ZINC

By Jozef Plachy

In 1996, domestic zinc mine production declined by more than 2%. Zinc was extracted from 23 mines in 8 States. *(See tables 2 and 3.)* During the year, four mines ceased production, and one mine was reactivated. For the sixth consecutive year, Alaska was the leading zinc mining State, and was followed by Tennessee, New York, Missouri, and Montana. U.S. mine production greatly exceeded smelter capacity, resulting in more than two-thirds of the zinc concentrate being exported, mainly to Canada. Based on the recoverable content and the average annual U.S. price, the value of zinc mine production exceeded $600 million.

The 1996 zinc metal production by the three primary smelters-refineries from domestic and a small amount of imported concentrate was about 3% lower than that of 1995. *(See table 4.)* The imbalance between concentrate production and smelter capacity may be partially redressed by planned capacity increases at the Clarksville, TN, and the Sauget, IL, smelters.

Apparent consumption decreased slightly, and imports of zinc metal decreased by more than 3%. About one-half of the refined zinc was used for galvanizing.

U.S. producer prices, which are based on the London Metal Exchange (LME) daily cash price and include a premium, increased by more than 4% between January and December. However, the average price for zinc was slightly less than that of the previous year, in spite of an almost 25% decline in LME stocks.

Despite numerous mine closings, world mine production increased by about 3%, to 7.4 million metric tons. Canada remained the world's largest producer, and was followed by Australia, China, Peru, and the United States. These countries accounted for about 63% of total world production of zinc concentrates. *(See table 17.)* Total zinc metal production decreased slightly, to 7.5 million tons. China, Canada, Japan, and the United States accounted for about 38% of total world zinc metal production. *(See table 18.)* LME stocks declined from 664,700 tons at the beginning of January to 506,800 tons by yearend. Total world stocks were down by 20%, to 922,000 tons at yearend, equivalent to 6.5 weeks of consumption.

Legislation and Government Programs

The Defense Logistics Agency (DLA) is authorized (Public Law 102-484) to sell 45,000 tons (50,000 short tons) of zinc per fiscal year from the National Defense Stockpile (NDS) as long the sale does not cause undue disruption of the zinc market. Actual sales amounted to 16,512 tons (18,201 short tons). The DLA has maintained that the market for its stockpiled zinc metal, 90% of which is either high grade or prime western grade, included the whole zinc market; the American Zinc Association (AZA), however, insisted that the market for stockpiled zinc is principally the high-grade zinc market. To settle the disagreement, the U.S. Congress asked the General Accounting Office (GAO) to investigate the dispute between the AZA and the DLA. The GAO concluded that the usual market for stockpiled zinc is the total U.S. zinc market, which amounts to more than 1.2 million tons, dwarfing the amount sold from the stockpile (U. S. General Accounting Office, 1996).

In August, the U.S. Department of the Interior invited the public to participate in the revision of regulations for lead and zinc mining on Indian Reservations by submitting written comments to the Bureau of Indian Affairs. The proposed revision pertained to leasing of the Quapa Indians' land, which is under the jurisdiction of Ottawa County, OK, for the discovery, testing, development, mining, and processing of all lead and zinc minerals. The proposed revisions, if implemented, will set a precedent for mining on other Indian Reservations (Bureau of Indian Affairs, 1996).

On September 16, 1996, the U. S. Environmental Protection Agency (EPA) granted an exemption from hazardous waste control to Bekaert Steel Corp. of Rogers, AR. The decision involved the treatment of wastewater sludge from electroplating operations at the Rogers facility. The EPA determined that the concentration of zinc was below the level of regulatory concern and should not present a hazard to human health or the environment. The regulation requires that the content of wastewater be analyzed annually. The request was backed by the AZA, which used this opportunity to request that zinc be removed permanently from the list of hazardous wastes, disposal of which is regulated by the Land Disposal Restrictions, to "additional constituents" which can be disposed of in municipal dumps.

Production

Mine Production.—U.S. zinc mine output, expressed in recoverable zinc content, declined by more than 2% in 1996, mainly because of several mine closings—the Rosiclare Mine, IL, in January, the New Market Mine, TN, in September, and the Jefferson City Mine, TN, in October—and the temporary closure of the Leadville Mine, CO, in December. The potential concentrate shortfall was partially offset by the reopening of the Greens Creek Mine, AK, in July.

The production of zinc ore at the Red Dog Mine in Alaska, owned by NANA Regional Corp. and leased by Cominco Ltd.'s subsidiary, Cominco Alaska Inc., declined by about 7%, to 2.1

million tons. Because of improved milling efficiency—from 75% in 1995 to 83% in 1996—concentrate production increased by 2,000 tons, to 587,200 tons, which contained 324,722 tons of zinc (Cominco Ltd., 1997).

Cominco began a $104 million expansion of the Red Dog Mine that was expected to increase production by about 40% during the next 3 years, with most of the increase expected in 1999. Most of the planned increase was to come from raising the rate of production in the main ore body, estimated to have a remaining life of as much as 20 years. Together with the recently discovered Aqqaluk zone, which doubled the size of zinc reserves at Red Dog while maintaining a combined zinc grade of 16%, the total reserves at Red Dog were expected to be sufficient for at least 40 years of operation (Mining Journal, 1996g).

Encouraged by the recent discovery, Cominco continued to explore for further deposits around the Red Dog Mine. The latest discovery included zinc-lead-silver mineralization immediately north of the Aqqaluk zone. Two holes, drilled 140 meters apart, intersected a mineralized zone grading from 12% to 26% zinc with small amounts of lead and silver. The new zone was only partially delineated, and additional drilling was planned for 1997 (Mining Record, 1996a).

Zinc is Cominco's largest single source of revenue, representing 48% of the total. To maintain its prominence, 46% of the company's $48 million worldwide exploration budget was directed towards zinc prospects, mainly in North America (Northern Miner, 1997a).

Korea Zinc Co. Ltd., of the Republic of Korea, secured a 25% stake in the joint venture Tintic Utah Metals LLC. The joint venture was headed by Chief Consolidated Mining Co., the United States, which had a 50% interest; Akiko Gold Resources, Canada, held the remaining 25%. The venture planned to develop the New Burgin polymetallic deposit in Utah and to explore the surrounding 3,600-hectare (9,000-acre) Tintic property for additional mineralization. Thyssen Mining Construction of Canada, Ltd., the North American Subsidiary of Thyssen Schachtbau GmbH of Germany, agreed to conduct preliminary engineering design and cost evaluations for shaft sinking, underground development, and contract mining. According to Sunshine Mining, the previous owner, the deposit has minable reserves of 1.4 million tons of ore containing 6.7% zinc, 21% lead, and 566 grams of silver per ton. The project is expected to come on-stream in late 1998 (Mining Journal, 1996d).

Because of depressed concentrate prices and high treatment charges, ASARCO Incorporated decided to close its Leadville Mine in Colorado at yearend. As the first employees of the already depleted work force were leaving the mine in mid-December, Asarco reconsidered its decision and decided to resume mining operations in 1997. The restart of operations was to be phased in during January with full employment in February; full production was expected by mid-March (Platt's Metals Week, 1996).

The Greens Creek Mine, the polymetallic underground zinc-lead-silver-gold mine on Admiralty Island off Juneau, Alaska, reopened at the end of July, 5 months ahead of schedule. The mine is owned by a joint venture of Kennecott Greens Creek Mining Co. (70.3%) and Hecla Mining Co. (29.7%). Between 1993 and 1995, when the mine was closed, exploration efforts around Greens Creek successfully identified a high-grade ore deposit called the Southwest Zone. The new deposit allowed profitable mining at prevailing metal prices during the last 5 months of 1996. The metal content of the ore produced in 1996 amounted to 10,843 tons of zinc, 3,810 tons of lead, 193 tons of copper, 77 tons of silver, and 233 kilograms of gold. The full annual production rate of about 40,000 tons of zinc was expected in the first quarter of 1997, when grinding and flotation circuits were to be completed. The total known reserves were expected to give Greens Creek a 17-year mine life at intended production rates. The owners of Greens Creek signed a land exchange agreement with the U.S. Forest Service for exploration rights to about 3,000 hectares (7,500 acres) of land surrounding the mine (Mining Record, 1996c).

Crandon Mining Co. was awaiting approval from Wisconsin State Government for its Rhinelander Mine. The deposit reportedly contains about 55 million tons of recoverable ore at grades of 9.4% zinc and 0.4% copper, with small amounts of lead and precious metals. The company anticipated building a 2-million-ton-capacity mill, producing between 200,000 and 300,000 tons of zinc concentrates and about 20,000 tons of combined copper-lead concentrate per year. At the planned production rate, the mine would be operational for about 28 years (Metal Bulletin, 1996d).

