

# COPPER

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Mine production of recoverable copper in the United States continued its decade-long upward trend, rising by about 1% to a record high level. However, as a result of a decline in the average price received for refined copper, the estimated value of domestic mine production remained unchanged at about \$4.6 billion. While the United States maintained its position as the world's second largest mine producer of copper, accounting for about 17% of world production, its percentage share of global production continued to decline. Chile, where mine production increased by about 9% in 1997, and where it has increased by 65% since 1993, was the largest mine producer, increasing its share to more than 28% of world production. The United States retained its position as the largest producer and consumer of refined copper, accounting for 18% and 21% of world production and consumption, respectively. Domestic production and consumption of refined copper rose by about 5% and 7%, respectively, both reaching record-high levels.

Of the 36 mines operating in 10 States that produced reportable quantities of copper, the top 18 accounted for almost 99% of production. The principal mining States, in descending order, Arizona, Utah, New Mexico, Nevada, Montana, and Wisconsin, accounted for more than 99% of production. Mine capacity of 2.07 million metric tons was up by about 40,000 tons from the 1996 revised value, and capacity utilization rose to 93.5%.

During the year, 7 primary and 4 secondary smelters, 8 electrolytic and 6 fire refineries, and 14 electrowinning plants operated in the United States. With the exception of the startup of a new solvent extraction-electrowinning (SX-EW) operation, the operating status of these plants remained unchanged from that of 1996.

Electrowon production, which had increased significantly in the previous 2 years, rose by only about 2% and accounted for 30% and 24% of domestic mine production and refinery production, respectively. The conversion of old scrap to alloys and refined copper rose significantly during the year, reversing a 4-year downward trend, contributing 495,000 tons of copper to the market, and accounting for 17% of apparent industrial demand. High copper prices and strong demand during the first half of the year encouraged the recycling of copper.

Copper was consumed, as refined copper and as direct melt scrap, at about 35 brass mills, 15 wire-rod mills, and 600 foundries, chemical plants, and miscellaneous consumers. According to data compiled by the Copper Development Association Inc. (CDA), mill product shipments to the U.S. market, including net imports, rose to a record high level of 3.77 million tons (Copper Development Association Inc., 1998).

The net import reliance for refined copper, as a percentage of apparent consumption, remained unchanged at about 13%. Canada was the largest U.S. trading partner for unwrought copper, accounting for 46% of refined copper imports and of total

imports of unwrought copper, and 24% of refined exports and 46% of total unwrought copper exports. Japan and Taiwan together accounted for an additional 48% of refined copper exports.

Copper was mined in about 50 countries, of which the top 2, Chile and the United States, accounted for 46%, and the top 10 for about 81% of the world total. The world reserves and reserve base for copper were estimated to be 340 million tons and 640 million tons, respectively. The United States had about 15% each of reserves and reserve base.

World copper inventories fluctuated during the first half of 1997, but, during the second half of the year, world reported stock levels began to climb, reversing the general downward trend that occurred over the 1994-96 period. Reported yearend global inventories peaked at over 1 million tons, up from 680,000 tons at yearend 1996. Copper prices during the first half of the year trended upward from the low levels established in the second half of 1996; the U.S. producer price averaged \$1.16 per pound for the first 6 months of 1997. However, in July, with inventories on the rise and global expectations of increasing copper production, prices declined sharply; the U.S. producer price averaged only \$0.83 per pound in December and \$1.07 for the year.

## Legislative and Government Programs

In November, Congress passed S. 1228, the "50 States Commemorative Coin Program Act," which authorized the minting of circulating commemorative 25-cent coins honoring each of the 50 States. Redesign of the quarter was to begin in 1999, with the issuance of 5 coins per year, commemorating 5 States, during each of the 10 years the program is to be in effect. The reverse sides of the coins are to be emblematic of the States, selected in the order in which the States either ratified the Constitution or were admitted to the Union. In section 4, to be referenced as the United States \$1 coin Act of 1997," the bill also authorizes the U.S. Department of the Treasury to create a new gold-colored coin to replace the Susan B. Anthony dollar. Absent from the legislation is the requirement, sought by some legislators, to force the mandatory retirement of the \$1 note, which proponents felt would result in substantial cost savings to the mint (Congressional Record, 1997a). It was expected that minting of the coins would add to the demand for copper through increased circulation of the dollar coin and collector interest in the commemorative quarters. The new quarters would have the same composition as the current quarters, 91.2% copper. At least one study estimated that an additional 3 billion quarters may be necessary to meet expected demand. Though not yet determined, the new gold-colored dollar was expected to have a composition similar to the quarters (Platt's Metals Week, 1997d).

In July, in accordance with the Clean Air Act, the U.S.

Environmental Protection Agency (EPA) signed a new national ambient air quality standard for particulate matter and ozone. The new particulate matter standard, first proposed in December 1996, which could have a significant impact on the mining and mineral-processing industries, provides increased protection against a wide range of particulate-matter-related health hazards. The new standard for particles that are 2.5 microns or smaller sets concentration limits of 15 micrograms per cubic meter as an annual mean and 65 micrograms per cubic meter as the 24-hour mean. The existing standard regulates particles that are 10 microns in size or smaller and sets an average annual concentration limit of 50 micrograms per cubic meter and an average daily limit of 150 micrograms per cubic meter. The new standards were expected to take effect between 2000 and 2002 (Platt's Metals Week, 1997e).

In 1989, the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal came into force and has since been ratified by more than 100 countries, including the United States, although the latter has not passed legislation necessary to implement the convention. An international Technical Working Group met four times between September 1995 and February 1997 to consider which materials should be classified as hazardous and, hence, affected by the various bans. The group elected to include copper scrap, copper slags, and copper oxide mill scale in the B list, the list of materials not covered by the Basel Convention as hazardous and, thus, not subject to any export ban (Buchholtz, 1997). In February 1998, the Basel Convention held its Fourth Meeting of the Council of Parties in Kuching, Malaysia, and adopted the A list, wastes characterized as hazardous and therefore subject to regulation, and the B list, as developed by the Technical Working Group. However, material contained in list B is not precluded from regulation if it contains any of a core list of materials to be controlled to the extent that they exhibit hazardous characteristics (International Copper Study Group, 1998c).

## Production

The more than decade-old upward trend in domestic mine production continued, with mine production in 1997 rising by about 1%. Increased production from the first full year of operation at the Robinson Mine in Nevada, startup of SX-EW production at the Silver Bell Mine in Nevada, and incremental expansion at several other mines, including the Morenci and Bagdad Mines in Arizona, was partially offset by the closure of two small mines in 1996 and the depletion of reserves and closure of the Flambeau Mine in Wisconsin during 1997.

Capacity utilization at domestic mines rose to a 93.5% as companies sought to reduce unit operating costs in anticipation of lower average copper prices and to keep integrated rod-mills supplied. As a result of the higher capacity utilization rates and the closure of several labor-intensive underground mines in 1995 and 1996, productivity at domestic mines in 1997, as calculated from employment data compiled by the Mine Health and Safety Administration, rose to 68 kilograms of copper per worker-hour, compared with 64 kilograms in 1995. Productivity has generally trended upward since 1989, when only 50 kilograms of copper per worker-hour was produced.

Primary smelter production, which rose 10% for the year, increased substantially during the second half of the year following a 6-week shut down of Kennecott's Utah smelter, beginning in April, for rebuilding of the flash converting furnace and installation of a new casting wheel. By yearend, monthly primary production from the 7 operating smelters was at or above the record high level set in 1973 when there were 15 primary smelters operating in the United States. Secondary smelter production declined 16%, continuing the downward trend that began with the closure of Southwire Co.'s Gaston, SC, secondary smelter in 1994. At the end of August, Franklin Smelting and Refining Co. in Philadelphia was closed indefinitely. Franklin had an estimated capacity of 15,000 tons of blister per year.

Total refined production rose by more than 4%, or about 100,000 tons. Primary refined, which accounted for about one-half of the increase, declined during the first half of the year owing to a shortage of anode, but rose sharply during the second half of the year, following the upward trend in primary smelter production. Production of electrowon copper, which had trended upward over the past 3 years, was essentially unchanged in 1997. Secondary production increased 11%.

**Company Reviews.**—ASARCO Incorporated's copper mine production, including its share of Southern Peru Copper Corp.'s (SPCC) production, declined from 1996's production by 17,000 tons, to 443,000 tons, owing to an almost 30,000-ton-drop in domestic concentrate production. Partially offsetting the drop in concentrate production were increases in domestic production from SX-EW and increases in Peruvian production. Production at the new SX-EW operations at the Silver Bell Mine in Arizona began in July and totaled almost 9,000 tons for the year. Though harder ore resulted in lower concentrator throughput and an overall 4,000-ton production decline at the Mission Complex, ore grades improved slightly owing to the first full year of production from the underground mine. An overland conveyor at Mission was completed in August; it is designed to transport 53 million tons of waste per year at a cost savings of \$0.08 per ton of waste. Production at Ray Mine's Hayden concentrator declined by about 19,000 tons in 1997, owing to curtailments during the fourth quarter of 1996 and the first 5 months of 1997 in order to reduce concentrate inventories. Ray SX-EW increased 5% owing to the application of a new leach technology to low-grade sulfide material. Combined production from Asarco's Hayden and El Paso smelters was essentially unchanged at 300,000 tons, while total refinery output rose by 27,000 tons owing to increased SX-EW production and record-high production of 447,000 tons at the Amarillo Refinery (ASARCO Incorporated, 1998).

Cyprus Amax Minerals' total copper production rose 33% owing to the first full year of production from its 51% interest in the El Abra Mine in Chile and incremental expansions at its domestic operations. At the Bagdad Mine in Arizona, production rose 11,000 tons to 112,000 tons, owing to higher sulfide ore grades and improved recovery. However, leach production of 12,000 tons was down slightly owing to significantly reduced mining of leach ore that was nearing depletion. At the Miami Mine, a 100% heap leach operation, SX-EW production rose to 71,000 tons, up 5,000 tons from that of 1996. The electrolytic refinery at Miami produced 151,000 tons of refined copper, down 3% from the previous year, owing to lower anode production from

the associated smelter. Total production at the Sierrita Mine rose about 7,000 tons to 112,000 tons; production from SX-EW increased from 16,000 to 18,000 tons. Production at the Tohono Mine near Casa Grande, AZ, fell from 18,000 tons in 1996 to 12,000 tons in 1997 following cessation of mining in July, while the company evaluated the potential for a larger-scale mine-leach operation. SX-EW production was expected to continue at a lower rate from existing leach pads (Cyprus Amax Minerals Company, 1988a).

In September, Equatorial Mining NL of Australia exercised an option to purchase Cyprus Amax's Mineral Park Mine near Kingman, AZ, and its Tonopah copper resources in Nevada. Equatorial reportedly planned to double electrowon production at Mineral Park from the current level of about 2,500 metric tons per year. A feasibility study had been completed for developing an open pit and a 29,000-ton-per-day-of-ore heap-leach and SX-EW plant at Tonopah. Equatorial anticipated producing 26,000 tons of copper cathode per year at an average cash operating cost of \$0.50 per pound of copper. The company estimated reserves to be 90.5 million tons of ore grading 0.33% copper. Development was expected to proceed once funding was secured for the \$74 million project (Platt's Metals Week, 1997b).

Production at mines owned or controlled by Phelps Dodge Corp., including those in Chile, rose by 46,000 tons to 893,000 tons (Phelps Dodge's share of production was 737,000 tons). Production at domestic mines rose by about 30,000 tons owing to increased concentrate and electrowon production at the Morenci Mine, where production rose for the 10th consecutive year. Mine production at Morenci, 492,000 tons, was up by 30,000 tons from that of 1996 year and was equally divided between concentrate and SX-EW production. Production at Phelps Dodge's Tyrone and Chino Mines was essentially unchanged at 72,000 and 153,000 tons, respectively. Combined production from Phelps Dodge's two smelters, 322,000 tons, was down by about 3% from that of 1996. Production of cathode from the El Paso, TX, refinery of 413,000 tons has remained essentially unchanged since 1994 (Phelps Dodge Corp., 1998a).

During 1997, exploration efforts continued to outline additional resources in the Morenci area. At the Coronado deposit, an estimated 163 million tons of sulfide material grading 0.69% copper, and 281 million tons of leach ore grading 0.29% copper, were delineated and added to reserve estimates. At Tyrone, an additional 71 million tons of mine-for-leach reserves grading 0.34% copper were identified (Phelps Dodge Corp., 1998a).

In February 1998, Phelps Dodge announced that the conditions of its December 4 offer had been met, and that it had acquired the assets of the Continental Mine in New Mexico from Cobre Mining Company Inc. (Phelps Dodge Corp., 1998d). The property consists of two underground mines and one open pit adjacent to Phelps Dodge's Chino Mine. With purchase of the property by Phelps Dodge, previously announced plans by Cobre for development of a 20,000-ton-per-year SX-EW operation were uncertain.

