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ZINC

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Mr. Jolly is a physical scientist (geologist) with more than 30 years of mining experience, including positions with Hecla Mining Co., Roan Selection Trust, and the U.S. Geological Survey. He has been a mineral commodity specialist for the Bureau of Mines for 17 years and the zinc specialist for the past 8 years. Domestic survey data were prepared by Lura M. Nightlinger and Tony E. Morris, mineral data assistants.

Zinc-producing mines in Alaska, Montana, and New Mexico opened in 1989, resulting in increased domestic output for the third straight year. A world-class zinc mine in Alaska, scheduled to open in late 1989, experienced startup problems, and its official opening was rescheduled for early 1990. Refined zinc metal production was the highest since 1981. Improved production was attributable to near-capacity output at U.S. primary smelters and increased zinc recovery from steelmaking dusts. In 1989, U.S. mines produced 4.0% of world mine output, and U.S. smelters produced 5.0% of world refined metal output.

Domestic metal consumption declined modestly in 1989 but was the second highest in the 1980's decade. The consumption decrease was largely attributable to sharply reduced automobile production in the last quarter of the year. Exports of concentrate, scrap, refined metal, and compounds were the best in years, whereas imports generally declined. Nonetheless, net imports of basic zinc products accounted for $1 billion of the Nation's trade imbalance.

World mine production was second highest, whereas world smelter output was a record high. World mine and smelter capacity utilization rates were high throughout the year; however, little new capacity was added to either category in 1989.

World zinc metal consumption exceeded 7 million metric tons for the third straight year and was estimated to have been slightly less than the record-high consumption attained in 1988. High consumption resulted in record zinc prices early in the year; however, prices eased in the latter-half of the year owing to a slight fall in demand and increased stock levels.

LEGISLATION AND GOVERNMENT PROGRAMS

Environmental and trade issues continued to be the major thrusts of governmental and legislative actions in 1989. The Environmental Protection Agency (EPA) applied its revised interpretation of the Bevill Amendment (exclusion) to solid waste from the extraction, beneficiation, and processing of ores and minerals. On September 1, EPA identified 5 wastestreams as having Bevill status and conditionally retained 20 other wastestreams for further consideration.[1] All other mineral processing wastes were permanently removed from the Bevill exclusion and were subject to subtitle C regulation of the Resource Conservation and Recovery Act (RCRA) if they exhibit hazardous characteristics. In late September, EPA proposed to retain only 13 of the 20 conditionally retained wastes for further study; this proposal, which was to be finalized in mid-January 1990, retained slag from primary zinc processing, the only zinc related waste remaining in the Bevill exclusion. Final regulatory determination for Bevill processing wastes was expected in January 1991.

Sites that fall under the Comprehensive Environmental Response, Compensation, and Liability Act are called Superfund sites. A number of the Superfund sites associated with zinc mining and processing attracted considerable attention during 1989. The two most prominent sites were the 21-square-mile area surrounding the Bunker Hill lead-zinc smelter complex in Idaho, and the Tristate lead-zinc mining district of Kansas, Missouri, and Oklahoma. The former owner of Bunker Hill, Gulf Resources and Chemical Corp., agreed to keep at least $150 million in domestic assets to ensure against its potential liability for the cleanup of mainly lead-contaminated soil and residues at the complex and the area around the smelter site. In 1989, cleanup efforts centered on a program to remove and replace up to 2 feet of contaminated soil at private residences, mainly in the nearby mining town of Kellogg.

In the Tristate district, EPA continued its efforts in a few selected areas to reduce heavy-metal contamination of surface and subsurface water caused by lead-zinc mining activity carried out in the area from about 1848 to 1970. Through 1989, about $6 million had been spent on the cleanup of mining sites in the Tar Creek area of Oklahoma. Other areas in the district have been identified as possible Superfund sites. One of these was the Galena, KS, area where an $8 million cleanup program was proposed. Cleanup efforts have or were expected to involve recontouring existing land surfaces and redirecting surface streams around mineral areas, burial of residues of mining operations, blocking of mine shafts that provide surface water access to underground workings, and stabilization of mining-related surfaces by revegetation. Mining companies that operated in the Tar Creek, Galena, and other areas in the district have been named by EPA as the "potentially responsible parties" for the pollution problems and might be liable for some or all of the cleanup costs.