Smelter and Refinery Production.—Savage Zinc Inc., a subsidiary of Australia's Savage Resources Limited, applied to the Tennessee State Government for approval to increase the capacity of its Clarksville smelter from 100,000 to 260,000 tons of zinc per year. The approval process was expected to take more than a year, after which a detailed feasibility study would have to be completed. Savage Zinc also started processing refinery residues to improve the recovery of zinc and byproducts, including germanium. The company lost about 4,000 tons of metal output because of roaster difficulties in August. Part of the loss was made up from its own stocks, and the rest was purchased from outside sources, including metal purchased from the DLA (Metal Bulletin, 1996m).

In April, Korea Zinc Co. Ltd. acquired the Illinois-based 82,000-ton-per-year Sauget smelter from Big River Zinc Corp., a wholly owned subsidiary of Big River Resources. The Sauget smelter obtained most of its concentrate from mines in Tennessee and Missouri and imported about 20% of its feed from Canada, Mexico, and Peru. Six months after the purchase, Korea Zinc announced a two-part strategy to increase the output of its newly acquired smelter—the first focused on environmental issues, namely reducing waste, increasing recovery, and ensuring better environmental control and the second part called for expanding production from the current 88,000 to 120,000 tons per year, mainly by eliminating bottleneck problems (Fineberg, 1996a).

Secondary Production.—Between 1984 and 1996, world secondary zinc recovery increased three times faster than

primary zinc metal production. Secondary recovery provided more than one-quarter of the world's refined zinc output in 1996. In the United States, secondary zinc recovery increased by about 7%, to 377,000 tons, equivalent to 31% of consumption. *(See tables 9 and 10.)* This rapid increase was caused by the introduction of new economically feasible technologies spurred by strict environmental protection laws.

One of the new dezincing technologies was developed by Metal Recovery Technologies Inc., in cooperation with the American Iron & Steel Institute and the U.S. Department of Energy. Metal Recovery began commercial dezincing operations at its new plant in East Chicago, IN, in October. The process involved washing galvanized steel scrap in two consecutive rolling drums containing a solution of sodium hydroxide to dissolve zinc, which is then removed from the solution by electrowinning. This new technology enabled a 99% rate of recovery in the form of 99.8% pure zinc powder. About 73,000 tons of high-grade black scrap (steel) per year and 1,750 tons of zinc per year is expected to be produced from the 75,000 tons of treated scrap. Owing to initial startup problems, only 50 tons of zinc powder was produced in 1996 (Metal Bulletin, 1996i).

Interamerican Zinc Inc. (IZI) moved its dross-processing operation from Adrian, MI, to a location adjacent to an aluminum recycling plant it is building with Alchem Aluminum Inc. in Coldwater, Michigan. The capacity of the new secondary zinc plant is the same as that of the Adrian plant—20,000 tons of continuous galvanizer grade zinc slab, making IZI the largest U.S. recycler of drosses from the steel galvanizing industry.

Consumption

Domestic data for zinc consumption was developed by the U.S. Geological Survey from voluntary surveys of U.S. operations. Large consumers were canvassed monthly, and smaller ones, annually. Between 65% and 70% of zinc-consuming companies were surveyed, of which about 70% responded. Consumption for nonrespondents was estimated on the basis of prior consumption and industry trends. Reported consumption of refined zinc accounted for about 65% of apparent metal consumption.

Apparent domestic consumption of slab zinc fell by 22,000 to 1,210,000 tons. Electrogalvanizing and hot-dip galvanizing, mainly for sheet and strip, continued to be the principal uses of zinc metal, consuming about one-half of total production. As the annual cost of metallic corrosion in the United States is estimated to be about $300 billion, it is not surprising that galvanizing is the largest application of zinc and is expected to continue to expand. Consequently, three new plants began operations in 1996—a 400,000-ton-capacity hot-dip plant in Delta, OH, a 350,000-ton-capacity hot-dip plant in Granite City, IL, and a 260,000-ton-capacity hot-dip/galvalume plant in Birmingham, AL. An additional three plants are to be added in 1997 and five more plants in 1998, raising galvanizing capacity by more than 4 million tons and consumption of zinc by about 120,000 tons. The largest consumers of hot-dipped galvanized steel are the construction and automotive sectors, using 45% and 33%, respectively (Christiansen, 1996).

Stocks

In 1996, the imbalance between supply and demand was offset by drawing down of stocks. In the United States, stocks of refined zinc decreased by nearly 5%. An even larger decrease was recorded by LME stocks, which fell by nearly 24%, to 506,800 tons, the lowest level since 1993. According to industry experts, the zinc market should remain in a substantial deficit during 1997 and possibly through 1998. While world metal production is forecast to rise to only 7.60 million tons, consumption is expected to reach 7.72 million tons, generating a deficit of 120,000 tons in 1997 (Mining Journal, 1997e).

Prices

The decline in stocks did not stimulate any noticeable price increase in 1996. Although the average domestic price for North American Special High Grade zinc was lower than that of the previous year, the daily price at yearend was nearly 4% higher than in the beginning of the year, indicating a possible upward turn in domestic prices in 1997. The price of zinc on the U.S. market consists of an LME base price plus a premium reflecting delivery fees, the availability of zinc, and other market conditions. The annual average premium was 4.61 cents per pound of refined zinc metal.

Foreign Trade

The pattern of U.S. trade in zinc has remained essentially unchanged for several years; refined (slab) zinc is the overwhelmingly important imported form, ore concentrates the overwhelmingly important exported form. Overall, net imports of zinc contained in all forms (ore through finished metallurgical products and compounds) changed little in 1996. The relatively high domestic zinc prices in the first half of 1995 had encouraged importation of slab zinc in that year. As the price eased in the latter months of 1995 and through the first 7 months of 1996, imports decreased somewhat. Nonetheless, imports of slab zinc were equivalent to about 68% of apparent consumption of slab zinc in 1996, compared with 70% in 1995—both figures were typical of the percentages in recent years. The majority of the imported slab zinc originated in ores from Cominco's Red Dog Mine, in Alaska, which were smelted and refined at Cominco's plant at Trail, BC, and shipped from Canada.

Because of growing domestic demand, coupled with ebbing demand in the Far East, exports of secondary zinc declined to about 45,500 tons, valued at $30 million. Imports of secondary zinc declined by 25%, to 32,000 tons, composing about 2.2% of annual consumption of zinc. Dross generated by continuous hot-dip galvanizers remained in high demand for domestic use and exports alike, with the price for the dross reaching up to

80% of the cash LME price for zinc. Consequently, increased amounts of the dross were used by domestic secondary producers, reducing exports. With a nearly 70% share, Taiwan remained the largest importer of U.S. scrap, and was followed by India and Canada.

World Review

Australia.—Australian production of zinc concentrate increased by more than 14%, owing to the opening of the Hercules Mine, the reopening of the Potosi Mine, and the expansion of the Woodcutters Mine. Inauguration of the Century Mine in Queensland, however, was delayed until 1997. Rio Tinto Zinc Corp.-Conzinc Riotinto of Australia (RTZ-CRA) reportedly has been frustrated in its attempt to develop the Century deposit by the impasse in its negotiations with the local Waanyi people, who claim ownership of the land under Australia's Native Title Act. The deposit was discovered in 1990 by CRA, and reportedly has proven reserves of 116 million tons grading 10.2% zinc, 2.3% lead, and 38 grams of silver per ton of ore (Mining Journal, 1996i). Production was planned at 780,000 tons of zinc concentrate per year and 84,000 tons of lead concentrate per year. One-half of the proposed zinc concentrate was to be shipped to Pasminco's Budel smelter in the Netherlands, which requires zinc concentrates low in iron.

Pasminco's production of zinc concentrate in fiscal year 1995 (ending on June 30, 1996) was slightly lower than that of fiscal year 1994. All its production came from four mines—Broken Hill, Elura, Potosi, and Roseberry. Because of declining zinc content of the ore at the Broken Hill Mine, the 2.4-million-ton production had to be supplemented, at a rate of 200,000 tons per year, with ore from the nearby Potosi open pit mine. Pasminco also decided to resume production at its Hercules Mine in Tasmania, following the signing of a 2-year joint venture agreement with Mancala, a mining management and contracting company in Australia. Ore will be trucked to the nearby Roseberry mill, where it will augment zinc concentrate from the Roseberry underground mine by about 5,000 tons in the first year and close to 8,000 tons in the second year (Metal Bulletin, 1996l). Pasminco also proposed a joint venture to Coolgardie Gold, for exploration and possible development of its deposit in the Lawn Hill Platform, 50 kilometers southeast of the Century deposit and 150 kilometers north of the Mount Isa Mine. If commercially viable, then it could augment and eventually replace diminishing production at the Broken Hill Mine. Preliminary drilling results at Lawn Hill in October revealed a significant 11-meter-wide deposit grading 8.2% zinc and 1.6% lead at a depth of 103 meters (Metal Bulletin, 1996k).