Mine production at Kennecott Utah Copper's Bingham Canyon Mine rose by about 7,000 tons to 305,000 tons. Design modifications to the Garfield smelter were completed in May, including replacement of the anode casting system. By December, the smelter was operating at design capacity of about

310,000 tons of anode per year, and the downstream refinery was at 90% of capacity. Kennecott's production of refined copper increased by 115% to 115,700 tons. Prior to completion of the renovations, Kennecott had exported significant quantities of concentrate and had sold copper matte to other domestic smelters (Rio Tinto plc-Rio Tinto Ltd., 1998).

Broken Hill Proprietary Co. Ltd. (BHP) of Australia, through its operating entity, BHP Copper Group, headquartered in San Francisco, operated the San Manuel, Pinto Valley, and Robinson Mines. Though exploration activities were deferred at its Superior Mine, which closed in 1996, plans for the adjacent Magma ore body were being developed. BHP's Robinson Mine, which consists of three principal mining areas, completed its first full year of production from the Liberty and the Veteran-Tripp pits, which began production in 1997. The concentrator grinding circuit, consisting of a single semiautogenous grinding mill in series with two ball mills, has the capacity to process 42,000 tons of ore per day. Copper recovery in 1997 was boosted from an initial 65% to over 85% through process optimization (Broken Hill Proprietary Co. Ltd., BHP Fact Sheet 1997-Robinson, accessed June 2, 1998, at URL <http://www.BHP.com.au/copper/indes.htm>). BHP was proceeding with its feasibility study, scheduled for completion in May 1998, for its Florence Project in Arizona, slated to be the world's first stand-alone in situ copper leach project. By the end of 1997, all major permits had been secured for a 35,000-ton-per-year SX-EW facility. BHP had identified 321 million tons of leach ore grading 0.37% (Broken Hill Proprietary Co. Ltd., BHP Fact Sheet 1997-Florence, accessed June 2, 1998, at URL <http://www.BHP.com.au/copper/indes.htm>).

Inmet Mining Corp. announced that it had agreed to sell its Copper Range Co. copper refinery at White Pine, MI, to BHP Copper for \$11.25 million. Proceeds from the sale, completed in January 1998, were expected to fund reclamation activities at the White Pine Mine and smelter, which closed in 1995. The refinery has continued to operate on anode copper imported from Canada (Inmet Mining Corp., 1997).

At yearend 1996, Arimetco International Inc., owner and operator of the Yerington Mine in Nevada and the Johnson Camp Mine in Arizona, announced that it had filed for reorganization under Chapter 11 of the U.S. Federal Bankruptcy Code. The company cited as the source of its financial difficulties the compound impact of lower copper prices, serious production problems at its Yerington Mine that temporarily lowered output and raised unit production costs, and the high cost of maintaining and developing nonproducing properties (Platt's Metals Week, 1997a).

In July, Arimetco suspended mining operations at its Johnson Camp Mine, but continued to generate copper from the leaching of existing heaps. By yearend, the company reported having completed a feasibility model for recovering gold and copper at its Sullivan property. Its Paradise Peak property remained idle and was reportedly available for sale.

In July, the U.S. Forest Service issued a final record of decision on its final environmental impact statement announcing that it would approve a mining plan for Cambior Inc.'s Carlota Mine project, west of Miami, AZ. The approval stipulated that Cambior use existing roadways, back-fill open pits, and minimize

its need for new water sources. However, in December, Carlota announced that it was indefinitely postponing development because of continuing delays in obtaining other Federal permits (Leaming, 1998).

## Trade

In response to increased demand, net imports of refined copper rose sharply for the second consecutive year to 554,000 tons, compared with 374,000 tons in 1996. Net imports of all unwrought copper products rose to 359,000 tons, compared with 279,000 tons in 1996. In 1995 the United States had been a net exporter of unmanufactured copper. Exports of copper concentrate continued to decline from their peak level in 1994 owing to increased production from Kennecott's smelter and closure of the Flambeau Mine in Wisconsin, which had been shipping ore to Canada. Exports of copper scrap, which had declined in 1996, remained essentially unchanged in 1997.

According to Bureau of the Census data compiled by the Copper and Brass Fabricators Council, U.S. net imports of all copper and copper-alloy semifabricated products, 100,000 tons, were up from those of 1996 by about 43%. Canada and Mexico, the largest U.S. trading partners, together accounted for 66% of semifabricated copper exports and 30% of imports. Net exports to Canada of about 66,000 tons were up by about 47% from 1996. Mexican imports and exports were essentially balanced for the second consecutive year. (Copper and Brass Fabricators Council, Inc., 1998).

In July, Congress enacted the Taxpayer Relief Act of 1997. Included in the Act were provisions that extended the Generalized System of Preferences (GSP) Program. The extension was retroactive to May 31, 1997, the previous expiration date of the program. The GSP Program grants duty-free status to certain imports from developing countries, subject to a threshold per capita gross national product and to specific import ceiling guidelines. Copper materials eligible for the GSP Program include copper ores and concentrates, unwrought copper, and certain copper semifabricates (Congressional Record, 1997b).

## Prices and Stocks

Following a global drawdown in inventories in 1996 of about 140,000 tons, the domestic and world supply of copper remained tight during the first half of 1997. According to data compiled by the International Copper Study Group (ICSG), global inventories fluctuated during the first half of the year. By the end of June, inventories had risen by only about 20,000 tons, and previously forecast copper surpluses had yet to materialize. In the United States, inventories rose by about 19,000 tons, principally owing to an infusion of copper into London Metal Exchange Ltd. (LME) warehouses in California. Copper prices, responding to the tightness in supply, rose during the first half of 1997; the U.S. producer price, which averaged \$1.04 in December 1996, averaged \$1.16 per pound for the first half of 1997.

In July, despite continued strong domestic demand for refined copper, the domestic supply of refined copper outstripped demand, and copper inventories rose by 35,000 tons, reaching 200,000 tons for the first time in more than 4 years. Most of the

increase in stocks occurred at U.S. LME warehouses. LME spot contracts traded at a premium to Comex contracts throughout the month, encouraging the flow of material into LME warehouses. In response to domestic and worldwide increases in LME stocks, copper prices fell sharply in July. Prices continued to trend downward in response to rising inventories, and by the end of September, combined world-wide LME and Comex stocks had risen to almost 380,000 tons, up from 260,000 tons on August 1, and the U.S. producer price for refined copper had fallen to about \$0.97 per pound. Global and domestic inventories continued to accumulate. At yearend, combined worldwide LME and Comex stocks had risen to more than 450,000 tons, and total world inventories had reached over 1 million tons, the highest level since 1993. The U.S. producer price for refined copper averaged only \$0.83 per pound in December.

Copper scrap prices trended upward during the first half of 1997, following the upward trend in refined copper prices. In the first half of the year, the New York average buying price for No. 1 scrap at brass mills, and No. 2 scrap at refiners, averaged \$1.08 and \$.090 per pound, respectively. In July, scrap prices followed refined prices in a downward spiral; the No. 1 and No. 2 scrap prices averaged \$0.91 and \$0.74, respectively, during the second half of the year. The margin between refined copper and No. 2 scrap averaged \$0.26 per pound during the first half of the year and declined with lower prices, averaging \$0.24 per pound during the second half of the year. In December, when No. 2 scrap averaged only \$0.62 per pound, the margin had shrunk to \$0.21 per pound.

## Consumption

Consumption of refined copper by domestic manufacturers rose by 6.8%, to 2.8 million tons. In addition to refined copper, domestic manufacturers directly consumed (melted or processed into chemicals) 1.07 million tons of copper-base scrap containing about 990,000 tons of recoverable copper. An additional 77,000 tons of copper was recovered in the consumption of aluminum-, nickel-, and zinc-base scrap. The total quantity of copper recoverable from the direct consumption of scrap, 1.07 million tons, increased by about 10% from that of 1996.

Consumption of refined copper at wire-rod mills increased by about 8% and accounted for about 77% of domestic consumption of refined copper. In response to wire-rod mill closures in 1995 that resulted in the loss of about 225,000 tons of capacity, several mills took steps to increase capacity, and U.S. wire-rod capacity increased from an estimated 2.13 million tons prior to the mill closures in 1995 to 2.18 million tons in 1997.

Cyprus Amax Minerals Co. reported that its Miami, AZ, wire-rod mill operated above design capacity for the second consecutive year, increasing production by 7% to more than 133,000 tons, and that its Chicago plant produced 169,000 tons of wire rod, a 4% increase from that of 1996 (Cyprus Amax Minerals Company, 1998a).

Phelps Dodge, the world's largest producer of copper wire rod with plants in El Paso, TX, and Norwich, CT, boosted its wire-rod production by about 35,000 tons, to 680,000 tons. This compares with production of only 590,000 tons in 1995 (Phelps Dodge Corp., 1998a). Annual capacity at Essex Group Inc.,

which operates three wire-rod mills upstream from its wire and cable manufacturing operations, has increased by more than 100,000 tons since 1995.

Brass mills were the second largest consumers of refined copper and the largest consumers of copper-base scrap, accounting for 21% of refined consumption and about 58% of copper scrap consumption. Consumption of refined copper at brass mills was essentially unchanged, while copper recovered from scrap consumed at brass mills rose by about 19%.

According to data compiled by the CDA, shipments of copper and copper-alloy products to the U.S. market by fabricators (wire mills, brass mills, foundries, and powder producers), including net imports, rose by about 5% to 3.77 million tons containing an estimated 3.4 million tons of copper. About 70% of these shipments were as pure (unalloyed) copper products. Wire mill products accounted for about 47% of total shipments to the domestic market. In building construction, the largest end use sector, shipments rose by almost 5% and accounted for about 42% of the market. Building construction included products used for building wire, plumbing and heating, air conditioning and commercial refrigeration, builders hardware, and architectural applications. Other use sectors included: electric and electronic products, 25% of shipments; industrial machinery, 11%; transportation equipment, 13%; and consumer and general products, 9%. According to the CDA, mill product shipments have risen 27% over the past 20 years and the market distribution of shipments has shifted; shipments to building construction have grown as a percentage of total shipments, and shipments to industrial machinery, transportation, and consumer and general products have declined. The percentage of shipments to electric and electronic products has remained relatively unchanged (Copper Development Association Inc., 1998).

## World Review

The global balance between the production and consumption of refined copper shifted markedly over a 12-month period, beginning in mid-1996. During the second half of 1996, following an almost 18-month period where global inventories of refined copper had remained relatively constant, copper supplies tightened, and inventories declined by about 150,000 tons. During the first half of 1997, inventories, on average, remained near the yearend 1996 level of 660,000 tons. However, beginning in July, global inventories began a precipitous climb, and by yearend had exceeded 1 million tons for the first time since 1994 (International Copper Study Group, 1998a). The oversupply that developed reflected an increase in production of refined copper and a decline or stagnation in demand during the second half of the year. Monthly ICSG refined production data indicate that global refined production increased by over 300,000 tons during the second half of 1997, while global demand declined by about 50,000 tons, principally owing to weaker East Asian demand where stock market crashes, currency devaluations, and tightened economic policies were creating economic crises that threatened the economies of several countries. In Thailand, the region's second largest copper consumer, where wire rod and wire and cable production had already slowed during the first half of 1997, currency devaluation, rising interest rates, and stringent economic

policies in the second half of the year further depressed demand. In Japan, a consumption tax in April further depressed an already weak demand (CRU International Ltd., 1997a). Copper prices inversely followed the trend in supply, rising with declining inventories in the latter part of 1996, and continuing to rise in the first half of 1997 in response to continued tight supplies. However, with the rise in inventories in July, prices began a steep decline, ending the year at the lowest level since 1993.

According to ICSG data, total world demand for refined copper rose by about 570,000 tons, an increase of 4.5%. Despite an economic crisis in the East Asian market that led to a lower than anticipated growth rate, consumption by all Asian countries (as classified by the United Nations), increased by 3%, principally owing to growth in the Republic of Korea, the Philippines, Taiwan, and Turkey. China, Japan, Indonesia, and Thailand all reported slight declines in consumption. Consumption in Europe rose by 4.6% owing to strong demand in France, Germany, Italy, and Spain (International Copper Study Group, 1998a).

World mine production rose by about 400,000 tons, about 4%, to almost 11.4 million tons. Most of the increase was accounted for by Chile, where production rose by 276,000 tons to 3.39 million tons, up from 2.06 million tons in 1993 at the beginning of its rapid expansion period. Significant production increases also occurred in several major copper-producing countries, including Indonesia, Kazakstan, Mexico, Mongolia, Peru and South Africa. Partially offsetting these increases were significant declines in Canada and Papua New Guinea, and the Philippines. Production in Papua New Guinea declined sharply owing to the shutdown of the Ok Tedi Mine in August, when drought conditions prevented shipments of concentrates on the dried-up Fly River. World mine capacity increased by about 500,000 tons, to 12.6 million tons (International Copper Study Group, 1998b).

In 1997, world smelter production rose by about 300,000 tons to 11.1 million tons. The increase was accounted for by increased primary production. The quantity of copper recovered from scrap declined owing to reduced Chinese production. Estimated world smelter capacity also increased by about 300,000 tons, and capacity utilization remained unchanged at about 81%. Although numerous smelter projects were planned and capacity was forecast to rise by almost 1.5 million tons during the next 2 years, only a handful of major expansions took place in 1997.