The final draft of the Basel Convention for the control of transboundary movements of hazardous wastes and their disposal was completed. The President was expected to approve the Convention in early 1990 with Senate ratification expected by 1993. The Convention is designed to ensure that exported hazardous wastes will be transported,

TABLE 1

SALIENT ZINC STATISTICS

(Metric tons unless otherwise specified)

	1985	1986	1987	1988	1989
United States:					
Production:					
Domestic ores, recoverable content	226,545	202,983	216,327	244,314	275,883
Value thousands	$201,607	$170,050	$119,924	$324,249	$499,103
Slab zinc:					
From domestic ores	198,005	191,079	205,275	196,476	166,424
From foreign ores	63,204	62,290	56,070	44,818	96,652
From scrap	72,563	62,912	82,589	88,492	95,133
Total	333,772	316,281	343,934	329,786	358,209
Secondary zinc[1]	256,455	255,752	r327,944	r248,461	251,795
Exports:					
Ores and concentrates (zinc content)	23,264	3,269	16,921	33,590	78,877
Slab zinc	1,011	1,938	1,082	482	5,532
Imports for consumption:					
Ores and concentrates (zinc content)	90,186	75,786	46,464	62,966	40,974
Slab zinc	610,900	665,126	705,985	749,133	711,554
Stocks of slab zinc, Dec. 31:					
Industry	119,892	100,563	96,372	r85,854	90,711
Government stockpile	340,577	340,577	340,577	340,577	340,577
Consumption:					
Slab zinc:					
Reported	770,671	705,963	798,148	r833,473	887,203
Apparent (rounded)[2]	961,000	999,000	1,052,000	1,089,000	1,060,000
All classes (rounded)[3]	1,257,000	1,274,000	r1,383,000	r1,340,000	1,314,000
Price: High Grade, cents per pound (delivered)	40.37	38.00	41.92	60.20	82.06
World:					
Production:					
Mine thousand metric tons	r6,758	r6,936	7,232	p7,015	e7,062
Smelter do.	r6,786	r6,691	7,009	p7,115	e7,187
Price: London, cents per pound	36.23	34.19	36.20	r51.11	76.70

e Estimated. p Preliminary. r Revised.

[1] Excludes secondary slab and remelt zinc.

[2] Domestic production plus net imports plus or minus stock changes.

[3] Based on apparent consumption of slab zinc plus zinc content of ores and concentrates and secondary materials.

treated, and/or disposed of by the importing country in a manner that is consistent with the protection of the environment and human health. This could impact future U.S. exports of zinc scrap, wastes, and residues, especially to developing countries where environmental controls are below accepted standards.

On January 1, the U.S. Bureau of the Census replaced the Tariff Schedule of the United States (TSUS) with the Harmonized Tariff Schedule of the United States (HTS) to surmount increasing difficulties arising from the use of different tariff classification systems in other countries and changing international needs. The new system was international in scope and provided a means for most countries to have a single modern structure for product classification thereby easing duty determination, statistical accounting, and transportation documentation. Many new classification subdivisions were also added to HTS to reflect changes in technology, trade patterns, and user requirements. Because of many, mostly minor, differences between the two U.S. tariff systems, the statistical trade data of 1989 and that of prior years may not be comparable.

Also on January 1, the United States and Canada formed the world's largest free trade area by implementing the United States-Canada Free-Trade Agreement (FTA) Implementation Act of 1988. The FTA eliminates all tariffs on U.S. and Canadian goods by 1998. U.S. duties on imports of zinc metal, alloys, and dutiable zinc chemicals were to be phased out at 10% per year over 10 years.

In April, the Non-Ferrous Metals Producers Committee (NFMPC) submitted a petition to the U.S. Trade Representatives (USTR) seeking identification of the copper, lead, and zinc industries under section 409(b) of the FTA, which has provisions for addressing unfair trade practices. The NFMPC contended that these domestic industries would face in-

creased competition from subsidized imports from Canada. On July 5, the USTR, in consultation with the Secretary of Commerce, concluded that a reasonable likelihood existed that the copper and lead industries could face increased competition from subsidized production in Canada. Data on the zinc industry, however, were insufficient to identify it under the 409(b) provision, but the USTR would seek zinc information within the scope of any study on the lead industry that might be initiated as a result of the USTR decision on lead.

U.S. zinc-producing companies continued to be granted a depletion allowance of 22% on domestic production of zinc and 14% on foreign production in 1989. The Superfund taxes on production of zinc chloride and zinc sulfate also were unchanged, remaining at $2.22 and $1.90 per ton, respectively.

STRATEGIC CONSIDERATIONS

Supply

U.S. zinc mine and smelter production and available capacity are inadequate to supply U.S. zinc requirements. Ore reserves are sufficient at operating mines to permit increased output on a short-term basis and some mines on a care and maintenance basis could be reactivated in 3 to 12 months.

