-- r/	-- r/	--
Laos e/	200	200	906 r/ 3/	1,030 r/ 3/	895 3/
Malaysia	6,458	6,402	5,175	5,065 r/	5,756 3/
Mexico	3 e/	1	2 e/	5 3/	5 3/
Mongolia	8 r/	34 r/	18 r/	10 r/	40 3/
Namibia	4 r/	2	--	-- e/	--
Niger e/	20	20	10	10	10
Nigeria 6/	278	357 r/	139 r/	150 r/ e/	200
Peru	20,275	22,331	27,004	27,952	25,747 3/
Portugal	4,332	4,627	4,800 e/	4,000 e/	4,000
Russia e/	10,460 3/	9,000	8,000	7,500	4,500
Rwanda	50 e/	242	200	-- e/	--
Spain e/	4 3/	2	2	2	2
Tanzania	9	3	--	-- e/	--
Thailand	3,926	2,201	1,457	756 r/	700
Uganda e/	3	43	(5/)	(5/)	(5/)
United Kingdom	1,922	1,973	2,103	2,396 r/ 3/	376 3/
Vietnam e/	4,000	4,500	4,500	4,800 r/	4,500
Zambia	9	3	--	-- e/	-- e/
Zimbabwe	100	10	10	1 e/	1
Total	178,000	193,000 r/	206,000 r/	210,000 r/	206,000

e/ Estimated. r/ Revised.

1/ World totals and estimated data are rounded to three significant digits; may not add to totals shown.

2/ Table includes data available through July 2, 1999.

3/ Reported figure.

4/ Includes content of tin tungsten concentrate.

5/ Less than 1/2 unit.

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

TABLE 10
TIN: WORLD SMELTER PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons)

Country	1994	1995	1996	1997	1998 e/
Argentina: Primary e/	100	100	100	100	100
Australia:					
Primary	315	570	460	605	655 3/
Secondary e/	260	300	300	300	300
Total e/	575	870	760	905	955
Belgium: Secondary e/	5,000	5,000	3,000	3,000	2,500
Bolivia: Primary	15,285	17,709	16,733	16,853 r/	11,102 3/
Brazil:					
Primary	20,400	16,787 r/	18,361 r/	17,525 r/	17,500
Secondary e/	250	250	250	250	250
Total e/	20,700	17,000 r/	18,600 r/	17,800 r/	17,800
Bulgaria: Secondary	22	12	8	10	10
Burma: Primary	200 e/	190 e/	--	--	--
China: Primary e/	67,800	67,700	71,500	67,700 r/	78,800
Congo (Kinshasa): Primary e/ 4/	100	100	-- r/	-- r/	--
Czech Republic: Secondary e/	100	100	100	100	100
Denmark: Secondary e/	100	100	100	100	100
Germany: Primary and secondary e/	100 3/	100	100	100	100
Greece: Secondary e/	150	150	100	100	150
India: Secondary e/	100	100	--	--	--
Indonesia: Primary e/	31,000	38,628 3/	39,000	40,000	35,000
Japan: Primary	706	630	524	507	500 3/
Malaysia: Primary	37,990	39,433	38,051 r/	38,400 r/	27,900 3/
Mexico: Primary	768	770	1,234	1,188	1,200
Nigeria: Primary	179	259 r/	100 r/	100 r/ e/	150
Norway: Secondary e/	90	70	50	50	50
Peru: Primary	-- r/	-- r/	2,370 r/	8,999 r/	14,363 3/
Portugal: Primary and secondary e/	100	100	100	100	100
Russia: e/					
Primary	11,500	9,500	9,000	6,700	3,000
Secondary	1,000	1,000	1,000	1,000	500
Total	12,500	10,500	10,000	7,700	3,500
South Africa: Primary e/ 5/	43	--	--	--	--
Spain: e/					
Primary	500	500	150	150	150
Secondary	200	100	50	50	50
Total	700	600	200	200	200
Thailand: Primary	7,759	8,243	10,981	12,028 r/	12,000
United Kingdom: Secondary e/	100	100	100	100	100
United States: Secondary	11,700	11,600	11,600	12,400 r/	16,100 3/
Vietnam: Primary	2,300 r/	2,400 r/	2,300 r/	2,400 r/	2,400
Zimbabwe: Primary	82	--	--	--	--
Grand total:	216,000 r/	223,000 r/	228,000 r/	231,000 r/	225,000
Of which:					
Total primary	197,000 r/	204,000 r/	211,000 r/	213,000 r/	205,000
Total secondary	19,000 r/	18,900 r/	16,700 r/	17,400 r/	20,300
Total undifferentiated	200	200	200	200	200

e/ Estimated. r/ Revised.

1/ World totals, U.S. data, and estimated data are rounded to three significant digits; may not add to totals shown.

2/ Whenever possible, total 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 July 2, 1999.

3/ Reported figure.

4/ Formerly Zaire.

5/ South Africa's only operating tin mine closed in early 1994.