In Chile, a 50,000-ton-per-year expansion of the Refimet S.A. smelter was completed, bringing annual capacity to 170,000 tons. In China, a new 100,000-ton flash smelter was commissioned to replace the 70,000-ton-per-year Tonglin Nonferrous Metals Corp. reverberatory smelter. In India, Sterlite Industries completed the installation and startup of an Isasmelt smelter, which was projected to produce 100,000 tons per year of copper at full capacity. In Mexico, the addition of an El Teniente converter at La Caridad smelter boosted capacity from 180,000 tons of copper per year to 280,000 tons (International Copper Study Group, 1998b).

World production of refined copper rose substantially for the third straight year, increasing by 880,000 tons, or 7%. One-third of the increased refined production (290,000 tons) was from expansion of electrowon production, principally in Chile (263,000 tons). Total world refinery capacity, including electrowinning, rose by about 1 million tons. Electrolytic refinery capacity

increased substantially in Chile with the completion of a 100,000-ton expansion of the Las Ventanas refinery and in Mexico with the startup of the 300,000-ton-per year La Caridad refinery. In the United States, capacity utilization increased with increased production from the Kennecott smelter.

**Argentina.**—The Bajo el Alumbra Mine, owned by MIM Holdings Ltd. (50%), North Ltd. (25%), and Rio Algom (25%), began production in October, at a mining rate of 80,000 tons per day of ore. By yearend, more than 30,000 tons of copper in concentrate had been produced. The project, with proven and probable ore reserves of almost 700 million tons, cost more than \$1 billion to develop and is projected to have at least a 20-year mine life. Capacity is projected to rise to 190,000 tons of copper per year by 1999 (Mining Magazine, 1997; Mining Engineering, 1998a). A nearby property, Agua Rica, 70% owned by BHP, was reported to have 1.2 billion tons of copper resources. Field activities during the year including drilling into high-grade ore zones and development of two bulk sample adits and test pads for leaching (Mining Engineering, 1998b). Cambior Inc. announced the completion of a feasibility study for the El Pachón copper project, located in Argentina near the border with Chile, and the signing of a protocol agreement between the governments of Argentina and Chile that will facilitate efficient operation of the project. Cambior estimated reserves to be 880 million tons grading 0.62% copper. Initial production of 250,000 tons per year of copper in concentrate was not expected to begin until late in 2002 (Cambior Inc., 1997).

**Australia.**—Expansion of Western Mining Corp.'s Olympic Dam Project was reported to be running ahead of schedule, with startup now anticipated in late 1998. The expansion was originally projected to incrementally boost capacity from 85,000 tons per year to 200,000 tons per year of refined copper by 2000. Western Mining announced that it would seek necessary approvals for the project to expand to 350,000 tons per year. Mount Isa Mines Ltd. announced plans to develop its new Enterprise Mine to extract ore from ore bodies that extend 1,200 meters to 1,950 meters below the surface, making it Australia's deepest underground mine. Production from the new ore bodies was scheduled to begin in 1999. Copper and gold production began from the new Ernest Henry open pit in Queensland. At capacity, the mine was expected to produce 95,000 tons per year of copper in concentrate and 3,730 kilograms of gold (Bureau of Resource Sciences, Australia, 1997).

**Canada.**—Although production and capacity declined in 1997 for the second consecutive year, several projects were under development in Canada that are expected to significantly increase production and capacity over the next 3 years. At midyear, Teck Corp. closed its 12,000-ton-per-year Afton Mine owing to depletion of reserves. In Sudbury, Ontario, a 26-day labor strike in June shuttered Inco Ltd.'s 120,000-ton-per-year operations; and in August, Falconbridge Ltd.'s 50,000-ton-per-year operations were struck for 23 days. In British Columbia, Royal Oak Mines anticipated the startup of its Kemess gold-copper project (27,000 tons per year of copper in concentrate) by May 1998, and Princeton Mining Corp. began production at the Huckleberry Mine (37,000 tons of copper in concentrate per year) in September. In Quebec, MSV Resources closed its Copper Rand Portage Mine (8,000 tons per year) owing to ore depletion. In

Newfoundland, Inco announced that the Voisey's Bay nickel-copper-cobalt project, which was slated to generate 90,000 tons per year of copper initially, would be delayed at least 1 year beyond the previously announced late 1999 startup date owing to delays in the environmental review and approval process (Bokovay, 1998).

**Chile.**—Mine production and capacity continued to escalate, rising by about 275,000 tons and 350,000 tons, respectively. The Escondida Mine became the world's largest copper mine following the completion of a \$560 million Phase 3 expansion in 1996 that raised production capacity from 480,000 tons per year to more than 900,000 tons per year in 1997. Production in 1997 rose by about 9% to 927,000 tons, in part owing to higher ore grades, though it was not anticipated to remain at that level. The operating company, Minera Escondida Ltda., announced plans to close its Coloso SX-EW plant owing to technical problems with the ammonia leach process used to treat concentrate. Construction was progressing for an end of 1998 startup of a 125,000-ton-per-year SX-EW facility west of Escondida, and an engineering contract was awarded for a fourth expansion of the concentrator to accommodate declining ore grades (Mining Engineering, 1998b; Rio Tinto plc-Rio Tinto Ltd., 1998).

Production from Cyprus Amax Minerals' 51%-controlled El Abra project, which began production in December 1996, rose to 194,000 tons. With identified leach reserves of over 900 million tons, the project is expected to operate for at least an additional 18 years. About 500 million tons of sulfide resources have also been identified (Cyprus Amax Minerals Company, 1998b).

Phelps Dodge Corp. reported that a \$305 million expansion of the concentrator at its Candelaria Mine was completed during the fourth quarter of the year and that capacity was projected to rise by about 75,000 tons per year to a total of 172,000 tons per year of copper. As a result of the expansion, the expected mine life was reduced from 35 to 19 years (Phelps Dodge Corp., 1998a).

Corporación Nacional del Cobre De Chile (Codelco-Chile) reported that its total production rose by about 90,000 tons to 1.326 million tons, principally owing to increased production from its 49% share in the El Abra Mine. Commercial production from its Radomiro Tomic Mine began during December and was projected to reach 150,000 tons by 1999. The company estimated direct operating costs for this SX-EW operation at \$0.40 per pound. At its Andina Division, which produced 146,000 tons of copper, Codelco was proceeding with a \$370 million concentrator expansion that would nearly double the current 34,000-ton-per-day milling capacity and increase copper production by 110,000 tons per year. The expansion was projected to come on stream during the second half of 1998. At the Teniente Division, which produced 343,000 tons of copper, a planned expansion project scheduled to be started in 1998 was delayed until 1999. The Chuquibambilla Division, the country's second largest copper operation, produced 650,000 tons of copper (Corporación Nacional del Cobre De Chile, 1998).

At the Collahuasi project, prestripping of overburden was progressing faster than anticipated, and construction of a 45,000-ton-per-year SX-EW plant was on target for an April 1998 startup. Sulfide operations, projected to produce 330,000 tons of copper per year in concentrate, were expected on-stream later in 1998 (CRU International Ltd., 1997b).

**Indonesia.**—P.T. Freeport Indonesia Co.'s Grasberg Mine in Irian Jaya achieved record production of about 544,000 tons of copper, an increase of about 37,000 tons from that of 1996, owing to a record average daily mill throughput of 128,600 tons, a record recovery rate of 85.4%, and an increase in average ore grade from 1.35% copper to 1.37% copper. By yearend, startup operations had begun on its fourth concentrator, which was projected to increase ore throughput to more than 200,000 tons per day by mid-1998 and to increase production capacity to 770,000 tons per year. P.T. Freeport completed a "debottlenecking" of its Atlantic smelter-refinery in Spain, which enabled it to produce 290,000 tons of copper, twice its capacity when purchased in 1993. Construction of P.T. Freeport's 25%-owned smelter/refinery in Gresik, Indonesia, was 90% complete and operations were scheduled for startup in mid-1998. The smelter was expected to consume 600,000 tons per year of Grasberg concentrate to produce 200,000 tons of refined copper (Freeport-McMoRan Copper & Gold Inc., 1998).

**Peru.**—Production from SPCC mines increased by 1.1% to 311,000 tons. Production at the Cuajone Mine increased 4% to 159,000 tons as a result of higher ore grades and increased SX-EW production, and conversely, production declined by about 2% at the Toquepala Mine owing to lower ore grades and lower SX-EW recovery. Production at the Ilo refinery increased 20% to 233,000 tons following completion of an expansion in 1996. A 19% expansion, 59,000 tons, at the Cuajone Mine was scheduled to be completed in early 1999. Modernization plans for the Ilo smelter, to be completed in stages by 2003, included construction of a new acid plant, installation of a new smelting furnace, and modernization of converters (ASARCO Incorporated, 1998). Production from Cyprus Amax's Cerro Verde Mine, which consists of the Cerro Verde and Santa Rosa Pits, rose 16% to 55,000 tons of electrowon copper following an expansion and upgrade in 1996. At yearend, Cyprus approved the \$100 million development of the adjacent Cerro Negro deposit, though development was subsequently delayed owing to low copper prices (Cyprus Amax Minerals Company, 1998a).

BHP Magma Tintaya, Peru's second largest copper producer, reported production of 68,500 tons, a 16% increase from that of 1996, from its open pit. Centromin Peru, the state-owned mining company, produced 35,000 tons of copper, principally from its Cobriza Mine, and completed the sale of its La Oroya smelter and refinery to the Doe Run Company (Soldi, 1998).

**Philippines.**—Production continued to slide following the phaseout of Benguet Corp.'s Dizon Mine and a shift to gold production at the Lepanto gold-copper mine. Production by Marcopper Mining Corp. was suspended during the year and Maricalum Mining Corp.'s Sipalay Mine experienced work stoppages. Atlas Mining Co.'s operations remained on care and maintenance. Philex Mining's Paedal operations increased production by 55% and accounted for 60% of total Philippine output (Disini, 1998).

**Zambia.**—In 1996, following 4 years of studies, the state-owned Zambia Consolidated Copper Mines Limited (ZCCM) agreed to proceed with the privatization of its copper operations. By yearend 1996, ZCCM was offering at least nine different investment packages to a group of prequalified investors for distribution of its mining and electrical power assets (Mining

Annual Review, 1997). Though facing court challenges to the validity of the sale, India's Binani Corp. was awarded control of the Luanshya-Baluba Project, and Metorex Ltd., a consortium of South African and Canadian mining companies, was awarded control of the 10,000-ton-per-year Chibuluma copper mine. Both transactions were effective in late September (Platt's Metals Week, 1997g). ZCCM also announced that the mothballed Chambishi copper-cobalt mine was awarded to Canadian-based Ivanhoe Capital Corp., subject to the completion of contract negotiations, which was anticipated by yearend (Platt's Metals Week, 1997c). ZCCM announced in early November that it had awarded three of the packages, the Nkana/Nchanga mining and metallurgical complex, the Chambishi cobalt plant, and the Chingola refractory ore dumps, to the Kafue Consortium, a group comprised of Avim Ltd. (South Africa), Phelps Dodge Corp. (United States), and Commonwealth Development Corp. (United Kingdom). In fiscal year 1996-97, Nkana-Nchanga produced 172,000 tons of refined copper and it was anticipated that future production would increase above this level. ZCCM was currently repairing two of four reverberatory furnaces at the Nkana smelter and had announced plans to double production at the 60,000-ton-per-year Nkana Mine (Platt's Metals Week, 1997f). However, the project was placed in jeopardy when Phelps Dodge and Noranda withdrew from the consortium in May 1998, after months of failed negotiations over project elements (Phelps Dodge, 1998b).

### Current Research and Technology

The Universal Auto Radiator Manufacturing Co. of Pittsburgh installed a pilot plant to produce brazed copper-brass radiators using the new CuproBraz manufacturing process. Developed under sponsorship of the International Copper Association, the new technology offers several advantages over the process used to braze aluminum radiators including a much greater temperature tolerance and greater production speed. Also, the technology does not require separate fluxing or washing operations and is thus a more compact system, requiring less floor space. The new CuproBrazed radiators were expected to be 30% to 40% lighter than conventional sweated copper-brass radiators and cost 10% less than aluminum radiators to produce. Though copper dominates the replacement market, aluminum radiators account for about 95% of the original equipment radiators installed in American cars (Copper Topics, 1998).

In September, IBM announced that it had developed the technology to replace aluminum conductors in its integrated circuits. Scientists had been attempting to develop copper as an alternative to aluminum because aluminum's lower conductivity was placing limits on miniaturization. Copper could not be directly substituted for aluminum because silicon, the dominant semiconducting material, is "poisoned" by atomic diffusion of copper into the silicon. IBM overcame this problem by isolating the copper using a proprietary coating between the copper and silicon. IBM also developed the technology to etch the fine copper wires that could lead to interconnections as narrow as 0.1 micron, compared with 0.25 micron for aluminum. The new chips are expected to run four times faster than their aluminum counterparts and cost less to produce (Copper Topics, 1997).