Korea Zinc Co. Ltd. plans to build a new zinc refinery in Townsville, north Queensland. The first stage of the $775 million construction is to start in April 1997. Production is expected to begin in February 2000 at an initial level of 170,000 tons of zinc concentrate per year. According to the agreement between Korea Zinc and the Queensland Government, after completion of the first stage, Korea Zinc is to undertake a feasibility study for the second stage, which will include a lead smelter and an expansion of the zinc refinery (Mining Journal, 1996c).

Bolivia.—Most of the 1996 increase in Bolivia's zinc ore production came from the opening of the Don Francisco Mine and the expansion of the Andacaba Mine, both of which are located in southern Bolivia. The Don Francisco Mine began production in June and is scheduled to produce 200 tons per day in 1997. Ore reserves reportedly amount to 230,000 tons grading 18% zinc and 79 grams of silver per ton of ore. By 1998, the Don Francisco and the Andacaba Mines, which began expansion in summer 1996, were expected to yield 17,400 tons of zinc, 2,700 tons of lead, and 37 tons of silver per year. Andacaba's reserves were estimated to be 1.7 million tons grading 9.5% zinc, 3.3% lead, and 302 grams of silver per ton of ore. Both mines were purchased by the Denver-based Atlas Corp. in October for $4 million in cash and 4 million Atlas shares (Mining Journal, 1996f).

Canada.—The world zinc market was marked by the unexpected closures of several zinc mines at yearend. Because of low prices, a strong Canadian dollar, and technical problems, at least three Canadian mines closed. The first mine to cease operation was Goldstream Mine, owned by Bethlehem Resources Corp. The Faro Mine, owned by the Anvil Range Mining Corp., and the Gonzague-Langlois (formerly Grevet) Mine, owned by Cambior Inc., closed temporarily. If both of these remain closed in 1997, the already tight world concentrate supply will decline by about 230,000 tons. Despite these setbacks, the 1996 Canadian production of zinc in concentrate was about 10% higher than that of 1995 because of increased production at other mines and the reopening of the Gonzague-Langlois Mine during part of the year.

On December 20, Anvil Range Mining Corp. suspended mining operations at its Faro lead-zinc mine, Yukon Territory; 300 of the mine's 450 employees were affected. The Faro Mine comprises the Dy, the Grum, and the Vangorda deposits. The suspension reportedly resulted from a combination of production problems and weak metal prices. Delays in maintenance and scheduled repairs of the mill, as well as a lack of sufficient mining equipment, were said to have caused an 11% drop in output. In addition, the declining ore grade, from 8% combined zinc-lead in September to 6.7% in November, made the whole operation unprofitable. Milling operations were to continue for the first 3 months of 1997, processing the stockpiled low-grade ore at 50% of normal milling capacity. During that time, the whole operation was to be reevaluated and a decision made on whether to reopen the mine. Prior to its startup in 1995, the Grum open pit reportedly had 24.8 million tons of proven and probable reserves, grading 4.54% zinc, 2.74% lead, 46 grams of silver, and 0.7 grams of gold per ton of ore. Reserves of the Vangorda pit reportedly are nearly depleted but the nearby Dy deposit was said to contain an estimated 9.4 million tons of underground reserves grading 6.62% zinc, 5.5% lead, 80.3 grams of silver, and 0.82 gram of gold per ton. Because only about 20% of the surrounding area has been explored, a $4.4 million exploration program was launched in June. Prior to

closure, planned production for 1997 was 170,000 tons of zinc in concentrate (Robertson, 1996).

After less than a year of operation, Montreal-based Cambior Inc. suspended production at its Gonzague-Langlois underground mine near Lebel-sur-Quévillon, northwestern Quebec. The December closure was caused by low metal prices and the need to modify the method used to mine certain parts of the deposit. The company expected to restart operations in the second quarter of 1997, provided market conditions are favorable. At the projected rate of production, mine life is expected to be at least 12 years. Proven and probable reserves are said to amount to 11 million tons grading 8.5% zinc, and containing small amounts of copper, gold, and silver. Concentrate production in 1996 was expected to amount to 62,000 tons of zinc, 3,000 tons of copper, 8.8 tons of silver, and 20 kilograms of gold in concentrates from 910,000 tons of ore (Mining Record, 1996b). Most of the zinc concentrate from the Gonzague-Langlois Mine was processed at Noranda's electrolytic zinc refinery in Valleyfield, Quebec, with a zinc recovery of 91%. The refinery reportedly is to receive $61 million from Noranda in 1997, one-half of which will be used to improve the hydrometallurgical process, and the remainder to treat and dispose of production waste.

China.—China's large-scale, Government-owned lead and zinc enterprises continued a series of mergers to reduce production costs and to improve profits. In 1995, the Huludao zinc plant and the Shenyang smelter formed Huludao Northeastern Nonferrous Metals Enterprise, while Lingnam Lead and Zinc Group, based in Shaoguan, was formed by the Shaoguan smelter and the Fankou lead and zinc mine. Eventually, all the lead and zinc plants will be consolidated into four groups headquartered in Huludao, Liaoning Province, Zhuzhou, Hunan Province, Shaoguan, Guangdong Province, and Baiyin, Gansu Province. Chinese per capita zinc consumption, about 0.45 kilograms, is low compared with the world average of 1.2 kilograms (Mining Journal, 1996k) but has been projected to increase by about 6.6% per year for the next 4 years (Eldridge, 1996a). During the present 5-year plan covering the period from 1996 to 2000, smelting capacity is to increase by about 180,000 tons per year while mine output is to increase only marginally, necessitating large imports of zinc concentrates. In 1996, the capacity of the Zhuzhou smelter was increased by 100,000 tons to 250,000 tons per year (Eldridge, 1996b). An additional 80,000-ton increase in capacity is to come from small, locally controlled smelters.

Finland.—At the end of May, Outokumpu Oy began mining the recently discovered Mullikkoräme deposit, near the town of Pyhajarvai in central Finland. Proven reserves reportedly amount to 700,000 tons at a grade of 8% zinc with byproducts of lead and copper and small amounts of silver and gold. By the end of year, production reached a rate of 240,000 tons per year, enabling mining to continue for about 3 years. For processing, ore was transported 10 kilometers to the nearby Pyhasalmi concentrator (Metal Bulletin, 1996f).

Mining at the Pyhasalmi zinc-copper mine reached a depth of 1,050 meters. Outokumpu began a 2-year project to study potential extension of mining to a 1,400-meter depth. The mine's reserves reportedly are sufficient to maintain the 1-million-ton-per-year production rate until the year 2000 (Mining Journal, 1996h).

Outokumpu has decided to invest $112 million to increase the capacity of its Kokkola smelter, to ensure that the smelter will remain competitive. By using a new method of direct leaching of zinc concentrate, developed by Outokumpu, the Finnish smelter is expected to increase capacity from 170,000 to 225,000 tons per year by the end of 1998 (Fineberg, 1996c).

Iran.—Iran ranks 10th in the world in zinc resources but produced only small amounts of zinc metal in 1996. To increase zinc production, a new 30,000-ton-per-year smelter in Bafgh, 580 kilometers southeast of Teheran, is to be commissioned at the beginning of 1997. The Iranian Government's planned $300 million investment in zinc metal production also includes a 7,000-ton-capacity smelter in the northwestern city of Zanjan, a 7,000-ton-capacity smelter in Bandar Abbas on the Persian Gulf, and three smaller units. By 2000, total annual capacity is expected to reach 50,000 tons of zinc metal. The required feed was to come from increased production at existing mines and a possible new mine in Mehdiabad in Yazd Province (Metal Bulletin, 1996g).

Ireland.—The Galmoy Mine in County Kilkenny is the first base-metal mine opened in Ireland in nearly 20 years. It was developed by Arcon Mines, a wholly owned subsidiary of Arcon International Resources. Resources of 6.2 million tons grading 11.4% zinc and 1.1% lead with low iron content and a trace of cadmium, reportedly have been identified. Production began at the end of 1996 and is expected to reach 650,000 tons of ore per year, yielding 120,000 tons of zinc concentrate by 1997. All the production has been presold to several European smelters (Mining Journal, 1996j).

In January 1996, Ireland's Ivernia West Plc., together with Minorco SA, proceeded with development of the Lisheen project. The ore body was found by Ivernia in 1980, and in 1994, Minorco bought a 50% interest in the project. The zinc-lead mine is expected to be one of the 10 largest mines in the world, producing an estimated 320,000 tons of zinc concentrates and 60,000 tons of lead concentrates per year for about 13.5 years (Metal Bulletin, 1996h). Production is scheduled to begin in 1998, and when fully operational, the mine is expected to provide employment for as many as 350 people.