The domestic ore reserve base is large but could not be tapped adequately until after the first year or so of an emergency condition. Domestic smelter capacity is woefully lacking and would be the limiting factor for increased U.S. refined zinc output. Inadequate zinc smelter capacity also severely limits the Nation's ability to produce a number of strategic and critical zinc byproduct materials such as cadmium, germanium, and indium.

Although the Red Dog Mine in northwest Alaska was expected to more than double U.S. zinc mine output by 1991, this new output was not expected to improve U.S. self-sufficiency because all of the zinc concentrates were scheduled for export. Even if Red Dog concentrates were redirected for U.S. consumption only, little or no smelter capacity is available to process the material. In 1989, for example, domestic zinc mine production substantially exceeded U.S. smelter feed requirements resulting in net exports of about 39,000 tons of zinc in concentrate.

Although imports constitute a large proportion of U.S. zinc supply, about 60% of the zinc metal, concentrate, and compound imports come from Canada and Mexico, and, therefore, the risk of supply disruption is low. Other traditional sources of zinc supply depends on sea transport, and the risk of supply disruption is considerably higher.

Substitutes

Substitution for zinc depends on price and availability of substitutes as well as their technical suitability. In an emergency situation, some substitutions may not be possible because the substituting materials themselves are critical or strategic. Virtually all areas of zinc use have been susceptible to some form of reduced zinc consumption either through substitution or technical innovation. Zinc, aluminum, magnesium, and plastics are competitive materials in diecasting where weight, temperature tolerances, and surface finish are important factors. Aluminum and plastic sheet are substitutes for galvanized steel sheet; the use of molded plastics for automobile body parts in particular, has increased at the expense of galvanized steel sheet uses. Although emphasis on corrosion protection has led to increased zinc consumption in the galvanizing sector, former all-zinc coatings are increasingly being replaced by zinc alloy coatings containing less zinc than before, thinner coatings (reduced coating weights), or alloys such as aluminum-based Galvalume. Aluminum alloys, stainless steel, cast iron, and plastics have replaced significant tonnages of brass in building and marine hardware, plumbing goods, and decorative uses.

The competition in chemical and pigment uses of zinc is also substantial. Aluminum and magnesium replace zinc as reducing agents in chemical reactions, and titanium and zirconium compounds are highly competitive in pigment, ceramic, and enamel applications. Zinc compounds formerly were consumed in large amounts in the paint, photocopy, and synthetic fiber industries, but consumption in these industries has been severely impacted by substitution or technological change. Titanium dioxide largely replaced zinc oxide pigments in the paint industry. Zinc-sensitized photocopy paper use declined rapidly following the development of the "plain-paper copier." Somewhat similarly, zinc compounds used in the production of rayon fell as rayon was displaced by other synthetic fibers.

Stockpile

A stockpile of zinc for national defense purposes has been maintained by the Government for more than 50 years. Materials in the National Defense Stockpile (NDS), managed by the Department of Defense since July 1988, can be released by the President if deemed necessary for defense or essential civilian purposes.

During World War II, the Government regulated the zinc industry and accumulated zinc stocks to ensure adequate supplies for the war effort. Concerns related to national defense after the war resulted in various stockpiling programs that evolved into the current NDS. The stockpiles contained a record-high inventory of 1.44 million tons of zinc in 1959, but sales of zinc considered excess of goals reduced this inventory to 340,194 tons by the end of 1975. The stockpile goal for zinc, 1.293 million tons, was established in April 1980, but no zinc had been purchased through 1989 to meet this goal. At the end of 1989 the zinc stockpile totaled 343,202 tons, including 2,625 tons of zinc contained in brass. The zinc metal stockpile consisted of 183,175 tons of High Grade (HG), 121,752 tons of Prime Western (PW), and 35,650 tons of other grades. New, sharply lower zinc goals were considered by the Department of Defense in 1989 and were expected to be proposed in 1990.

PRODUCTION

Mine Production

Spurred by continuing strong markets and high zinc prices, U.S. zinc mine production increased for the third straight year. Zinc production began at a new mine in Alaska, a reopened group of mines in Montana, and a copper mine in New Mexico. Startups at three other mines that were scheduled to open in 1989 were delayed by technical and/or permitting problems. The strong market outlook for zinc led

to renewed interest in a number of closed domestic zinc mining properties, several of which were being evaluated for reopening in 1990 or 1991.

The 20 leading U.S. zinc-producing mines accounted for more than 97% of production, with the 5 leading mines accounting for 47%. Tennessee, for the 29th time in the past 32 years, was the principal zinc-producing State, followed by Missouri, New York, Colorado, Alaska, Montana, and Idaho. The leading domestic zinc mine producers were ASARCO Incorporated, Jersey Miniere Zinc Co. (JMZ), and Zinc Corporation of America (ZCA).