## Outlook

U.S. mine capacity is expected to decline by about 20,000 tons in 1998 owing to closure of the Flambeau Mine in 1997, and lower recovery from leach solutions at several mines that suspended mining of new leach ore. Mine production and capacity utilization in 1998, however, are expected to decline, with projected mine production falling by over 100,000 tons to 1.83 million tons. In early 1998, in response to sustained lower prices, a number of companies announced production cutbacks and project deferrals. In January, Cyprus Amax announced that it would be curtailing 27,000 tons of higher-cost production at its Bagdad and Sierrita Mines (Cyprus Amax Minerals Company, 1998b). At the end of February, BHP Copper Corp. announced that it would curtail copper sulfide operations at its Pinto Valley Mine in Arizona and eventually lay off 447 of the mine's 598 employees. In March, Phelps Dodge announced a revised mine plan for its Chino Mine that would result in the loss of 45,000 tons of electrowon production over a 3-year period (Phelps Dodge Corp., 1998c). Mine capacity through the year 2000 is expected to increase only nominally as most planned property development or mine expansions have been deferred beyond that period owing to low copper prices.

Refinery production in 1998 is expected to remain at about the same level as in the previous year despite the first full year of production from Kennecott's smelter/refinery complex since completion of renovations. Cutbacks in electrowon production and an anode feed shortage are expected to moderate the growth in primary production, and a scrap shortage occasioned by low prices is expected to reduce secondary production.

Consumption of refined copper during the first 6 months of 1998 was about 9% higher than in the equivalent period in 1997; consumption for the full year 1998 is projected to rise only about 5% above that of 1997. The amount of copper recovered from old scrap, which rose during 1997, declined during the first half of 1998 in response to sustained lower copper prices. No new secondary capacity is expected, and lower prices could further depress scrap collection. Recycling of new scrap has trended upward with increased domestic consumption of mill products. Growth in new scrap recycling in 1998 was expected to lag behind the growth in refined copper demand as tight scrap supplies encourage the substitution of refined copper for scrap at brass mills and other consumers.

World mine capacity is expected to grow rapidly in the next several years. According to data compiled by the ICSG, world mine capacity growth is expected to accelerate in 1998, increasing by about 800,000 tons. Smelter capacity is projected to grow by less than 600,000 tons, but, since about 300,000 tons of mine growth will come from electrowinning, should be more than adequate to meet mine production growth. The current shortage of concentrate relative to smelter capacity is expected to persist and result in continued low capacity utilization from global smelters. Refinery capacity is projected to grow by more than 900,000 tons and be more than sufficient to meet the growth in mine production. While global demand for refined copper grew by more than 4% (550,000 tons) in 1997, the continuing economic crisis in Asia is expected to reduce growth in demand in 1998 to about 300,000 tons. Given the large expansion of mine

and refinery capacity, production of refined copper in 1998 is projected to exceed demand (International Copper Study Group, 1998b).

Beyond 1998, growth of mine capacity is expected to continue to outstrip that of consumption. Annual capacity at operating mines or mines now under development is projected to rise from the current 12.6 million tons to 14.5 million tons by 2000. About 600,000 tons of the increase is projected to come from SX-EW production. Chile is expected to account for most of the increase, where capacity is expected to grow from the current 3.5 million tons to as much as 4.6 million tons per year. Significant increases are also projected for Argentina, Australia, Indonesia, and Zambia. This growth has been modified by the current depressed market, which has led companies to defer an estimated 500,000 tons of planned development to beyond the year 2000. Delays in environmental permitting have also contributed to project delays. With new smelter projects under consideration in more than a dozen countries, smelter capacity could rise by 1.5 million tons by 2000, thus keeping pace with the projected growth in copper contained in concentrates.

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<sup>1</sup>Prior to January 1996, published by the U.S. Bureau of Mines.

TABLE 1  
SALIENT COPPER STATISTICS 1/

(Metric tons unless otherwise specified)

	1993	1994	1995	1996	1997	
United States:						
Mine production:						
Ore concentrated 2/	thousand metric tons	262,000	271,000	267,000	274,000	284,000
Average yield of copper 2/	percent	0.49	0.47	0.46	0.46	0.46
Recoverable copper:						
Arizona		1,160,000	1,160,000	1,170,000	1,240,000	1,250,000
Michigan, Montana, Utah		387,000	397,000	384,000	339,000	337,000
New Mexico		224,000	234,000	250,000	256,000	259,000
Other States		31,100	55,700	47,400	85,600 r/	96,500
Total recoverable		1,800,000	1,850,000	1,850,000	1,920,000	1,940,000
Total value	millions	\$3,640	\$4,430	\$5,640	\$4,610	\$4,570
Smelter production: 3/						
From domestic and foreign ores		1,270,000	1,310,000	1,250,000	1,300,000	1,440,000
From scrap (new and old)		415,000	397,000	354,000	339,000	285,000
Total smelter		1,680,000	1,710,000	1,600,000	1,640,000	1,720,000
Byproduct sulfuric acid, sulfur content	thousand metric tons	1,230	1,200	1,210	1,240 r/	1,370
Refinery production:						
Primary materials:						
Electrolytic from domestic ores		1,210,000	1,280,000	1,300,000	1,290,000	1,370,000
Electrolytic from foreign materials		88,600	63,500	91,200	147,000	113,000
Electrowon		491,000	493,000	539,000	574,000	586,000
Total primary		1,790,000	1,840,000	1,930,000	2,010,000	2,060,000
Secondary materials (scrap):						
Electrolytic		337,000	269,000	215,000	193,000	233,000
Fire refined		123,000	122,000	137,000	152,000 r/	151,000
Total secondary		460,000	392,000	352,000	345,000 r/	383,000
Total refined		2,250,000	2,230,000	2,280,000	2,350,000 r/	2,450,000
Secondary copper produced:						
Recovered from new scrap		748,000	827,000	874,000	891,000 r/	956,000
Recovered from old scrap		543,000	500,000	442,000	428,000	496,000
Total copper from scrap		1,290,000	1,330,000	1,320,000	1,320,000 r/	1,450,000
Copper sulfate:						
Production		46,400	48,400	52,000	43,500 r/	48,400
Stocks, Dec. 31		2,990	2,510	2,770	W	W
Exports:						
Refined		217,000	157,000	217,000	169,000	92,900
Unmanufactured 4/		685,000	752,000	894,000	683,000	618,000
Imports:						
Refined		343,000	470,000	429,000	543,000	647,000
Unmanufactured 4/		637,000	763,000	825,000	961,000 r/	978,000
Copper stocks, Dec. 31:						
Blister and in-process material		146,000	171,000	174,000	173,000	180,000
Refined copper:						
Refineries		33,400	42,500	38,000	32,200	59,700
Wire rod mills		34,700	39,800	24,800	32,100	24,600
Brass mills		14,100	8,530	7,110	14,000	14,300
Other industry		3,650	4,090	3,030	2,700	2,700
New York Commodity Exchange (COMEX)		67,200	24,200	21,500	26,600	83,000
London Metal Exchange (LME), U.S. warehouses.		--	--	68,200	38,300	129,000
Total refined		153,000	119,000	163,000	146,000	314,000
Consumption:						
Refined copper, reported		2,360,000	2,680,000	2,530,000	2,610,000 r/	2,790,000
Apparent consumption, primary refined and old scrap		2,510,000	2,690,000	2,540,000	2,830,000	2,950,000
Price:						
Producer, weighted average	cents per pound	91.56	111.05	138.33	109.04	106.92
COMEX, first position	do.	85.28	107.05	134.72	105.87	103.58
LME, Grade A cash	do.	86.76	104.64	133.12	104.05	103.25
World production:						
Mine	thousand metric tons	9,430 r/	9,520 r/	10,100	11,000	11,400
Smelter	do.	9,930 r/	10,000 r/	10,300 r/	10,800 r/	11,100
Refinery	do.	11,300	11,200	11,900	12,600 r/	13,500

See footnotes at end of table.

TABLE 1--Continued  
SALIENT COPPER STATISTICS 1/

r/ Revised. W Withheld to avoid disclosing company proprietary data.

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

2/ Yield calculations include precipitates but excludes copper recovered from leaching by solvent extraction-electrowinning.

3/ Includes primary copper produced from foreign ores, matte, etc., to avoid disclosing company proprietary data.

4/ Includes copper content of alloy scrap.

TABLE 2  
LEADING COPPER-PRODUCING MINES IN THE UNITED STATES IN 1997, IN ORDER OF OUTPUT 1/

Rank	Mine	County and State	Operator	Source of copper	Capacity (thousand metric tons)
1	Morenci	Greenlee, AZ	Phelps Dodge Corp.	Copper-molybdenum ore, concentrated and leached.	495
2	Bingham Canyon	Salt Lake, UT	Kennecott Utah Copper Corp.	do.	310
3	Chino	Grant, NM	Phelps Dodge Corp.	do.	162
4	Sierrita	Pima, AZ	do.	do.	143
5	Ray	Pinal, AZ	ASARCO Incorporated	Copper ore, concentrated and leached.	125
6	Mission Complex	Pima, AZ	do.	Copper ore, concentrated.	115
7	Bagdad	Yavapai, AZ	Cyprus Amax Minerals Co.	Copper-molybdenum ore, concentrated and leached.	115
8	San Manuel	Pinal, AZ	BHP Copper Co.	do.	147
9	Pinto Valley	Gila, AZ	do.	do.	76
10	Cyprus Miami	do.	Cyprus Amax Minerals Co.	Copper ore, leached.	73
11	Tyrone	Grant, NM	Phelps Dodge Corp. and Burro Chief Copper Co.	Copper ore, concentrated and leached.	70
12	Robinson	White Pine, NV	BHP Copper Co.	Copper ore, concentrated.	70
13	Continental	Silver Bow, MT	Montana Resources Inc.	Copper-molybdenum ore, concentrated.	50
14	Continental	Grant, NM	Cobre Mining Co.	Copper ore, concentrated.	35
15	Flambeau	Rusk, WI	Kennecott Minerals Corp.	do.	18
16	Casa Grande	Pinal, AZ	Cyprus Amax Minerals Co.	Copper ore, concentrated and leached.	15
17	Miami	Gila, AZ	BHP Copper Co.	Copper ore, leached.	12
18	Silver Bell	Pima, AZ	ASARCO Incorporated	Copper ore, concentrated and leached.	12

1/ The mines in this list accounted for 98% of the U.S. mine production in 1997.

TABLE 3  
MINE PRODUCTION OF COPPER-BEARING ORES AND RECOVERABLE COPPER CONTENT OF ORES PRODUCED  
IN THE UNITED STATES, BY SOURCE AND TREATMENT PROCESS 1/

(Metric tons)

Source and treatment process	1996		1997	
	Gross weight	Recoverable copper	Gross weight	Recoverable copper
Mined copper ore:				
Concentrated	274,000,000 r/	1,290,000	284,000,000 2/	1,310,000
Leached	NA	574,000	NA	586,000
Total	NA	1,860,000	NA	1,900,000
Copper precipitates shipped; leached from tailings, dump, and in-place material	25,100	18,900	20,800	15,600
Other copper-bearing ores 3/	7,480,000	40,400 r/	7,700,000	28,200
Grand total	XX	1,920,000	XX	1,940,000

r/ Revised. NA Not available. XX Not applicable.

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

2/ In 1997, 22.4 metric tons of gold and 393 metric tons of silver were recovered from concentrated ore. The average value of gold and silver per metric ton of ore concentrated was \$1.06.

3/ Includes gold ore, gold-silver ore, lead ore, lead-copper ore, lead-zinc ore, molybdenum ore, silver ore, tungsten ore, zinc ore, fluorspar, flux ores, clean up, ore shipped directly to smelters, and tailings.

TABLE 4  
CONSUMPTION OF COPPER AND BRASS MATERIALS IN THE UNITED STATES, BY ITEM 1/

(Metric tons)

Item	Brass mills	Wire rod mills	Foundries, chemical plants, miscellaneous users	Smelters, refiners, ingot makers	Total
1996:					
Copper scrap	909,000 r/ 2/	(3/)	61,300	655,000 r/	1,630,000
Refined copper 4/	588,000	1,980,000	45,500 r/ 5/	(6/)	2,610,000 r/
Hardeners and master alloys	893	--	2,200 r/	--	3,100 r/
Brass ingots	--	--	120,000 r/	--	120,000 r/
Slab zinc	63,600	--	(7/)	(7/)	86,400
Miscellaneous	--	--	--	(8/)	(8/)
1997:					
Copper scrap	1,010,000	(3/)	62,700	682,000	1,750,000
Refined copper 3/	597,000	2,140,000	47,500 5/	(6/)	2,790,000
Hardeners and master alloys	652	--	2,240	--	2,890
Brass ingots	--	--	125,000	--	125,000
Slab zinc	54,400	--	(7/)	(7/)	76,800
Miscellaneous	--	--	--	--	--

r/ Revised.

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

2/ Includes consumption of copper scrap at wire rod mills to avoid disclosing company proprietary data.

3/ Withheld to avoid disclosing company proprietary data; included in "Brass Mills."

4/ Detailed information on consumption of refined copper can be found in table 5.

5/ Includes consumption of refined copper at ingot makers to avoid disclosing company proprietary data.

6/ Withheld to avoid disclosing company proprietary data; included in "Foundries, chemicals plants, miscellaneous users."

7/ Withheld to avoid disclosing company proprietary data; included in "Total."