Italy.—The state-owned resources group, Enirisorse SpA, began the process of privatizing its zinc smelter in Porto Vesme, Sardinia, and its refinery in Crotone, Calabria, southern Italy. The Porto Vesme zinc smelter produces about 70,000 tons of zinc slab per year using the Imperial Smelting Process. The Crotone electrolytic refinery, originally owned by Ente Nazionale Idrocarburi, produces about 100,000 tons of refined zinc plus other products, such as cadmium, indium, and germanium. Only about one-fourth of the required feed is sourced from the Iglesias area of Sardinia: the remainder is imported (Metal Bulletin, 1996e).

Japan.—Zinc production declined by more than 10%, owing mainly to the closure in June of Mitsubishi Materials Corp.'s

Barajima smelter near Akita in northwestern Tahaku. Commissioned in 1953, its capacity had risen from the initial 6,720 to 105,000 tons per year by 1996. Proximity to the port and its reliance on imported concentrate was at first beneficial because the value of the yen was low. When the value of the yen began to rise, it was more economical, given the high cost of production, to import metal than to make it. During its last months, production was running at 80% of capacity, and the smelter was losing about $9.3 million per month (McCulloch, 1996). Although primary zinc production stopped, the Akita plant's alloy production facility will continue production at a rate of about 1,500 tons per month.

Kazakstan.—In November, the Government of Kazakstan announced plans to combine the Ust-Kamenogorsk base metal smelter, Leninogorsk and Ziryanovsk mining and processing enterprises, and the Irtysh copper smelter into a new company named AO (Aktsionernoye Obshchestvo) Kaztsink. All the enterprises are located within a 300-kilometer radius and are connected by rail. The Ust-Kamenogorsk base metals smelter reportedly has the capacity to produce 145,900 tons of lead, 215,000 tons of zinc, 37,100 tons of blister copper, and 6,600 tons of cathode copper per year. The Leninogorsk base metals mining and smelting enterprise reportedly has a mining capacity of 3.9 million tons of polymetallic ore per year, and its smelter has the capacity to produce 106,500 tons of zinc per year. The Zyryanovsk mining enterprise reportedly has the capacity to mine 6.4 million tons of polymetallic ore per year, and to process 5.2 million tons of ore per year, and is capable of producing copper, lead, and zinc concentrates. The newly formed Kaztsink would also have mining rights in the Maleyevsk, the Ridder-Sokol, and the Tishinsk mineral fields. The combined smelter production capacity would be 321,500 tons of zinc metal per year, far above the ability of domestic mines to supply concentrate. Only about one-half Kazakstan's refined zinc production was from domestic feed. Because of the lack of a domestic source of concentrate and the resulting under utilization of capacity, one of Ust-Kamenogorsk's three plants was closed for the entire year, and closure of additional plants is expected. If all smelters of the new AO Kaztsink were to remain in operation, then an investment of $270 million would be needed for modernization and repairs and for repaying a combined debt of $173 million (Mining Journal, 1996b). The future of the smelters will depend on the availability of concentrate, both domestic and imported.

In addition to AO Kaztsink, the small Tekeli lead and zinc mining and beneficiation complex in the Taldy-Kurgan region in the eastern part of the country consists of three mines and two beneficiation plants. The concentrates are sent to the Chimkent zinc smelter in southern Kazakstan, as well as to the Ust-Kamenogorsk smelter.

Peru.—Peru's zinc concentrate production increased by 68,313 tons, to 760,563 tons, a 9.9% increase over that of 1995. Empresa Minera del Centro del Peru S.A. (Centromin) posted the largest net increase, 16,000 tons of zinc in concentrate (U.S. Embassy, Lima, Peru, 1997). This 9.1% increase was achieved in spite of disruptions caused by continued privatization efforts and the resulting uncertain future. The strategy for privatization of Centromin was modified following the unsuccessful attempt to sell it as a single entity in 1994. The following year, the newly created Privatization Committee broke up the state mining enterprise into small independent units and decided to sell each unit individually. In September 1996, the Yauliyacu (formerly known as Casapalca) mining-smelting complex near Lima was offered for privatization. A month later, the Antamina copper-zinc deposit and the Quicay and the Paucaray gold properties were sold to Canadian companies. The Yauliyacu complex consists of a smelting plant, a 979,000-ton-capacity mill, and an underground polymetallic mine containing about 6.5 million tons of potential reserves of predominantly zinc ore (Fineberg, 1996b). The last unit offered for sale in 1996 was the Yauricocha polymetallic underground mine and mill, 350 kilometers southeast of Lima. It reportedly has reserves of 2.8 million tons and potential reserves of 6 million tons grading 5.3% zinc, 2.8% lead, 1.1% copper, 132 grams of silver, and 0.8 gram of gold per ton of ore. The daily mill capacity is about 1,500 tons, and the mine's typical annual production, expressed in contained metal in concentrate, is 18,000 tons of zinc, 7,000 tons of lead, 2,000 tons of copper, and 37 tons of silver. Because of lack of interest in Yauricocha, the Government initially decided to lower the asking price and eventually suspended the sale altogether. Sales of the Centromin components were to continue in the first quarter of 1997, when at least 51% of the shares of the 62-year-old La Oroya refinery complex was to be offered for sale (Metal Bulletin, 1996c).

Mining began in April at the Iscaycruz zinc-lead mine, operated by Empresa Minera Iscaycruz S.A. A 25-kilometer-long pipeline carries the concentrate from mine to the filter plant in Churin, outside of Lima. Production of zinc concentrate started in July and reached full annual capacity of 125,000 tons in December. Production for the year totaled 60,000 tons of zinc and 8,000 tons of lead in concentrate. The mine reportedly has proven and probable reserves of 2.7 million tons grading 21.4% zinc and 2.2% lead. Minera Iscaycruz is owned by Glencore International of Switzerland (45%), Corp. Minera Nor Peru S.A. (25%), Perubar S.A. (15), and Cia. de Minas Buenaventura S.A. (15%) (Mining Journal, 1996a).

According to Government estimates, by 2000, Peru will be producing 1 million tons of zinc in concentrate, up from 700,000 tons in 1996. The Cajamarquilla smelter, near Lima, is expected to play a significant part in that increase. A 20,000-ton-per-year expansion has been approved by Minero Peru, and a feasibility study to expand the capacity to 230,000 tons per year has been commissioned. Cajamarquilla is already one of the five most competitive smelters, and the expansion reportedly could make it the most efficient producer of refined zinc in the world. The net cost of converting concentrates to refined zinc at Cajamarquilla was 12.9 cents per pound. Cajamarquilla is owned by Cominco (82%), Marubeni Corp. (17%), and by employees (1%) (Metal Bulletin, 1996b).

Spain.—Boliden Mineral AB of Sweden, through its Spanish subsidiary Boliden Apirsa, plans to invest $100 million in the development of the Los Frailes deposit, near Seville. The zinc-

lead-copper-silver deposit lies only 1 kilometer from the Aznalcóllar Mine, which closed at the end of 1996 owing to depletion of reserves. Average ore grade reportedly is 3.82% zinc, 2.17% lead, 0.35% copper, and 60 grams of silver per ton of ore (Hotter, 1996). The open pit mine and mill will have a production capacity of 110,000 tons of zinc, 45,000 tons of lead, 6,000 tons of copper, and 85 tons of silver per year. Because the Los Frailes Mine is so close to the old mine, the existing infrastructure is being used for processing.

In 1996, Ireland's Navan Resources purchased Minas de Almagrera S.A. from the Government-owned Sociedad Estatol de Participaciones Industriales for $3.43 million as part of Spain's privatization program. With the purchase, Navan acquired a metallurgical complex at Calanas that is capable of treating more than 1 million tons of polymetallic ore per year. Navan also acquired the Sotiel and the Migollas Mines. The Calanas complex will become fully operational with supplemental ore from Navan's Aguas Tenidas project, just 20 kilometers away, where a feasibility study was carried out for a possible production of 35,000 tons of zinc and 10,000 tons of lead concentrate. Reserves at Aguas Tenidas reportedly total 13.4 million tons of ore grading 5.7% zinc, 1.7% lead, 1.3% copper, 38 grams of silver, and 3 grams of gold per ton of ore. Almagrera's reserves at the time of sale included the 50-million-ton reserve at Sotiel reportedly grading 3.8% zinc, 1.6% lead, and 0.6% copper and the 6.4-million-ton Migollas deposit grading 3.84% zinc, 1.63% lead, and 0.62% copper (Metal Bulletin, 1996j).

Tunisia.—Following an evaluation of the capital investment required to lower the production cost, Société Minière de Bougrine S.A. suspended the operation of its Bougrine zinc-lead mine in Tunisia in October. According to the company officials, the added expenditure was not justified in light of current prices. The mine, in which Canada's Inmet Mining Corp. has a 48% interest, began operation in 1994. The 1996 production was expected to be 50,000 tons of zinc in concentrate and 8,500 tons of lead in concentrate, up from 38,000 and 6,300 tons, respectively, in 1995 (Metal Bulletin, 1996a).