In Tennessee, zinc was produced at six underground mines by three companies: Asarco, JMZ, and Union Zinc Inc., the parent company of JMZ. Union Zinc bought USX Corp.'s operating east Tennessee zinc mine in June, in part to secure zinc concentrate supply for JMZ's Clarksville, TN, smelter. The mining operation, renamed the Jefferson City Zinc Div. of Union Zinc, had an annual capacity to produce about 22,000 tons of zinc concentrate plus large amounts of agricultural and construction limestone.

Asarco achieved record output at its four mining operations in east Tennessee. According to the company's annual report, Asarco milled 2.72 million tons of ore producing 63,230 tons of zinc in concentrate in 1989, compared with 2.68 million tons of ore milled yielding 67,850 tons of zinc in 1988. Zinc recovery from ore averaged 93.2% in 1989. At yearend, ore reserves at the four mines were 5.7 million tons averaging about 3.3% zinc, about the same ore tonnage and grade reported at the end of 1988.

Zinc was produced by three companies, Asarco, Doe Run Co., and Cominco American Inc., a subsidiary of Cominco Ltd., as a coproduct of lead at nine underground lead mines along the Viburnum Trend in southeastern Missouri. The State's production was up substantially from that of 1988, mainly because of increased output at most mines, especially at Asarco's two mines. According to the Asarco annual report, zinc output in concentrate at the West Fork Mine was 13,060 tons, up 2,200 tons from 1988, and at the Sweetwater Mine production was 4,260 tons, up 2,800 tons. At yearend, ore reserves at the West Fork Mine were 8.3 million tons averaging 1.5% zinc and 5.8% lead with some copper and silver and at the Sweetwater Mine, 21.9 million tons of ore averaging 4.84% lead and 0.58% zinc.

The Doe Run Co., a joint venture of Fluor Corp. and Homestake Mining Co., produced about 28,000 tons of zinc in 49,700 tons of concentrate at four mills that processed 4.35 million tons of ore from six company mines in 1989. Yearend ore reserves at the six Doe Run mines totaled about 60 million tons averaging 5.1 % lead, 0.9% zinc, and 0.3% copper.

Zinc output at the Magmont Mine, a joint venture of Cominco American and Dresser Industries Inc., fell slightly from that of 1988 owing to a small decrease in ore output. According to the Cominco annual report, the Magmont mill processed about 1 million tons of ore grading 1% zinc yielding 7,720 tons of zinc in 13,400 tons of concentrate in 1989. Ore reserves continued to decline and were expected to be exhausted in about 3 years. At yearend, ore reserves totaled 3.3 million tons, a drop of 0.6 million from 1988. Ore reserves averaged 7.5% lead, 1.2% zinc, and 0.3% copper.

At the end of the year, Cominco Alaska Inc., a subsidiary of Cominco Ltd., had completed nearly all phases of mine and mill construction at its Red Dog zinc-lead-silver mine in northwest Alaska. The first ore was fed into the semiautogenous mills in early November, and the first concentrate was delivered to the port site, 52 miles southwest of the mine, on December 6. Technical problems, however, delayed full commissioning of facilities, and regular production operations were rescheduled to start in the first quarter of 1990. Total annual production, planned in 1991, was expected to be 508,000 tons of zinc concentrate, 109,100 tons of lead concentrate, and 45,000 tons of bulk concentrate.

Capital expenditures on the Red Dog project to the end of 1989 totaled $317 million for the mine and mill complex and $170 for the road and port facilities. Ore reserves at Red Dog were 77 million tons grading 17.1% zinc, 5.0% lead, and 2.6 ounces of silver, potentially sufficient for a mine life of 50 years.

The Greens Creek Mining Co., the operating company and a wholly owned subsidiary of RTZ Ltd. through its Kennecott Corp. subsidiary, and minority partners, Hecla Mining Co., Exalas Resources Corp., and CSX Oil and Gas Corp. brought the Greens Creek silver-gold-zinc-lead mine on Admiralty Island, AK, on-stream in February 1989 at a cost of about $79 million. Full production was not achieved during the year because of startup problems. According to the Hecla annual report, Greens Creek Mining milled 240,000 tons of ore in 1989 and produced concentrates containing 18,010 tons zinc, 8,700 tons lead, 5.17 million ounces of silver, and 23,500 ounces of gold. At yearend, ore reserves were 2.65 million tons averaging 8.4% zinc, 3.4% lead, 23.6 ounces of silver per ton, and 0.21 ounce of gold per ton.