8/ Revised to zero.

TABLE 5  
CONSUMPTION OF REFINED COPPER SHAPES IN THE UNITED STATES, BY CLASS OF CONSUMER 1/

(Metric tons)

Class of consumer	Cathodes	Ingots and ingot bars	Cakes and slabs	Wirebar, billets, other	Total
1996:					
Wire rod mills	1,970,000 r/	--	--	10,800 r/	1,980,000
Brass mills	357,000	23,700	80,800	126,000	588,000
Chemical plants	--	--	--	1,110	1,110
Ingot-makers	W	--	W	3,640	3,640
Foundries	1,750	3,120 r/	W	10,900 r/	15,800 r/
Miscellaneous 2/	W	W	W	28,600	28,600
Total	2,320,000 r/	26,800 r/	80,800	181,000 r/	2,610,000 r/
1997:					
Wire rod mills	2,130,000	--	--	12,800	2,140,000
Brass mills	356,000	26,300	81,100	134,000	597,000
Chemical plants	--	--	--	1,010	1,010
Ingot-makers	W	--	W	4,190	4,190
Foundries	1,410	3,140	W	12,100	16,600
Miscellaneous 2/	W	W	W	29,900	29,900
Total	2,490,000	29,500	81,100	194,000	2,790,000

r/ Revised. W Withheld to avoid disclosing company proprietary data; included with "Wirebar, billets, and other."

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

2/ Includes iron and steel plants, primary smelters producing alloys other than copper, consumers of copper powder and copper shot, and other manufacturers.

TABLE 6  
COPPER RECOVERED FROM SCRAP PROCESSED IN THE UNITED STATES,  
BY KIND OF SCRAP AND FORM OF RECOVERY 1/

(Metric tons)

	1996	1997
Kind of scrap:		
New scrap:		
Copper-base	853,000 r/	909,000
Aluminum-base	37,800 r/	46,800
Nickel-base	91	91
Zinc-base	--	--
Total	891,000 r/	956,000
Old scrap:		
Copper-base	394,000	465,000
Aluminum-base	33,400 r/	30,300
Nickel-base	47	28
Zinc-base	17	19
Total	428,000	496,000
Grand total	1,320,000 r/	1,450,000
Form of recovery:		
As unalloyed copper:		
At electrolytic plants	193,000	233,000
At other plants	163,000 r/	161,000
Total	355,000 r/	394,000
In brass and bronze	892,000 r/	979,000
In alloy iron and steel	739	743
In aluminum alloys	70,700 r/	77,500
In other alloys	110	113
In chemical compounds	305	252
Total	964,000 r/	1,060,000
Grand total	1,320,000 r/	1,450,000

r/ Revised.

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

TABLE 7  
COPPER RECOVERED AS REFINED COPPER AND IN ALLOYS AND OTHER FORMS  
FROM COPPER-BASE SCRAP PROCESSED IN THE UNITED STATES, BY TYPE OF OPERATION 1/

(Metric tons)

Type of operation	From new scrap		From old scrap		Total	
	1996	1997	1996	1997	1996	1997
Ingot makers	36,200	35,200	90,200	96,500	126,000	132,000
Refineries 2/	123,000 r/	91,400	222,000	292,000	345,000 r/	383,000
Brass and wire-rod mills	677,000 r/	771,000	46,700	32,800	724,000 r/	804,000
Foundries and manufacturers	17,100	11,200	35,900	43,900	53,000	55,100
Chemical plants	305	252	--	--	305	252
Total	854,000 r/	909,000	394,000	465,000	1,250,000 r/	1,370,000

r/ Revised.

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

2/ Electrolytically refined and fire-refined scrap based on source of material at smelter level.

TABLE 8  
PRODUCTION OF SECONDARY COPPER AND COPPER-ALLOY PRODUCTS  
IN THE UNITED STATES, BY ITEM PRODUCED FROM SCRAP 1/

(Metric tons)

Item produced from scrap	1996	1997
Unalloyed copper products:		
Electrolytically refined copper	193,000	233,000
Fire-refined copper	152,000 r/	151,000
Copper powder	10,100	9,880
Copper castings	706	739
Total	355,000 r/	394,000
Alloyed copper products:		
Brass and bronze ingots:		
Tin bronzes	12,500	14,300
Leaded red brass and semi-red brass	92,000	88,200
High leaded tin bronze	12,000	14,100
Yellow brass	6,810	7,380
Manganese bronze	7,400	7,510
Aluminum bronze	7,910	7,430
Nickel silver	1,860	2,280
Silicon bronze and brass	5,630	6,240
Copper-base hardeners and master alloys	13,700	13,400
Miscellaneous	11	600
Total	160,000	162,000
Brass mill and wire rod mill products	888,000	953,000
Brass and bronze castings	44,000	45,300
Brass powder	634	740
Copper in chemical products	305	252
Grand total	1,450,000 r/	1,550,000

r/ Revised.

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

TABLE 9  
COMPOSITION OF SECONDARY COPPER-ALLOY PRODUCTION IN THE UNITED STATES 1/

(Metric tons)

	Copper	Tin	Lead	Zinc	Nickel	Aluminum	Total
Brass and bronze ingot production: 2/							
1996	129,000 r/	4,870 r/	8,270 r/	17,300 r/	282 r/	28 r/	160,000
1997	130,000	5,020	8,720	17,300	269	22	162,000
Secondary metal content of brass mill products:							
1996	717,000	886	7,270	160,000	W	W	888,000
1997	769,000	1,050	7,810	174,000	W	W	953,000
Secondary metal content of brass and bronze castings:							
1996	39,000	1,050	1,460	2,330	85	120	44,000
1997	40,700	693	1,010	2,670	78	151	45,300

r/ Revised. W Withheld to avoid disclosing company proprietary data; included in "Total."

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

2/ Includes approximately 96% from scrap and 4% from other than scrap.

TABLE 10  
CONSUMPTION AND YEAR ENDING STOCKS OF COPPER-BASE SCRAP 1/

(Metric tons, gross weight)

Scrap type and processor	1996		1997	
	Consumption	Stocks	Consumption	Stocks
<b>No. 1 wire and heavy:</b>				
Smelters, refiners and ingot makers	142,000 r/	6,440 r/	149,000	8,320
Brass and wire-rod mills	363,000 r/	NA	413,000	NA
Foundries and miscellaneous manufacturers	28,500	NA	35,800	NA
<b>No. 2 mixed heavy and light:</b>				
Smelters, refiners and ingot makers	216,000 r/	6,510 r/	230,000	6,310
Brass and wire-rod mills	34,600	NA	34,900	NA
Foundries and miscellaneous manufacturers	3,880	NA	2,770	NA
<b>Total unalloyed scrap:</b>				
Smelters, refiners and ingot makers	358,000 r/	12,900 r/	379,000	14,600
Brass and wire-rod mills	397,000 r/	14,500 r/	448,000	13,800
Foundries and miscellaneous manufacturers	32,400	2,480 r/	38,600	2,990
<b>Red brass: 2/</b>				
Smelters, refiners and ingot makers	58,600	2,250	58,300	2,280
Brass mills	7,390	NA	8,780	NA
Foundries and miscellaneous manufacturers	15,100	NA	10,100	NA
<b>Leaded yellow brass:</b>				
Smelters, refiners and ingot makers	27,400	1,500	28,000	1,400
Brass mills	371,000	NA	404,000	NA
Foundries and miscellaneous manufacturers	1,930	NA	1,930	NA
<b>Yellow and low brass: All plants</b>				
Cartridge cases and brass: All plants	59,600	725	53,900	852
<b>Auto radiators:</b>				
Smelters, refiners and ingot makers	46,100	NA	66,800	NA
Smelters, refiners and ingot makers	65,700	1,670	72,200	1,390
Foundries and miscellaneous manufacturers	4,700	NA	4,470	NA
<b>Bronzes:</b>				
Smelters, refiners and ingot makers	12,500	793	12,100	775
Brass mills and miscellaneous manufacturers	13,400	NA	14,900	NA
<b>Nickel-copper alloys: All plants</b>				
Nickel-copper alloys: All plants	23,300	360	17,800	424
<b>Low grade and residues:</b>				
Smelters, refiners and miscellaneous manufacturers	83,100	4,080	87,100	14,000
<b>Other alloy scrap: 3/</b>				
Smelters, refiners and ingot makers	42,000	2,410	38,400	2,050
Brass mills and miscellaneous manufacturers	6,180	NA	6,570	NA
<b>Total alloyed scrap:</b>				
Smelters, refiners and ingot makers	297,000	13,800	303,000	23,200
Brass mills	512,000	25,100	558,000	29,100
Foundries and miscellaneous manufacturers	28,900	3,570	24,100	2,920
<b>Total scrap:</b>				
Smelters, refiners and ingot makers	655,000 r/	26,700 r/	682,000	37,900
Brass and wire-rod mills	909,000 r/	39,600 r/	1,010,000	42,900
Foundries and miscellaneous manufacturers	61,300	6,050	62,700	5,910

r/ Revised. NA Not available.

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

2/ Includes composition turnings, silicon bronze, railroad car boxes, cocks and faucets, gilding metal, and commercial bronze.

3/ Includes refinery brass, beryllium copper, and aluminum bronze.

TABLE 11  
CONSUMPTION OF PURCHASED COPPER-BASE SCRAP 1/ 2/

(Metric tons, gross weight)

Type of operation	From new scrap		From old scrap		Total	
	1996	1997	1996	1997	1996	1997
Ingot makers	47,700	46,900	126,000	141,000	174,000	188,000
Smelters and refineries	122,000 r/	122,000	359,000	373,000	481,000 r/	495,000
Brass and wire-rod mills	852,000 r/	972,000	57,700	33,800	909,000 r/	1,010,000
Foundries and miscellaneous manufacturers	21,000	13,600	40,200	49,100	61,300	62,700
Total	1,040,000	1,150,000	583,000	597,000	1,630,000	1,750,000

r/ Revised.

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

2/ Consumption at brass and wire-rod mills assumed equal to receipts.

TABLE 12  
FOUNDRIES AND MISCELLANEOUS MANUFACTURERS CONSUMPTION  
OF BRASS INGOT AND REFINED COPPER AND COPPER SCRAP  
IN THE UNITED STATES 1/

(Metric tons)

Ingot type	1996	1997
Tin bronzes	33,900	31,200
Leaded red brass and semired brass	69,700 r/	73,800
Yellow, leaded, low brass 2/	8,350 r/	7,930
Manganese bronze	3,660 r/	5,780
Nickel silver 3/	960	2,040
Aluminum bronze	3,810 r/	4,110
Hardeners and master alloys 4/	2,200 r/	2,240
Total brass ingot	123,000	127,000
Refined copper consumed	45,500 r/	47,500
Copper scrap consumed	61,300	62,700

r/ Revised.

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

2/ Includes silicon bronze and brass.

3/ Includes copper nickel and nickel bronze and brass.

4/ Includes special alloys.

TABLE 13  
AVERAGE PRICES FOR COPPER SCRAP AND ALLOY-INGOT, BY TYPE

(Cents per pound)

Year	Brass mills No. 1 scrap	Refiners No. 2 scrap	Dealers' buying (New York)		Alloy-ingot (New York)	
			No. 2 scrap	Red brass turnings and borings	No. 115 brass (85-5-5-5)	Yellow brass (405)
1996	101.53	84.42	75.27	51.85	140.25	136.50
1997	99.58	81.98	69.15	51.25	138.50 1/	135.25 1/

1/ List price quotes effective July 1996.

Source: American Metal Market.



TABLE 14  
U.S. EXPORTS OF UNMANUFACTURED COPPER (COPPER CONTENT), BY COUNTRY 1/

Country	Ore and concentrate		Matte, ash and, precipitates		Refined		Unalloyed copper scrap		Blister and anodes		Total	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
1996	195,000	\$230,000	37,000	\$57,700	169,000	\$401,000	197,000	\$350,000	23,100	\$61,000	622,000	\$1,100,000
1997:												
Belgium	233	236	763	11,400	258	496	3,850	22,600	141	202	5,250	34,900
Canada	64,500	103,000	33,500	44,400	21,900	50,900	116,000	174,000	17,100	36,600	253,000	408,000
China	19,200	11,400	--	--	432	674	20,000	30,000	1,110	2,440	40,800	44,500
Gabon	--	--	--	--	--	--	--	--	27	48	27	48
Germany	9,230	13,200	164	337	105	195	13,700	37,700	226	567	23,400	52,000
Hong Kong	49	76	34	69	165	327	27,200	42,800	4,390	8,370	31,800	51,700
India	--	--	21	40	9	14	3,510	3,790	27	106	3,560	3,950
Italy	15	23	--	--	71	943	--	--	626	1,500	713	2,470
Japan	20,800	35,100	108	316	18,300	43,000	15,500	45,900	973	2,370	55,700	127,000
Korea, Republic of	13,200	16,700	8	12	3,520	7,630	2,490	3,810	2,540	8,780	21,800	36,900
Mexico	83	153	22,500	33,000	8,730	15,600	859	1,590	730	1,360	32,900	51,700
Singapore	13	101	2	18	636	1,450	227	397	752	1,740	1,630	3,700
Taiwan	--	--	142	239	26,700	67,300	677	1,110	1,840	3,920	29,300	72,500
Thailand	--	--	21	30	8,090	19,100	40	56	121	319	8,270	19,500
Trinidad and Tobago	--	--	265	964	--	--	19	58	58	199	342	1,220
Other	59	152	479	2,910	4,020	13,000	1,170	1,280	921	3,220	6,640	20,600
Total	127,000	180,000	57,900	93,700	92,900	221,000	205,000	365,000	31,600	71,700	515,000	931,000

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

Source: Bureau of the Census.