Exploration.—World exploration expenditure by international mining companies for metals and minerals continued to grow for the third consecutive year. The composite annual expenditure of companies with at least a $3 million allotment for exploration, grew to about $3.5 billion, compared with only $2.7 billion in 1995. Also, the number of companies active in exploration increased from 154 to 223 in 1996, of which 112 were active in base metals exploration. If smaller companies were added to the total, then the estimated worldwide exploration expenditure for nonferrous metals would amount to $4.6 billion. Most of the exploration was conducted in Latin America, followed by Australia and Canada. Zinc deposit discoveries in Latin America include the Bogara deposit at the Florida Canyon area, Peru, the Aripuana project in northern Mato Grosso State, western Brazil, the Campo Morado deposit in Guerrero State, Mexico, and the San Fernando area, central Cuba. In Australia, Pasminco entered into a joint venture with Coolgardie Gold to explore a 500-square-kilometer area 150 kilometers north of Mount Isa, Queensland, where preliminary exploration drilling uncovered zinc mineralization ranging between 8.2% and 10.2% zinc. In a joint venture with Finland's Outokumpu, SIPA Resources of Australia discovered a 6.2-million-ton deposit at Sulphur Springs, Western Australia, at an average grade of 8.54% zinc and a small amount of copper. In Canada, the exploration by the joint venture of Westmin Resources Ltd. (60%) and Atna Resources Ltd. (40%) resulted in the discovery of a 5.3-million-ton deposit grading 13% zinc, 1.5% lead, 1.41% copper, 359 grams of silver, and 1.8 grams of gold per ton in the Wolverine area in the Yukon-Tanana Terrane in southwestern Yukon Territory (Northern Miner, 1996b). In June, Anvil Range Mining Corp. began a $6 million exploration in the vicinity of its Faro Mine. Inmet Mining Corp. reportedly will be able to continue operating its Winston Lake Mine for another 7 years because of the discovery of an additional 1.3-million-ton reserve grading 15.5% zinc and 0.9% copper. Additional exploration in Canada was conducted by Diadem Resources at the Pekan River area in Quebec and by Fortune Minerals in the Mazenod Lake area of the Northwest Territories, where grab samples reportedly showed metal concentrations up to 7.36% zinc, 3.8% lead, 1.4% copper, and 11.6 grams of silver per ton of ore (Whyte, 1996).

Outlook

The closure of several zinc mines at yearend may further aggravate the already short supply of concentrates anticipated for 1997. As new mines come on-stream, this shortage should gradually disappear. By 2000, the world mine production is forecast to increase by almost 1.4 million tons, about one-third of which is to come from Australia. This additional production should come from new mines at Century, Cannington, and Blendecale and, to a lesser extent, from expanded production of the existing Elura and Roseberry Mines. Australia's share of world production should increase from 18% in 1995 to 29% by 2000. This increased mine production may create an excess of concentrates into the next century, because expansion of smelter capacity will likely lag behind concentrate production. By the end of 1996, only one new smelter had been approved—the 170,000-ton smelter in Townsville, Australia. Production at this Korea Zinc-built smelter should start in October 1999. If needed, the best chance for additional smelting capacity could come from expansion of the existing smelters and the proposed 220,000-ton Gencor smelter in South Africa. Even if all these capacities should be brought on-stream, it would not affect the zinc market until about the year of 2000. In the meantime, increased consumption and constant metal production will further reduce the world stockpile and put upward pressure on the zinc price. It is anticipated that the total reported stocks of zinc could drop, from a peak level of 1.64 million tons in 1994, to 450,000 tons by the end of 1998.

References Cited

Bureau of Indian Affairs, 1996, Lead and zinc mining operations and leases on

Quapaw indian lands: Federal Register, v. 61, no. 167, August 27, p. 1-10.
Christiansen, Suzanne, 1996, Construction underpins U.S. investments: Metal Bulletin Monthly, June, p. 33-37.
Cominco Ltd., 1997, 1996 Annual report: Vancouver, British Columbia,61 p.
Eldridge, David, 1996a, Chinese lead and zinc set for fast growth: Metal Bulletin, no. 8081, May 23, p. 7.
———1996b, New Zn plant supports Zhuzhou growth: Metal Bulletin, no. 8083, May 30, p. 5.
Fineberg, Seth, 1996a, Big River sets growth plans: American Metal Market, v. 104, no. 201, October 16, p. 4.
———1996b, Centromin plans sale of zinc, lead prospects: American Metal Market, v. 104, no. 153, August 8, p. 3.
———1996c, Outokumpu sets $112M zinc boost: American Metal Market, v. 104, no. 152, August 7, p. 3.
Hotter, Andrea, 1996, Los Frailes keeps the zinc flag flying: Metal Bulletin Monthly, November, p. 30-33.
McCulloch, Russ, 1996, MMC retreats from zinc smelting: Metal Bulletin Monthly, June.
Metal Bulletin, 1996a, Bougrine set to increase production: Metal Bulletin, no. 8105, August 19, p. 3.
———1996b, Cajamarquilla seeks power for expansion: Metal Bulletin,no. 8127, November 7, p. 5.
———1996c, Centromin sets minimum price for Yauliyacu: Metal Bulletin, no. 8129, November 14, p. 9.
———1996d, Crandon Mining plans to develop Rhinelander deposit: Metal Bulletin, no. 8096, July 15, p. 6.
———1996e, Enirisorse begins Zn-Pb privatization: Metal Bulletin no. 8075, May 2, p. 5.
———1996f, In Brief: Metal Bulletin, no. 8118, October 7, p. 10.
———1996g, Iran to boost production: Metal bulletin, no. 8141, December 31, p. 3.
———1996h, Ivernia funds Lisheen development with right issue: Metal Bulletin, no. 8097, July 18, p. 6.
———1996i, Metal Recovery to start dezincing operation: Metal Bulletin, no. 8053, February 12, p. 15.
———1996j, Navan Resources acquires Spain's Minas de Almagrera: Metal Bulletin, no. 8128, November 11, p. 7.
———1996k, Pasminco to enter jv with Coolgardie: Metal Bulletin,no. 8122, October 21, p. 6.
———1996l, Pasminco to restart Tasmanian Mine: Metal Bulletin, no. 8107, August 29, p. 5.
———1996m, Savage to expand U.S. zinc smelter: Metal Bulletin, no. 8057, February 26, p. 7.
Mining Journal, 1996a, Iscaycruz suspension: Mining Journal, v. 327, no. 8407, December 6, p. 458-459.
———1996b, Kazaks combine zinc-lead plants: Mining Journal, v. 328, no. 8410, January 3, p. 3.
———1996c, Korea Zinc agreement: Mining Journal, v. 327, no. 8403, November 8, p. 374.
———1996d, Korea Zinc in Utah: Mining Journal, v. 327, no. 8390, August 9, p. 106.
———1997e, Lead and zinc trends, v. 328, no. 8427, May 2, p. 360.
———1996f, Market news: Mining Journal, v. 327, no. 8400, October 18, p. 313.
———1996g, Mine expansion at Red Dog... : Mining Journal v. 326, no. 8376, May 3, p. 334.
———1996h, Production to start at Mullikkorame: Mining Journal, v. 326, no. 8378, May 17, p. 383.
———1996i, Sale of the Century: Mining Journal, v. 328, no. 8411, January 10, p. 1 and 18.
———1996j, Year of progress at Galmoy: Mining Journal, v. 326, no. 8369, March 15, p. 194.
———1996k, Zinc—Asia to the rescue?: Mining Journal, v. 326, no. 8379, May 24, p. 408.
Mining Record, 1996a, Additional drilling planned for new zone at Red Dog: Mining Record, v. 107, no. 44, October 30, p. 2.
———1996b, Cambior Inc.: Mining Record, v. 107, no. 36, September 4, p. 53.
———1996c, Full production at Greens Creek projected for first quarter of '97: Mining Record, v. 107, no. 44, October 30, p. 5.
Northern Miner, 1997a, Cominco expands search for zinc: Northern Miner, v. 83, no. 6, April 7, p. C19.
———1996b, Partners expand Wolverine: Northern Miner, v. 82, no. 40, December 2, p. 1.
Platt's Metals Week, 1996, Asarco reverses Leadville Mine shutdown decision: Platt's Metals Week, December 16, p. 1 and 6.
Robertson, Rob, 1996, Mothballed Faro seen as victim of Murphy's Law: The Northern Miner, v. 82, no. 40, December 2, p. 1.
U.S. Embassy, Lima, Peru, 1997, Peru's mine production increases 5.2 percent in 1996: U.S. State Department Telegram 001908 (March 1997), p. 1-5.
U.S. Environmental Protection Agency, 1996, Hazardous waste management system—Identification and listing of hazardous waste—Final exclusion: Federal Register, v. 61, no. 180, September 16, p. 1-7.
U.S. General Accounting Office, 1996, National Defense Stockpile—Disposal of excess zinc: Washington DC, U.S. General Accounting Office, GAO/NSIAD-97-30, p. 1-24.
Whyte, James, 1996, Mazenod Lake: Northern Miner v. 82, no. 40, December 2, p. B2.