TABLE 15  
U.S. EXPORTS OF COPPER SEMIMANUFACTURES, BY COUNTRY 1/

Country	Pipes and tubing		Plates, sheets, foil, and bars		Bare wire, including wire rod 2/		Wire and cable, stranded		Copper sulfate	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
1996	24,700	\$93,700	48,200	\$174,000	38,700	\$121,000	9,070	\$56,100	2,320	\$2,320
1997:										
Australia	375	1,240	87	401	299	1,490	92	601	246	632
Austria	14	53	804	2,010	41	485	5	42	--	--
Bahamas, The	--	--	3	21	5	17	335	1,170	--	--
Belgium	79	468	40	1,650	11	110	66	987	--	--
Brazil	43	196	8	63	94	625	71	983	42	132
Canada	8,080	27,500	17,000	59,900	20,400	56,900	3,400	12,100	1,260	3,000
China	413	2,090	1,310	7,890	13	203	35	462	284	774
Costa Rica	14	59	964	5,130	65	217	37	319	10	30
Denmark	11	38	1	6	29	252	20	140	126	394
Dominican Republic	51	153	4	69	1,970	5,210	367	2,060	--	--
El Salvador	--	--	405	2,760	347	903	232	1,090	--	--
France	428	2,590	51	796	290	3,370	161	3,930	107	377
Germany	2	29	306	1,450	92	825	131	2,370	119	554
Hong Kong	110	566	1,760	13,600	164	1,210	138	1,560	321	787
Indonesia	25	216	1	21	--	--	69	482	151	436
Israel	160	1,180	402	1,810	26	152	37	288	2	8
Italy	234	988	1,600	9,030	4	64	25	238	122	393
Japan	46	266	3,310	13,200	159	891	214	2,480	2,260	6,270
Korea, Republic of	62	404	2,150	13,100	57	897	241	1,450	1,880	4,860
Malaysia	400	2,000	59	374	1,490	3,690	21	236	3	10
Mexico	10,500	33,300	7,650	28,000	19,900	65,000	6,530	36,400	200	633
Netherlands	499	2,050	259	697	41	392	10	131	77	229
Philippines	235	891	19	253	10	76	81	1,780	47	159
Saudi Arabia	304	1,170	114	446	12	67	305	2,140	--	--
Singapore	132	539	142	959	70	496	122	2,150	633	1,690
Spain	296	958	11	47	3	9	2	62	72	205
Sweden	--	--	1	28	6	39	11	240	1,210	4,020
Taiwan	312	1,360	2,650	12,200	179	1,300	28	482	705	1,690
Thailand	384	1,380	17	51	81	411	19	258	--	--
Trinidad and Tobago	3	7	2	4	995	2,720	50	789	--	--
United Kingdom	167	1,060	131	979	137	1,040	161	2,410	893	2,320
Venezuela	152	603	235	1,130	32	136	261	1,540	35	111
Other	1,620	6,130	873	2,910	577	3,610	1,740	10,400	575	1,910
Total	25,100	89,500	42,400	181,000	47,700	153,000	15,000	91,800	11,400	31,600

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

2/ Total exports of wire rod for 1996 were 25,500 tons valued at \$63 million and for 1997 were 26,200 tons valued at \$68 million.

Source: Bureau of the Census.

TABLE 16  
U.S. IMPORTS FOR CONSUMPTION OF UNMANUFACTURED COPPER (COPPER CONTENT), BY COUNTRY 1/

Country	Ore and concentrate		Matte, ash, and precipitates		Blister and anode		Refined		Unalloyed scrap		Total	
	Quantity (metric tons)	Value 2/ (thousands)	Quantity (metric tons)	Value 2/ (thousands)	Quantity (metric tons)	Value 2/ (thousands)	Quantity (metric tons)	Value 2/ (thousands)	Quantity (metric tons)	Value 2/ (thousands)	Quantity (metric tons)	Value 2/ (thousands)
1996	72,400	\$72,500	2,390	\$2,620	164,000	\$289,000	543,000	\$1,440,000	90,300	\$170,000	873,000	\$1,980,000
1997:												
Australia	4,040	8,270	--	--	--	--	8	28	2	18	4,050	8,320
Brazil	--	--	--	--	--	--	32,300	77,600	--	--	32,300	77,600
Canada	178	768	244	305	61,500	181,000	298,000	715,000	54,600	99,700	415,000	998,000
Chile	38,700	53,700	--	--	38,800	86,300	131,000	297,000	1,380	3,000	209,000	440,000
Colombia	--	--	--	--	--	--	286	647	1,650	2,880	1,940	3,530
Costa Rica	--	--	--	--	--	--	--	--	1,120	1,830	1,120	1,830
Dominican Republic	--	--	--	--	--	--	--	--	1,230	2,300	1,230	2,300
India	--	--	22	26	--	--	--	--	--	--	22	26
Japan	--	--	--	--	(3/)	5	5,970	16,400	(3/)	1	5,970	16,400
Kazakstan	--	--	--	--	--	--	5,020	12,000	--	--	5,020	12,000
Malaysia	--	--	1	41	--	--	--	--	--	--	1	41
Mexico	1,350	1,510	1,200	836	14,200	34,700	52,800	133,000	23,800	42,500	93,400	213,000
Panama	--	--	--	--	--	--	--	--	1,200	2,120	1,200	2,120
Peru	--	--	--	--	7,730	18,000	100,000	226,000	528	932	108,000	245,000
Russia	--	--	--	--	--	--	10,400	25,600	925	1,990	11,300	27,600
Spain	--	--	--	--	4,380	8,300	--	--	10	27	4,390	8,330
Taiwan	--	--	32	536	(3/)	3	(3/)	5	75	374	107	919
United Kingdom	--	--	95	150	96	5,310	201	529	--	--	392	5,990
Venezuela	13	389	--	--	--	--	--	--	1,200	1,850	1,210	2,240
Other	--	--	24	16	595	1,540	11,600	28,200	3,650	6,100	15,900	35,800
Total	44,300	64,600	1,620	1,910	127,000	335,000	647,000	1,530,000	91,400	166,000	912,000	2,100,000

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

2/ C.i.f. value at U.S. port.

3/ Less than 1/2 unit.

Source: Bureau of the Census.

TABLE 17  
U.S. IMPORTS FOR CONSUMPTION OF COPPER SEMIMANUFACTURES, BY COUNTRY 1/

Country	Pipes and tubing		Plates, sheets, foil, and bars		Bare wire, including wire rod		Wire and cable, stranded		Copper sulfate	
	Quantity (metric tons)	Value 2/ (thousands)	Quantity (metric tons)	Value 2/ (thousands)	Quantity (metric tons)	Value 2/ (thousands)	Quantity (metric tons)	Value 2/ (thousands)	Quantity (metric tons)	Value 2/ (thousands)
1996	611	\$3,460	58,700	\$245,000	57,000	\$149,000	4,620	\$25,200	17,400	\$15,900
1997:										
Australia	--	--	30	113	2	12	--	--	--	--
Canada	190	973	14,900	53,200	51,400	127,000	112	346	3,420	3,460
Chile	19	63	1,070	3,410	21	44	--	--	524	534
China	5	19	494	1,290	1,370	4,140	33	92	3,840	3,570
Finland	--	--	4,860	19,800	250	1,230	--	--	--	--
France	1	5	421	1,890	304	2,770	713	3,840	--	--
Germany	722	4,140	10,700	40,200	143	907	279	2,770	23	174
Hong Kong	(3/)	4	(3/)	21	--	--	--	--	--	--
India	--	--	225	261	(3/)	2	32	625	--	--
Israel	--	--	--	--	--	--	2,910	17,700	1,510	1,360
Italy	(3/)	2	1,190	3,930	51	382	41	276	18	18
Japan	(3/)	9	10,200	47,200	512	3,730	111	1,470	12	105
Korea, Republic of	--	--	9	122	61	344	2	21	--	--
Luxembourg	--	--	843	8,160	--	--	--	--	--	--
Malaysia	--	--	1,740	13,100	31	149	--	--	--	--
Mexico	16	58	1,460	4,890	278	936	6	66	11,300	10,500
Netherlands	56	305	185	461	11	119	--	--	--	--
Peru	--	--	1,500	3,570	128	423	--	--	1,530	1,310
Sweden	--	--	13,600	52,900	8	41	--	--	--	--
Taiwan	3	29	49	613	483	2,400	84	724	259	189
Turkey	--	--	22	62	1,280	5,450	57	259	--	--
United Kingdom	1	41	1,060	7,830	94	494	1	111	--	--
Venezuela	--	--	--	--	--	--	1,340	4,120	--	--
Other	--	13	1,280	6,200	272	822	20	155	97	112
Total	1,010	5,660	65,900	269,000	56,800	152,000	5,740	32,600	22,500	21,400

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

2/ C.i.f. value at U.S. port.

3/ Less than 1/2 unit.

Source: Bureau of the Census.

TABLE 18  
U.S. EXPORTS OF COPPER SCRAP, BY COUNTRY 1/

Country	Unalloyed copper scrap				Copper -alloy scrap			
	1996		1997		1996		1997	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Belgium	9,380	\$20,244	3,850	\$22,553	1,440	\$3,708	740	\$1,636
Canada	104,000	170,000	116,000	174,000	41,900	53,900	44,300	57,300
China	12,600	18,900	20,000	30,000	24,900	27,400	21,100	18,000
Germany	7,190	10,700	13,700	37,700	5,290	5,660	2,810	4,300
Hong Kong	28,600	41,200	27,200	42,800	43,200	62,900	32,500	41,300
India	3,960	3,740	3,510	3,790	29,800	31,600	24,100	25,500
Japan	19,300	61,000	15,500	45,900	18,700	33,700	16,100	28,700
Korea, Republic of	5,140	11,600	2,490	3,810	11,200	19,400	11,400	17,700
Mexico	2,470	4,010	859	1,590	4,030	6,000	7,940	15,700
Taiwan	1,340	2,200	677	1,110	4,970	6,460	4,070	5,690
Thailand	37	46	40	56	2,460	4,120 r/	1,710	2,460
United Arab Emirates	(2/)	(2/)	--	--	119 r/	211 r/	914	1,040
Other	3,620 r/	6,820 r/	1,410	1,740	7,310 r/	11,200 r/	6,700	7,890
Total	197,000	350,000	205,000	365,000	195,000	266,000	174,000	227,000

r/ Revised.

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

2/ Revised to zero.

Source: Bureau of the Census.

TABLE 19  
U.S. IMPORTS FOR CONSUMPTION OF COPPER SCRAP, BY COUNTRY 1/

Country or Territory	Unalloyed copper scrap		Copper-alloy scrap		
	Quantity (metric tons)	Value 2/ (thousands)	Gross weight (metric tons)	Copper content e/ 3/ (metric tons)	Value 2/ (thousands)
1996	90,300	\$170,000	122,000	87,700	\$171,000
1997:					
Argentina	--	--	185	133	345
Austria	--	--	28	20	678
Belgium	175	118	1,190	853	1,400
Canada	54,600	99,700	56,500	40,700	90,800
Chile	1,380	3,000	393	283	814
Colombia	1,650	2,880	1,820	1,310	3,420
Costa Rica	1,120	1,830	560	403	590
Dominican Republic	1,230	2,300	982	707	1,630
Germany	--	--	80	58	158
Japan	--	--	666	480	463
Malaysia	--	--	1,130	812	2,150
Mexico	23,800	42,500	38,700	27,800	59,900
Netherlands	--	--	317	228	409
Panama	1,200	2,120	1,170	842	1,460
Peru	--	--	1,070	768	982
Russia	925	1,990	778	560	913
Salvador	--	--	701	505	922
Spain	--	--	449	323	975
Taiwan	75	374	1,180	847	2,980
Ukraine	--	--	335	241	517
United Kingdom	--	--	1,870	1,340	3,610
Venezuela	1,200	1,850	2,330	1,680	2,230
Other	4,020	6,960	7,920	5,700	7,900
Total	91,400	166,000	120,000	86,700	185,000

e/ Estimated.

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

2/ C. i. f. value at U.S. Port.

3/ Under the Harmonized Tarriff System that was implemented January 1989, copper content is no longer available. Content is estimated to be 72% of gross weight.

Source: Bureau of the Census.