OTHER SOURCES OF INFORMATION

U.S. Geological Survey Publications

Zinc. Ch. in Minerals Yearbook, annual.[1]

Zinc. Ch. in Minerals Commodity Summaries, annual.[1]

Zinc. Mineral Industry Surveys, monthly.[1]

Zinc. Ch. in United States Mineral Resources, U.S. Geological Survey Professional Paper 820.

Other

American Metal Market (daily).

[1]Prior to January 1996, published by the U.S. Bureau of Mines.

TABLE 1
SALIENT ZINC STATISTICS 1/

(Metric tons unless otherwise specified)

		1992	1993	1994	1995	1996
United States:						
Production:						
Domestic ores, contained zinc		552,000	513,000	598,000	644,000	628,000
Domestic ores, recoverable zinc		523,000	488,000	570,000	614,000	600,000
Value, recoverable zinc	thousands	$674,000	$497,000	$619,000	$756,000	$615,000
Refined zinc:						
From domestic ores		227,000	214,000	201,000	223,000	214,000
From foreign ores		44,800	26,000	15,600	8,840	11,400
From scrap		128,000	141,000	139,000	131,000	140,000
Total		399,000	382,000	356,000	363,000	366,000
Secondary zinc 2/		238,000	217,000	222,000	222,000	238,000
Rolled zinc		48,200	W	W	W	W
Exports:						
Ores and concentrates (zinc content)		307,000	311,000	389,000	424,000	425,000
Slab zinc		565	1,410	6,310	3,080	1,970
Rolled zinc		5,430	6,600	6,680	5,180	5,020
Imports for consumption:						
Ores and concentrates (zinc content)		44,500	33,100	27,400	10,300	15,100
Refined (Slab) zinc		644,000	724,000	793,000	856,000	827,000
Rolled zinc		171	135	475	332	16,900
Stocks of slab zinc, Dec. 31:						
Producer		7,960	4,970	5,210	7,120	11,100
Consumer		57,900	61,600	64,600	64,400	58,400
Merchant		15,600	10,500	9,930	6,440	4,800
Total		81,500	77,000	79,700	78,000 r/	74,300
Government stockpile		341,000	326,000	286,000	272,000	257,000
Consumption:						
Refined zinc:						
Reported		814,000	828,000	843,000	917,000 r/	788,000
Apparent 3/		1,050,000	1,120,000	1,180,000	1,230,000 r/	1,210,000
All classes 4/		1,290,000	1,340,000	1,400,000	1,460,000	1,450,000
Price: Special High Grade, cents per pound		58.38	46.15	49.26	55.83	51.11
World:						
Production:						
Mine	thousand metric tons	7,250 r/	6,910 r/	7,000 r/	7,240 r/	7,440
Smelter	do.	7,260 r/	7,460 r/	7,450 r/	7,550 r/	7,530
Price: London Metal Exchange, cents per pound		56.24	43.64	45.26	46.82	46.50

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

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

2/ Zinc in metal products and compounds derived directly from scrap; refined secondary zinc is listed separately in the table.

3/ Domestic production plus net imports, plus or minus stock changes.

4/ Apparent consumption of refined zinc plus reported consumption of zinc in metal products and compounds derived directly from ore, concentrate, or scrap.

TABLE 2
MINE PRODUCTION OF RECOVERABLE ZINC IN THE UNITED STATES, BY STATE 1/

(Metric tons)

State	1995	1996
Alaska	321,000	331,000 2/
Montana	22,700	19,400
Other	270,000	249,000
Total 3/	614,000	600,000

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

2/ Data in part based on publicly available information.

3/ Includes production from Colorado, Idaho, Illinois, Missouri, New York, and Tennessee.

TABLE 3
LEADING ZINC PRODUCING MINES IN THE UNITED STATES IN 1996, IN ORDER OF OUTPUT

Rank	Mine	County and State	Operator	Source of zinc
1	Red Dog	Northwest Arctic, AK	Cominco Alaska Inc.	Zinc ore.
2	Elmwood-Gordonsville	Smith, TN	Savage Zinc Inc.	Do.
3	Balmat	St. Lawrence, NY	Zinc Corporation of America	Do.
4	Young	Jefferson, TN	ASARCO Incorporated	Do.
5	Pierrepont	St. Lawrence, NY	Zinc Corporation of America	Do.
6	Montana Tunnels	Jefferson, MT	Montana Tunnels Mining Inc.	Do.
7	Casteel 1/	Iron, MO	The Doe Run Co.	Lead ore.
8	Buick	do.	do.	Do.
9	Cumberland	Smith, TN	Savage Zinc Inc.	Zinc ore.
10	Clinch Valley	Grainger, TN	do.	Do.
11	Immel	Knox, TN	ASARCO Incorporated	Do.
12	Greens Creek	Southeastern, AK	Kennecott Mining Co.	Do.
13	Jefferson City	Jefferson, TN	Savage Zinc Inc.	Do.
14	Coy	do.	ASARCO Incorporated	Do.
15	New Market	do.	do.	Do.
16	Leadville Unit	Lake, CO	do.	Do.
17	Sweetwater	Reynolds, MO	do.	Lead-zinc ore.
18	West Fork	do.	do.	Do.
19	Fletcher	do.	The Doe Run Co.	Do.
20	Viburnum No. 29	Washington, MO	do.	Do.
21	Lucky Friday	Shoshone, ID	Hecla Mining Co.	Do.
22	Viburnum No. 28	Iron, MO	The Doe Run Co.	Do.
23	Rosiclare	Hardin and Pope, IL	Ozark-Mahoning Co.	Fluorspar.

1/ Includes Brushy Creek Mill.

TABLE 4
REFINED ZINC PRODUCED IN THE UNITED STATES 1/

(Metric tons)

	1995	1996
Primary:		
From domestic ores	223,000	214,000
From foreign ores	8,840	11,400
Total	232,000	226,000
Secondary	131,000	140,000
Grand total (excludes zinc recovered by remelting)	363,000	366,000

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

TABLE 5
REFINED ZINC PRODUCED IN THE UNITED STATES, BY GRADE 1/

(Metric tons)

Grade	1995	1996
Special High	117,000	111,000
Continuous Galvanizing	77,500	88,500
Other 2/	168,000	167,000
Total	363,000	366,000

1/ Data are rounded to three significant digits; may not add to totals shown.
2/ Includes High, Controlled Lead, and Prime Western grades.

TABLE 6
SLAB ZINC CAPACITY OF PRIMARY ZINC PLANTS IN THE UNITED STATES, BY TYPE OF PLANT AND COMPANY

(Metric tons)

Type of plant and company	Slab zinc capacity 1995	1996
Electrolytic:		
Big River Zinc Corp., Sauget, IL	82,000	82,000
Savage Zinc, Inc., Clarksville, TN	100,000 r/	100,000
Electrothermic:		
Zinc Corp. of America, Monaca, PA 1/	146,000	146,000
Total operating capacity	328,000 r/	328,000

r/ Revised.
1/ Includes secondary capacity.

TABLE 7
STOCKS AND CONSUMPTION OF NEW AND OLD ZINC SCRAP IN THE UNITED STATES IN 1996, BY TYPE OF SCRAP 1/

(Metric tons, zinc content)

Type of scrap	Stocks, Jan. 1	Receipts	Consumption: New scrap	Consumption: Old scrap	Consumption: Total	Stocks, Dec. 31
Diecastings	W	3,380	--	3,320	3,320	W
Flue dust	W	5,070	4,040	4,040	8,080	W
Galvanizer's dross	W	22,500	24,200	--	24,200	W
Old zinc 2/	22	W	--	W	W	W
Remelt die-cast slab	W	3,030	--	3,050	3,050	W
Remelt zinc 3/	20	W	W	--	W	24
Skimmings and ashes 4/	6,460	26,000	28,400	--	28,400	4,050
Other 5/	8,900	137,000	55,600	80,800	136,000	4,430
Total	15,400	197,000	112,000	91,200	203,000	8,500

W Withheld to avoid disclosing company proprietary data; included with "Other."
1/ Data are rounded to three significant digits; may not add to totals shown.
2/ Includes engraver's plates and rod and die scrap.
3/ Includes new clippings.
4/ Includes sal skimmings and die-cast skimmings.
5/ Includes chemical residues and solutions, electrogalvanizing anodes, fragmentized diecastings, and steelmaking dust.