TABLE 20  
COPPER: WORLD MINE PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons)

Country	1993	1994	1995	1996	1997 e/
Albania	900	800	800 e/	800 e/	1,000
Argentina e/	-- r/	-- r/	-- r/	-- r/	30,000
Armenia e/	1,000 r/	4,900 r/ 3/	7,000 r/	9,100 r/	9,000
Australia:					
By concentration or cementation	384,000	392,000	380,000 r/	471,000 e/	490,000
Leaching (electrowon)	18,000	23,600	40,200	53,800 e/	55,000
Total	402,000	415,600	419,900	524,800 e/	545,000 3/
Bolivia	94	79	127	92 r/	100
Botswana 4/	20,132	22,780	21,029	23,300 r/	19,800 3/
Brazil (concentrate)	43,396 r/	39,673 r/	48,933 r/	46,203 r/	40,000
Bulgaria	60,400	73,900	93,800 r/	105,600 r/	100,000
Burma	3,581	5,025	5,282	5,000 r/ e/	6,000
Canada:					
By concentration or cementation	729,900	614,500 r/	723,700 r/	685,900 r/	654,700 3/
Leaching (electrowon)	2,700	2,300	2,600 r/	2,500	2,700 3/
Total	732,600	616,800 r/	726,300 r/	688,400 r/	657,400 3/
Chile: 5/					
By concentration or cementation	1,900,300	2,018,900	2,116,100	2,480,100	2,511,000 3/
Leaching (electrowon)	155,100	201,000	372,500	635,700	881,000 3/
Total	2,055,400	2,219,900	2,488,600	3,115,800	3,392,000 3/
China e/	345,000	396,000	445,000	439,000	414,000
Colombia	--	1,000	2,800 r/	2,222 r/	1,145 3/
Congo (Kinshasa): 6/ 7/					
By concentration or cementation	6,900	7,200	6,800	6,200 e/	10,000
Leaching (electrowon)	39,400	22,800	22,600	43,800 r/	30,000
Total	46,300	30,000	29,400	50,000 r/ e/	40,000
Cuba e/	1,500	2,900 r/	2,000 r/	2,000 r/	5,800
Cyprus	--	--	--	1,688	6,000
Ecuador e/	100	100	100	100	100
Finland	11,131	13,243 r/	9,790 r/	9,300 r/	8,500
France	72	50	--	--	--
Georgia e/	3,000	1,600 r/ 3/	3,000 r/	5,100 r/	6,000
Honduras	1,000 e/	500 e/	-- r/	--	-- 3/
India	49,416	45,944	46,975	47,800 r/	40,000
Indonesia 7/	298,648	322,190	443,618	507,484	529,121 3/
Iran	86,600	117,900	102,200	107,600	108,000
Japan	10,277	6,043	2,376	1,145	932 3/
Kazakhstan e/	265,000 r/	285,000 r/ 3/	240,000	250,000	316,000
Korea, North e/	16,000	16,000	16,000	16,000	16,000
Korea, Republic of	5	5 e/	31	1 r/	--
Macedonia	7,224 r/	7,534 r/	7,140 r/	7,000 r/ e/	6,500
Malaysia	25,182	25,267	20,751	20,219 r/	18,555 3/
Mexico:					
By concentration or cementation	277,069 r/	268,889 r/	294,647 r/	295,303 r/	342,319 3/
Leaching (electrowon)	24,082 r/	25,799 r/	38,918 r/	45,407 r/	48,217 3/
Total	301,151 r/	294,688 r/	333,565 r/	340,710	390,536 3/
Mongolia	96,900	99,600	100,400	101,900	125,300 3/
Morocco	12,990	13,020	14,000	14,550 r/	14,600
Namibia	29,500	26,555	22,530	14,904	20,300
Nepal e/	2 3/	2	2	-- r/	--
Norway	8,696	7,408	6,799	7,400 r/	6,800
Oman	8,800	4,300	--	--	-- 3/
Papua New Guinea	203,945	209,329	212,737	168,024 r/	111,700 3/
Peru:					
By concentration or cementation	334,676 r/	329,302 r/	406,959 r/	398,303 r/	391,265 3/
Leaching (electrowon)	20,300	17,200	33,392	88,172 r/	99,738 3/
Total	354,976 r/	346,502 r/	440,351 r/	486,475 r/	491,003 3/
Philippines	136,257	116,163	108,063	54,487 r/	46,959 3/
Poland	382,600 r/	378,000	384,200 r/	421,900 r/	414,000
Portugal	153,797	133,629	134,181	110,000 e/	106,500 3/
Romania 7/	25,300	26,034	24,528	24,434 r/	23,190 3/
Russia	583,600	573,300	525,000	520,000 e/	505,000

See footnotes at end of table.

TABLE 20--Continued  
COPPER: WORLD MINE PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons)

Country	1993	1994	1995	1996	1997 e/
Saudi Arabia	925	917	925 e/	834 r/	840
Serbia and Montenegro	68,007	65,000	87,575	82,526	82,500
Slovakia e/	500	--	--	386	300
South Africa	166,348	160,100	161,600	152,595	186,000
Spain	6,691	4,940 r/	22,614 r/	37,510 r/	37,800
Sweden	88,909	79,384	83,600 e/	71,700 r/	86,600
Turkey 8/	39,163	34,902	40,085 r/	50,000 r/ e/	65,000
United States: 7/					
By concentration or cementation	1,310,000	1,360,000 r/	1,310,000	1,350,000 r/	1,350,000 3/
Leaching (electrowon) 9/	491,000	493,000	539,000	574,000	586,000 3/
Total	1,800,000	1,850,000 r/	1,850,000	1,920,000	1,940,000 3/
Uzbekistan	65,000	50,000 r/	40,000 r/	65,000 e/	50,000
Zambia: 10/					
By concentration or cementation (smelted)	284,900	289,800	268,900	278,800 r/	287,000
Leaching (electrowon)	111,300	83,400	54,800	55,000 e/	66,000
Total	396,200	373,200	323,700	333,800 r/	353,000
Zimbabwe: e/					
By concentration	8,200	9,350	7,900	9,000	5,000
Leaching (electrowon)	--	--	200	3,200	4,000
Total	8,200	9,350	8,100	12,200	9,000
Grand total	9,430,000 r/	9,520,000 r/	10,100,000	11,000,000	11,400,000

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/ Data represent copper content by analysis of concentrates produced except where otherwise noted. Table includes data available through July 10, 1998.

3/ Reported figure.

4/ Copper content of pelletized nickel-copper matte produced in smelter.

5/ Reported by Comision Chilena del Cobre (COCHILCO). Includes recoverable copper content of nonduplicative mine and metal products produced from domestic ores and concentrates, and leach production for electrowinning.

6/ Formerly Zaire.

7/ Recoverable content.

8/ Excludes copper content of pyrite.

9/ Includes electrowon from concentrates roast-leached.

10/ Data are for fiscal years beginning April 1 of year stated. Zambian-mined copper reported recovered during smelting and electrowinning.

TABLE 21  
COPPER: WORLD SMELTER PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons)

Country 3/	1993	1994	1995	1996	1997 e/
Albania, primary e/	2,300 4/	1,500	3,000	2,400	2,500
Australia:					
Primary	323,000	315,000 e/	215,000	289,000 e/	208,000 4/
Secondary e/	10,000	9,600	1,200	1,200	1,000
Total e/	333,000	325,000	216,000	290,000	209,000
Austria, secondary	46,856	49,562	53,400 e/	65,400 e/	66,000
Belgium:					
Primary	200	2,600	2,700	3,500	3,500
Secondary	142,000	145,000	152,000	153,800 r/	139,000
Total	142,000	148,000	155,000	157,300 r/	142,500
Brazil, primary	161,102	170,033	164,966	172,075 r/	172,100
Bulgaria:					
Primary e/	58,500	84,400	103,000 r/	99,400 r/	100,000
Secondary e/	5,000	5,000	5,000	5,000	5,000
Total	63,500	89,400	107,560 r/	104,398 r/	105,000
Canada:					
Primary	518,000	515,000	522,761	529,349	529,524 4/
Secondary	44,100	45,000 e/	90,929	83,344	96,957 4/
Total	562,100	560,000 e/	613,690	612,693	626,481 4/
Chile, primary 5/	1,234,000	1,259,400	1,293,700 r/	1,355,600	1,389,400 p/
China: e/					
Primary	443,000	482,000	538,000	615,600 4/	763,000
Secondary	183,000	212,000	466,000	382,000	200,000
Total	626,000	694,000	1,000,000	998,000	963,000
Congo (Kinshasa), primary: e/ 6/					
Electrowon	40,000	22,800	22,000	22,000	24,000
Other	6,500	7,200	5,600	6,000	10,000
Total	46,500	30,000	27,600	28,000	34,000
Czech Republic, primary	500	-- e/	--	-- e/	--
Finland:					
Primary	107,201	129,265	120,577 r/	135,400 r/	149,000
Secondary e/	12,000	12,000	12,000	15,000	10,000
Total e/	119,000	141,000	133,000 r/	150,000 r/	159,000
France, secondary e/	5,900	4,400	2,580 r/	2,300 r/	2,400
Germany:					
Primary	141,300	237,400	242,100	296,800 r/	273,000
Secondary e/	60,000	54,800 4/	66,000	88,600	76,000
Total	201,000 e/	292,200	308,000 e/	385,400 r/	349,000
Hungary, secondary e/	100	100	100	100	100
India, primary	37,372	51,232	39,496	45,300 r/	59,400 4/
Iran: 7/					
Primary	85,000	123,800 r/	100,000	91,300 e/	91,000
Secondary e/	7,000	6,800	6,100	6,000	6,000
Total	92,000 e/	130,600 r/	106,100	97,300 e/	97,000
Japan:					
Primary	1,086,937 r/	1,029,742 r/	1,043,275 r/	1,122,571 r/	1,214,172 4/
Secondary	97,888 r/	92,257 r/	125,206 r/	110,856 r/	136,274 4/
Total	1,184,825 r/	1,121,999 r/	1,168,481 r/	1,233,427 r/	1,350,446 4/
Kazakstan, undifferentiated	300,000 e/	285,000 r/ e/	242,800 r/	245,000 r/	310,000
Korea, North: e/					
Primary	23,000	23,000	24,000	24,000	24,000
Secondary	5,000	5,000	5,000	5,000	5,000
Total	28,000	28,000	29,000	29,000	29,000
Korea, Republic of, primary e/	142,000	160,000	165,000	165,000	165,000
Mexico:					
Primary	281,627 r/	271,741 r/	274,356 r/	280,462 r/	348,290 4/
Secondary e/	26,300	21,700	14,100	21,800	4,000
Total e/	308,000	293,000	288,000	302,000	352,000
Namibia, primary 8/	34,800 e/	29,781	29,799	16,659 r/	16,029
Norway, primary	37,205	39,416	31,146	35,300 r/ e/	32,600
Oman, primary	27,700	31,200	34,200	34,800	35,000

See footnotes at end of table.



TABLE 21--Continued  
COPPER: WORLD SMELTER PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons)

Country 3/	1993	1994	1995	1996	1997 e/
Peru, primary	337,329 r/	356,098 r/	345,119	323,797 r/	323,382 4/
Philippines, primary	212,446	200,255	242,171 r/	201,661 r/	206,160 4/
Poland:					
Primary	396,000 e/	388,600	395,260 r/	399,800 r/	415,000
Secondary e/	16,000	15,000	15,000	15,000	15,000
Total	412,000	403,600 r/	410,260 r/	414,800 r/	430,000
Portugal, secondary e/	1,000	--	--	--	--
Romania:					
Primary	25,200	23,449	23,345	32,622 r/	25,024 4/
Secondary e/	1,000	1,000	1,000	1,000	1,000
Total e/	26,200	24,400	24,300	33,600 r/	26,000
Russia:					
Primary e/	534,000 r/	514,000 r/	525,000 r/	550,000 r/	575,000
Secondary e/	10,000 r/	10,000 r/	20,000 r/	20,000 r/	25,000
Total	544,000 r/	524,300 r/	545,000 r/	570,000 r/	600,000
Serbia and Montenegro:					
Primary	44,112	69,000	70,074	59,940	60,000
Secondary	13,286	17,400	17,336	65,287	60,000
Total	57,398	86,400	87,410	125,227	120,000
Slovakia, primary e/	3,000	3,000	3,000	3,000	3,000
South Africa, primary	156,600	165,900	154,400	148,400	163,600
Spain:					
Primary	135,700	157,900 r/	139,900 r/	248,500 r/	289,000
Secondary	44,800	18,800 r/	19,100 r/	22,400 r/	24,000
Total	180,500	176,700 r/	159,000 r/	270,900 r/	312,700 4/
Sweden:					
Primary	76,298	79,100 e/	85,000 r/	100,000 r/	100,000
Secondary	22,102	19,600 e/	20,000 r/	25,000 r/	25,000
Total	98,400	98,700 e/	105,000 r/	125,000 r/	125,000
Turkey, undifferentiated 9/	39,638	30,400	33,700 e/	38,600 r/ e/	38,600
United States:					
Primary 10/	1,270,000	1,310,000	1,250,000	1,300,000	1,380,000 4/
Secondary	415,000	397,000	354,000	339,000	341,000 4/
Total	1,680,000	1,710,000	1,600,000	1,640,000	1,720,000 4/
Uzbekistan: e/					
Primary	65,000	50,000 r/	40,000 r/	65,000	50,000
Secondary	5,000	5,000	5,000	5,000	5,000
Total	70,000	55,000 r/	45,000 r/	70,000	55,000
Zambia, primary: 11/					
Electrowon	62,414	26,700	65,400	73,900 e/	70,000
Other	305,146	241,000	234,500	250,000 e/	246,000
Total	367,560	267,700	299,900	324,000 e/	316,000
Zimbabwe, primary e/ 12/	8,200	10,100	8,000 r/	7,000 r/	8,000
Grand total	9,930,000 r/	10,000,000 r/	10,300,000 r/	10,800,000 r/	11,100,000
Of which:					
Primary:					
Electrowon	102,000	49,500	87,400	95,900	94,000
Other	8,320,000 r/	8,530,000 r/	8,460,000 r/	9,010,000	9,430,000
Secondary	1,170,000 r/	1,150,000 r/	1,450,000 r/	1,430,000 r/	1,240,000
Undifferentiated	340,000 r/	315,000 r/	277,000 r/	284,000 r/	349,000

See footnotes at end of table.

TABLE 21--Continued  
COPPER: WORLD SMELTER PRODUCTION, BY COUNTRY 1/ 2/

e/ Estimated. p/ Preliminary. r/ Revised.

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

2/ This table includes total production of copper metal at the unrefined stage, including low-grade cathode produced by electrowinning methods. The smelter feed may be derived from ore, concentrates, copper precipitate or matte (primary), and/or scrap (secondary). To the extent possible, primary and secondary output of each country is shown separately. In some cases, total smelter production is officially reported, but the distribution between primary and secondary has been estimated. Table includes data available through July 10, 1998.

3/ Argentina presumably produces some smelter copper utilizing its own small mine output together with domestically produced cement copper, and possibly using other raw materials including scrap, but the levels of such output cannot be reliably estimated.

4/ Reported figure.

5/ Data include low-grade electrowon which is re-refined. Low-grade electrowon production is as follows, in thousand metric tons: 1993--28.7; 1994--24.5; and 1995-97--not available.

6/ Formerly Zaire.

7/ Data are for year beginning March 21 of year stated. Secondary production is estimated to be about 5% of total.

8/ Includes products of imported concentrate.

9/ Secondary production is estimated to be about 5% to 10% of total.

10/ Figures for U.S. primary smelter production may include a small amount of copper derived from precipitates shipped directly to the smelter for further processing; production derived from electrowinning and fire-refining is not included. Copper content of precipitates shipped directly to smelter are as follows, in metric tons: 1993--19,043; 1994--26,400; 1995--21,500; 1996--18,900; and 1997--15,600.

11/ For fiscal year beginning April 1 of year stated. Electrowon is total electrowon production reported, less the quantity reported as "finished production, leach cathodes."

12/ Includes impure cathodes produced by electrowinning in nickel processing.

TABLE 22  
COPPER: WORLD REFINERY PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons)

Country	1993	1994	1995	1996	1997 e/
Albania, primary e/	1,500	1,000	1,000	1,000	1,000
Argentina, secondary	15,000 e/	16,000 r/	16,000	16,000 r/ e/	16,000
Australia:					
Primary	285,000	311,900	242,000	314,000	271,000 3/
Secondary e/	24,000	24,000	18,000	--	--
Total e/	309,000	336,000	260,000	314,000 3/	271,000 3/
Austria:					
Primary	5,871	2,904	530 e/	1,000 e/	2,000
Secondary	46,856	49,562	53,000 e/	57,000 e/	74,000
Total	52,727	52,466	53,500 e/	58,000 e/	76,000
Belgium: 4/					
Primary	216,900 r/	215,200 r/	216,000 r/	191,000 r/	203,000 3/
Secondary	162,000 r/	160,000 r/	160,000 r/	163,000 r/	183,000 3/
Total	378,900	375,200	376,000	354,000	386,000 3/
Brazil, primary	161,102	170,033	164,966	172,075 r/	172,000
Bulgaria:					
Primary e/	24,300	21,500	25,700 r/	17,300 r/	20,000
Secondary e/	2,000	5,000	3,332 3/	5,000	5,000
Total	26,347	26,500	29,077 r/	22,301 r/	25,000
Canada:					
Electrowon	2,700	2,300	2,600	2,500	2,700
Primary	518,500 r/	502,200 r/	479,100	475,000 r/	460,600 3/
Secondary	40,400	45,400	90,900 r/	81,700	96,957 3/
Total	561,600	549,900 r/	572,600	559,200	560,257 3/
Chile, primary	1,268,200	1,277,400	1,491,500	1,748,200	2,116,600 p/
China: e/					
Primary	485,000	482,000	612,000	692,000	850,000
Secondary	245,000	254,000	467,000	428,000	350,000
Total	730,000	736,000	1,080,000	1,120,000	1,200,000
Congo (Kinshasa), 5/ primary 6/	34,100	29,000	33,000	28,000 e/	33,000
Czech Republic, primary	500	--	--	--	--
Egypt, secondary	4,600 r/	4,300 r/	4,400 r/	4,600 e/	4,600
Finland:					
Primary	67,700	58,400	63,700 e/	64,000 e/	100,000
Secondary	6,000	10,800	10,000 e/	10,000 e/	16,000
Total	73,700	69,200	73,700 e/	74,000 e/	116,000
France: e/					
Primary	18,400	16,600	4,200	10,500	5,800
Secondary	26,000	25,200	38,300	28,600	29,300
Total	44,400 3/	41,800 3/	42,500	39,100	35,100
Germany:					
Primary	270,592	253,000 e/	247,200	316,000 e/	296,000
Secondary e/	361,000	339,000	369,100 3/	355,000	378,000
Total	632,079	591,859	616,300	671,000 e/	674,000
Hungary, primary and secondary e/	11,000	11,000	11,000	11,000	11,000
India:					
Primary, electrolytic	30,100	40,100	33,900	34,800 r/	57,900
Secondary	6,700	8,900	7,300 e/	7,200 r/ e/	8,000
Total e/	36,800	49,000	41,200	42,000 r/	65,900
Iran: 7/					
Electrowon	--	--	--	1,500	7,300
Primary 8/	84,900	90,200	90,400	97,700 r/	96,000
Total	84,900	90,200	90,400	99,200 r/	103,000
Italy, primary and secondary	90,300	84,000	98,000 e/	85,800	86,000
Japan:					
Primary	1,099,083	1,025,510	1,081,235	1,140,502 r/	1,157,300 3/
Secondary	89,693	93,658	106,724	110,871 r/	121,400 3/
Total	1,188,776	1,119,168	1,187,959	1,251,373	1,278,700 3/

See footnotes at end of table.

TABLE 22--Continued  
COPPER: WORLD REFINERY PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons)

Country	1993	1994	1995	1996	1997 e/
<b>Kazakstan:</b>					
Primary	317,000 r/	280,000	255,600	263,300	300,000
Secondary e/	-- r/	-- r/	-- r/	-- r/	--
Total	317,000 r/	280,000 r/	255,600 r/	263,300 r/	300,000
<b>Korea, North: e/</b>					
Primary	22,000	22,000	22,000	23,000	23,000
Secondary	5,000	5,000	5,000	5,000	5,000
Total	27,000	27,000	27,000	28,000	28,000
<b>Korea, Republic of:</b>					
Primary	218,000	244,169	234,895	246,305	265,426 3/
Secondary e/	2,000	2,000	2,000	2,000	2,000
Total e/	220,000	246,000	237,000	248,000	267,000
<b>Mexico:</b>					
Primary:					
Electrowon	24,082 r/	25,799 r/	38,918 r/	45,407 r/	48,217 3/
Other	132,200 r/	144,800 r/	140,500 r/	180,100 r/	234,000
Secondary	14,818 r/	26,501 r/	32,782 r/	16,493 r/	14,800
Total	171,100	197,100 r/	212,200 r/	242,000 r/	297,000
Mongolia, electrowon	--	--	--	--	2,950
Norway, primary 8/	37,205	39,416	34,322	28,526	32,600
Oman, primary	20,539	24,194	33,900 r/	24,150 r/	25,000
<b>Peru:</b>					
Electrowon	20,300	17,200	33,392	88,172	99,738 3/
Primary	238,639 r/	248,213 r/	261,751 r/	249,890 r/	284,347 3/
Total	258,939 r/	265,413 r/	295,143 r/	338,062 r/	384,085 3/
Philippines, primary	165,954	154,713	158,109	155,774 r/	146,630 3/
<b>Poland:</b>					
Primary	404,170	405,093	405,708 r/	424,700 r/	425,000
Secondary	56,989	20,318	28,976	20,000 e/	20,000
Total	461,159	425,411	434,684 r/	444,700 r/	445,000
<b>Romania:</b>					
Primary	22,000 e/	22,113	22,013	28,305 r/	21,912 3/
Secondary e/	3,000	4,600	1,000	1,000	1,000
Total e/	25,000	26,700	23,000	29,300 r/	22,900
<b>Russia:</b>					
Primary	486,000 r/	452,000 r/	504,000 r/	513,000 r/	550,000
Secondary	40,000	50,000 r/	56,000 r/	57,000 r/	60,000
Total	526,000 r/	502,000 r/	560,000 r/	570,000	610,000
<b>Serbia and Montenegro:</b>					
Primary	43,410	66,308	71,304	59,940	60,000
Secondary	7,890	5,841	7,147	44,060	53,536 3/
Total	51,300	72,149	78,451	104,000	113,536 3/
Slovakia, primary and secondary	28,000	25,000	25,000 e/	25,000 e/	25,000
South Africa, primary 8/	127,900	129,622	124,300	123,000 r/ e/	126,500
<b>Spain: e/</b>					
Primary	137,230 3/	142,000	117,000	210,000	229,000
Secondary	42,000 3/	46,800	47,100	54,000	63,300
Total	179,230 3/	188,000	164,000	264,000	292,000
<b>Sweden:</b>					
Primary e/	76,300 3/	77,300	78,000 r/	100,000	90,000
Secondary	22,486	25,750	27,100 r/	25,000 e/	27,000
Total e/	98,786 3/	103,000	105,000 r/	125,000	117,000
Taiwan, secondary e/	10,000	10,000	8,000	6,000	4,000
Turkey, primary	92,400	82,700	98,500 e/	120,000	120,000
<b>United Kingdom:</b>					
Primary	10,629	11,078	28,000 e/	12,869	9,000
Secondary	35,949	35,586	50,500 e/	43,746	51,000
Total	46,578	46,664	78,500 e/	56,615	60,000

See footnotes at end of table.

TABLE 22--Continued  
 COPPER: WORLD REFINERY PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons)

Country	1993	1994	1995	1996	1997 e/
United States:					
Primary:					
Electrowon	491,000	493,000	539,000	574,000	581,000 3/
Other	1,300,000	1,350,000	1,390,000	1,430,000 r/	1,480,000 3/
Secondary	460,000	392,000	352,000	333,000 r/	383,000 3/
Total	2,250,000	2,230,000	2,280,000	2,340,000	2,450,000 3/
Uzbekistan: e/					
Primary	65,000 r/	85,000	75,000	75,000	72,820 3/
Secondary	10,000	5,000	5,000	5,000	5,000
Total	75,000 r/	90,000	80,000	80,000	77,800
Zambia, primary: 9/					
Electrowon	48,845	67,300	62,000 r/	58,000 r/ e/	67,000
Other	363,247	284,800	266,000 r/	276,000 r/ e/	263,000
Total	412,092	352,100	328,000 r/	334,000 r/	330,000
Zimbabwe: 10/					
Electrowon	--	--	200	3,200 e/	4,000
Primary	8,187	9,350	6,875 r/	10,900 r/ e/	5,000
Secondary e/	8,200	6,000	6,000	6,000	6,000
Total e/	16,400	15,400	13,100 r/	20,100 r/	15,000
Total, primary	9,200,000 r/	9,110,000 r/	9,540,000 r/	10,400,000 r/	11,200,000
Total, secondary	1,750,000 r/	1,670,000 r/	1,970,000 r/	1,880,000 r/	1,980,000
Total, primary and secondary, undifferentiated	379,000	379,000	383,000	371,000 r/	377,000
Grand total	11,300,000	11,200,000	11,900,000	12,600,000 r/	13,500,000

e/ Estimated. p/ Preliminary. r/ Revised.

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

2/ This table includes total production of refined copper, whether produced by pyrometallurgical or electrolytic refining methods and whether derived from primary unrefined copper or from scrap. Copper cathode derived from electrowinning processing is also included. Table includes data available through July 10, 1998.

3/ Reported figure.

4/ Includes leach cathode from Congo (Kinshasa), which is processed.

5/ Formerly Zaire.

6/ Excludes leach cathode exported for processing in Belgium.

7/ Data are for Iranian years beginning March 21 of that stated.

8/ May include secondary.

9/ Data are for fiscal year beginning April 1 of that stated. Electrowon covers only presumably high-grade electrowon cathodes reported as "finished production leach cathodes." Other, in addition to electrowon cathodes, includes a smaller amount of "finished product shapes" presumably cast from electro-refined cathodes, or any blister-anodes and low-anodes and low-grade electrowon cathodes that were furnace- or fire-refined.

10/ May include copper-nickel matte (copper content more than 6,000 tons per year) imported from Botswana for toll refining.