TABLE 8
PRODUCTION OF ZINC PRODUCTS FROM ZINC-BASE SCRAP IN THE UNITED STATES 1/

(Metric tons)

Products	1995	1996
Redistilled slab zinc	131,000	140,000
Other zinc metal products 2/	6,470	4,450
Zinc in chemical products	61,500	82,500
Zinc dust	21,800	26,700

1/ Data are rounded to three significant digits.
2/ Includes electrogalvanizing anodes, remelt die-cast slab, and other metal alloys.

TABLE 9
ZINC RECOVERED FROM SCRAP PROCESSED IN THE UNITED STATES, BY TYPE OF SCRAP AND FORM OF RECOVERY 1/

(Metric tons)

	1995	1996
Type of scrap:		
New scrap:		
Zinc-base	96,700	110,000
Copper-base	146,000 r/	155,000
Magnesium-base	148 r/	331
Total	242,000 r/	265,000
Old scrap:		
Zinc-base	85,700	88,100
Copper-base	24,400 r/	24,700
Aluminum-base	711	819
Magnesium-base	178 r/	186
Total	111,000 r/	114,000
Grand total	353,000	379,000
Form of recovery:		
Metal:		
Slab zinc	131,000	140,000
Zinc dust	21,800	26,700
Other 2/	W	W
Total	155,000	167,000
In zinc-base alloys	W	--
In brass and bronze	134,000	127,000
In other metal alloys	W	W
In chemical products:		
Zinc oxide (lead free)	33,600	47,100
Zinc sulfate	19,600	27,300
Zinc chloride	W	2,730
Miscellaneous	10,700	7,660
Total	198,000	211,000
Grand total	353,000	379,000

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

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

2/ Includes electrogalvanizing anodes and zinc content of slab made from remelt die-cast slab.

TABLE 10
U.S. CONSUMPTION OF ZINC 1/

(Metric tons)

	1995	1996
Refined zinc, apparent	1,230,000 r/	1,210,000
Ores and concentrates (zinc content)	1,650	1,670
Secondary (zinc content) 2/	222,000	238,000
Total	1,460,000	1,450,000

r/ Revised.

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

2/ Excludes secondary slab zinc and remelt zinc.

TABLE 11

U.S. REPORTED CONSUMPTION OF ZINC IN 1996, BY INDUSTRY USE AND GRADE 1/

(Metric tons)

Industry use	Special High Grade	High Grade	Prime Western	Remelt and other grades	Total
Galvanizing	98,000	89,600	157,000	53,800	398,000
Zinc-base alloys	141,000	W	--	W	142,000
Brass and bronze	W	W	W	W	87,400
Other	146,000	21,500	80,400	254	161,000
Total	385,000	111,000	238,000	54,000	788,000

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

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

TABLE 12

ZINC CONTAINED IN PIGMENTS AND COMPOUNDS 1/ PRODUCED AND SHIPPED IN THE UNITED STATES 2/

(Metric tons)

	1995		1996	
	Production	Shipments	Production	Shipments
Zinc chloride	W	W	2,730	2,770
Zinc oxide	104,000	104,000	125,000	128,000
Zinc sulfate	22,300	20,000	30,000	31,900

W Withheld to avoid disclosing company proprietary data.

1/ Excludes leaded zinc oxide and lithopone.

2/ Data are rounded to three significant digits.

TABLE 13

REPORTED SHIPMENTS OF ZINC CONTAINED IN ZINC OXIDE, BY INDUSTRY 1/ 2/

(Metric tons)

	1995	1996
Ceramics	2,710	4,950
Chemicals	24,000	26,200
Paints	3,840	5,430
Rubber	68,200	86,400
Other 3/	5,330	5,010
Total	104,000	128,000

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

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

2/ In addition, zinc contained in zinc oxide was imported as follows: 1995-39,300 (revised) and 1996-45,000; distribution cannot be distinguished by industry.

3/ Includes agriculture and photocopying.

TABLE 14
U.S. EXPORTS OF ZINC ORES AND CONCENTRATES, BY COUNTRY 1/

	1995		1996	
	Quantity (metric tons, zinc content)	Value (thousands)	Quantity (metric tons, zinc content)	Value (thousands)
Belgium	55,000	$27,300	61,100	$40,000
Canada	176,000	89,200	178,000	64,900
China	9,240	4,420	9,140	4,380
Germany	30,200	14,400	--	--
Japan	68,000	29,600	47,300	20,000
Korea, Republic of	22,300	10,700	46,100	22,000
Netherlands	25,400	12,300	60,200	28,800
Russia	6,870	2,300	--	--
Spain	15,400	3,330	19,800	5,630
Thailand	9,240	4,420	--	--
Other	6,320	2,940	3,440	4,020
Total	424,000	201,000	425,000	190,000

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 ZINC COMPOUNDS 1/

	1995		1996	
	Quantity (metric tons, gross weight)	Value (thousands)	Quantity (metric tons, gross weight)	Value (thousands)
Lithopone	342	$570	319	$2,040
Zinc chloride	1,690	1,250	1,470	1,230
Zinc compounds, n.s.p.f.	1,690	4,350	1,250	4,670
Zinc oxide	7,090	9,110	5,770	9,430
Zinc sulfate	4,210	2,260	5,230	2,970
Zinc sulfide	377	498	112	1,410

1/ Data are rounded to three significant digits.

Source: Bureau of the Census.

TABLE 16
U.S. IMPORTS FOR CONSUMPTION OF ZINC COMPOUNDS 1/

	1995		1996	
	Quantity (metric tons, gross weight)	Value (thousands)	Quantity (metric tons, gross weight)	Value (thousands)
Lithopone	1,450	$1,560	1,080	$1,030
Zinc chloride	2,450	2,370	2,420	2,140
Zinc compounds, n.s.p.f.	136	314	1,190	1,280
Zinc oxide	49,100	54,200	56,300	57,500
Zinc sulfate	5,400	3,820	4,050	2,840
Zinc sulfide	--	--	517	4,240

1/ Data are rounded to three significant digits.

Source: Bureau of the Census.

TABLE 17

ZINC: WORLD MINE PRODUCTION (CONTENT OF CONCENTRATE AND DIRECT SHIPPING ORE UNLESS NOTED), BY COUNTRY 1/ 2/

(Metric tons)

Country	1992	1993	1994	1995	1996 e/
Algeria	4,044	3,672	3,050	3,700 r/	3,700 3/
Argentina	40,978	31,395	26,933 r/	32,104 r/	33,000
Australia	1,025,000	1,010,000	995,000	937,000 r/	1,071,000 3/
Austria	15,787	20,014	-- e/	-- e/	--
Bolivia	143,936	122,638	100,742	146,131	144,000
Bosnia and Herzegovina e/	2,000	350	300	300	300
Brazil	149,000	171,800	145,900	167,259 r/	170,000
Bulgaria	29,000	32,000	28,500 r/	25,600 r/	19,800
Burma	1,078	850	1,316	721 r/	590
Canada	1,324,675	1,007,257	984,000	1,121,172 r/	1,235,274 3/
Chile	29,730	29,435	31,038	33,000 r/	30,000
China e/	758,000	775,000	990,000	1,010,000 r/	1,010,000
Colombia	277	279	275	275 e/	275
Czech Republic 4/	XX	1,500 e/	100	--	--
Czechoslovakia e/ 5/	7,500	XX	XX	XX	XX
Ecuador e/	100	100	100	100	100
Finland	32,817	22,529	16,916 r/	11,200 r/	25,000
France	16,539	13,834	1,000 e/	-- e/	--
Georgia e/	2,000	1,500	1,000	700	500
Germany e/	14,288 3/	--	--	--	--
Greece	27,496 r/	28,812 r/	33,216	20,400 r/	20,000
Honduras	29,008	18,256	16,697	26,213 r/	25,325 3/
India	152,800	156,300	147,300	154,500 r/	148,200 3/
Iran	66,000	77,000	72,900 r/	145,100 r/	75,600 3/
Ireland	194,100	193,700	195,000 e/	184,118 r/	164,168 3/
Italy	35,032	7,100	22,900	23,100 r/	20,000
Japan	134,510	118,599	100,653	95,274	79,709 3/
Kazakstan e/	250,000	250,000	190,000	225,000 r/	225,000
Korea, North e/	200,000	210,000	210,000	210,000	210,000
Korea, Republic of	21,883	13,808	7,122	7,747 r/	8,384 3/
Macedonia e/	8,800 r/	8,800 r/	8,800 r/	8,800 r/	8,500
Mexico	294,408	369,697	381,689	363,658	377,599 3/
Morocco	22,604	62,874	74,693	79,947 r/	79,662 3/
Namibia	36,053	28,380	33,414	30,209	33,955 3/
Norway	21,058	14,327	15,586	9,972 r/	5,200
Peru	604,525	664,045	690,017	692,250 r/	760,563 3/
Poland	151,700	150,900	151,000 r/	154,500 r/	155,000
Romania	25,813	28,017	35,357	36,737 r/	30,945 3/
Russia e/	160,000 r/	150,000 r/	145,000 r/	130,000 r/	135,000
Saudi Arabia e/	-- r/	-- r/	-- r/	-- r/	--
Serbia and Montenegro	19,718	9,704	1,609 r/	3,195 r/	4,000
Slovakia e/ 4/	XX	1,000	1,000	1,000	1,000
Slovenia	1,550	--	-- e/	--	--
South Africa	71,928	77,096	76,361	73,656 r/	76,853 3/
Spain	204,655	169,892 r/	150,425	172,469 r/	170,000
Sweden	171,539	168,617	159,858	160,000 e/	160,000
Thailand e/	62,000	70,000	56,000	20,000	30,000
Tunisia	4,090	2,400	14,548 r/	44,244 r/	31,920 3/
Turkey 6/	32,514	32,500 e/	34,000	7,538 r/	9,118 3/
United States	552,000	513,000	598,000	644,000	628,000 3/
Uzebekistan e/	50,000 r/	35,000 r/	30,000 r/	15,000 r/	12,000
Vietnam e/	15,000	15,000	15,000	15,000	15,000
Zaire e/	22,300 3/	6,500	1,000 r/	-- r/	--
Zambia 7/	14,706	16,704	--	--	--
Total	7,250,000 r/	6,910,000 r/	7,000,000 r/	7,240,000 r/	7,440,000

See footnotes at end of table.

TABLE 17--Continued
ZINC: WORLD MINE PRODUCTION (CONTENT OF CONCENTRATE AND DIRECT SHIPPING ORE UNLESS NOTED), BY COUNTRY 1/ 2/

e/ Estimated. r/ Revised. XX Not applicable.
1/ World totals, U.S. data, and estimated data are rounded to three significant digits; may not add to totals shown.
2/ Table includes data available through July 1, 1997.
3/ Reported figure.
4/ Formerly part of Czechoslovakia; data were not reported separately until 1993.
5/ Dissolved Dec. 31, 1992.
6/ Content in ore hoisted.
7/ Data are for years beginning Apr. 1 of that stated. Content of ore milled. Mine closed June 1994.

TABLE 18
ZINC: WORLD SMELTER PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons)

Country	1992	1993	1994	1995	1996 e/
Algeria, primary	25,000	29,000	24,000	24,300 r/	24,000
Argentina:					
Primary	34,500	31,000 r/	30,000 r/	31,000 r/	31,000
Secondary e/	2,800	2,800	1,000 r/ 3/	2,000 r/	2,000
Total	37,300	33,800 r/	31,000 r/	33,000 r/	33,000
Australia:					
Primary 4/	328,000 r/	316,000	323,000	320,000 r/	326,000 3/
Secondary e/	4,500	4,500	4,975 r/ 3/	4,500	4,500
Total e/	333,000 r/	321,000	327,975 r/ 3/	324,500 r/	331,000
Austria, primary and secondary	5,537	6,838	--	--	--
Belgium, primary and secondary	310,600	299,600	306,200	301,100 r/	297,400 3/
Brazil:					
Primary	180,414	183,393 r/	187,304 r/	188,033 r/	188,000
Secondary	7,000	7,200	7,000 e/	7,000 e/	7,000
Total	187,414	190,593 r/	194,000 r/ e/	195,000 r/ e/	195,000
Bulgaria, primary and secondary	57,820	54,039	79,500 r/	79,700 r/	80,800
Canada, primary	671,702	659,881	690,965	720,346 r/	715,553 3/
China, primary and secondary e/	719,000	857,000	1,010,000	1,080,000 r/	1,120,000
Czechoslovakia, secondary 5/	1,100	XX	XX	XX	XX
Finland, primary	170,523	170,934	173,000 e/	176,600 r/	175,000
France, primary and secondary	318,700	309,800	308,600 r/	290,000 r/ e/	320,000
Germany, primary and secondary	383,117	380,948	359,878	322,500 r/	327,000
Hungary, secondary e/	1,000	1,000	--	--	--
India:					
Primary	128,100	141,700	156,400	146,500	143,600 3/
Secondary e/	200	200	500	500	500
Total e/	128,000	142,000	157,000	147,000	144,000
Italy, primary and secondary	252,600	254,000 e/	255,900 r/	267,600 r/	260,000
Japan:					
Primary	645,000	609,300	571,900	573,900	500,700 3/
Secondary	135,600	135,200	141,400	143,000	141,500 3/
Total	780,600	744,500	713,300	716,900	642,200 3/
Kazakstan, primary	260,000 e/	260,000 e/	190,000 r/	168,300 r/	168,500 3/
Korea, North, primary e/	175,000	200,000	200,000	200,000	200,000
Korea, Republic of, primary	253,000	272,000 e/	271,110 r/	279,335 r/	286,526 3/
Macedonia, primary and secondar	30,000	30,000	30,000	30,000	30,000
Mexico, primary	151,600	209,900	209,200	222,748	221,736 3/
Netherlands, primary 6/	218,410	206,700	212,600	206,300 r/	212,400 3/
Norway, primary	127,564	129,192	131,921	121,576 r/	126,000
Peru, primary	124,000 r/	157,000 r/	182,000 r/	158,987 r/	173,138 3/
Poland, primary and secondary	134,600	149,000	156,000 r/	166,000 r/	165,000
Portugal, primary e/	2,200	3,500 r/	4,200 r/	4,200 r/	4,800
Romania, primary and secondary	11,600	14,100	18,500	14,000 r/	14,000
Russia: e/					
Primary	185,000 r/	200,000 r/	137,800 r/ 3/	167,000 r/	170,000
Secondary	60,000	60,000	50,000	50,000	50,000
Total	245,000 r/	260,000 r/	188,000 r/	217,000 r/	220,000

See footnotes at end of table.

TABLE 18--Continued
ZINC: WORLD SMELTER PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons)

Country	1992	1993	1994	1995	1996 e/
Serbia and Montengero, primary and secondary	14,182	6,985	3,895	5,976 r/	6,000
Slovakia, secondary e/ 7/	XX	1,000	1,000	1,000	1,000
Slovenia, primary and secondary e	2,500	2,500	2,500	2,500	2,000
South Africa, primary	83,200	96,154	93,850	98,782	99,000
Spain, primary and secondary	351,900	341,600 r/	294,700 r/	358,000 r/	350,000
Thailand, primary	60,557	65,000 e/	58,513	46,398	50,000
Turkey, primary	18,770	18,500	18,567	17,050 r/	25,000
Ukraine, secondary e/	15,000	15,000	15,000	5,000	2,000
United Kingdom, primary and secondary	96,813	102,391	101,300	105,998 r/	96,867 3/
United States:					
Primary	272,000	240,000	217,000	232,000	226,000 3/
Secondary	128,000	141,000 r/	139,000	131,000	140,000 3/
Total	399,000	382,000	356,000	363,000	366,000 3/
Uzbekistan, primary e/	65,000	65,000	70,000	70,000	40,000
Vietnam, primary and secondary e	10,000	10,000	10,000	10,000	10,000
Zaire, primary e/	18,800 3/	4,150 r/	1,000	--	--
Zambia, primary 8/	7,288	3,446	--	--	--
Grand total	7,260,000 r/	7,460,000 r/	7,450,000 r/	7,550,000 r/	7,530,000
Of which:					
Primary	4,210,000 r/	4,270,000 r/	4,150,000 r/	4,170,000 r/	4,110,000
Secondary	355,000	368,000	360,000 r/	344,000 r/	349,000
Undifferentiated	2,700,000	2,820,000 r/	2,940,000 r/	3,030,000 r/	3,080,000

e/ Estimated. r/ Revised. XX Not applicable.

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

2/ Wherever possible, detailed information on raw material source of output (primary--directly from ores, and secondary--from scrap) has been provided. In cases where raw material source is unreported and insufficient data are available to estimate the distribution of the total, that total has been left undifferentiated (primary and secondary). To the extent possible, this table reflects metal production at the first measurable stage of metal output. Table includes data available through July 1, 1997.

3/ Reported figure.

4/ Excludes zinc dust.

5/ Dissolved Dec. 31, 1992. All production in Czechoslovakia in 1992 came from Slovakia.

6/ Sales.

7/ Formerly part of Czechoslovakia; data were not reported separately until 1993.

8/ Data are for years beginning Apr. 1 of that stated. Imperial smelter production ceased in Mar. 1993. Electrolytic production was suspended Jan. 1991 to Mar. 1993 and ceased in Jan. 1994.