In Colorado, zinc production was a coproduct of gold-silver operations at the Leadville Unit (managed by Asarco, but jointly owned with the Resurrection Mining Co.) and at the Sunnyside Mine (a joint venture between Alta Bay Venture and Washington Mining Co.). Asarco produced almost 13,000 tons of zinc in concentrates, down about 500 tons from 1988. Both the tonnage of ore milled, 185,000 tons in 1989, fell as did the zinc recovery factor, which fell to 82.2% from 85.1% one year earlier. At yearend, ore reserves were down about 55,000 tons from 1988 and totaled 709,000 tons averaging 7.77% zinc, 3.22% lead, 0.18% copper, 2 ounces of silver per ton, and 0.07 ounce of gold per ton. At the Sunnyside Mine, 198,000 tons of ore was milled in 1989, resulting in yearend ore reserves totaling 546,000 tons estimated to average 5.4% zinc, 3.8% lead, 0.57% copper, 3.5 ounces of silver per ton, and 0.15 ounce of gold per ton.

In Montana, New Butte Mining Co., Inc. began initial production of zinc-silver-lead-gold ore in July at several of its mining properties at Butte. The ore was custom processed at the Contact Mill in Philipsburg, MT. The company was planning to build its own local mill in 1991. Geologic ore reserves at yearend totaled about 1.0 million tons averaging about 5.9% zinc, 1.7% lead, 10 ounces per ton of silver, and 0.06 ounce per ton of gold.

The Montana Tunnels Mining Co., a subsidiary of Pegasus Gold Inc., mined and milled 3.6 million tons of ore at its Montana Tunnels Mine in 1989; concentrates containing 14,900 tons of zinc, 6,800 tons of lead, 1.2 million ounces of silver, and 62,600 ounces of gold were

produced. The discovery of low-grade zones in the ore body and harder than expected ore adversely affected production in the first half of the year and resulted in development of a new mine plan during the year. Ore reserves were also reduced by 1.5 million tons and at yearend totaled 34 million tons averaging 0.62% zinc, 0.23% lead, 0.023 ounce of gold per ton, and 0.4 ounce of silver per ton. At 1989 production rates, a 9-year mine life was expected.

In Idaho, Hecla Mining Co. fully implemented its Lucky Friday Underhand Longwall (LFUL) mining method at the Lucky Friday Mine. The LFUL method, which utilizes rubber-tired vehicles, more mechanized equipment, a ramp system, and cemented sandfill, was developed to enhance safety and improve efficiency. In 1989, ore milled increased about 27,000 tons to 126,000 tons resulting in an output of 2,950 tons of zinc in concentrates, up about 900 tons from 1988. At yearend, ore reserves were 416,000 tons averaging 2.4% zinc, 14.4% lead, and 17.7 ounces of silver per ton.

In April, Cyprus Minerals Co. began zinc production at its Pinos Altos copper-zinc mine in New Mexico. The mine was opened in 1988 but produced only copper. The inactive Groundhog mill at Deming was leased to process the zinc ore. According to the Cyprus annual report, about 900 tons of zinc in concentrate was produced and sold in 1989. Reserves of zinc ore were about 0.9 million tons at yearend.

Both the Ward Mine in Nevada and the Star-Morning Mine in Idaho had been expected to open in 1989, but their openings were delayed owing to permitting and/or technical problems. Both, however, were expected to open in early 1990. Ore produced at the Ward Mine, wholly owned by Alta Gold Co. since November via the merger of Silver King Mines Inc. and Pacific Silver Corp. into Alta, was stockpiled during the year while awaiting the conversion of the nearby leased Taylor mill from a silver processing plant to a 900-ton-per-day base metal concentrator. Plans called for an annual production of about 10,500 tons of zinc, 600 tons of copper, 700 tons of lead, and 300,000 ounces of silver in concentrates. At yearend, ore reserves were 1.45 million tons averaging 6.1% zinc, 1.1% copper, 1.1% lead, and 2.4 ounces of silver per ton. The Ward Mine last operated in 1880.

Star Phoenix Mining Co. leased the closed Star-Morning Mine from Hecla and Bunker Hill Ltd. Partners in July. In late 1989, Star Phoenix began mine rehabilitation, including dewatering and upgrading the 1,000-ton-per-day mill at Burke. Plans called for a mid-1990 ore production target of about 13,000 tons per month, yielding about 1,000 tons of zinc concentrate per month. The zinc concentrates were scheduled to be processed at Cominco's zinc smelter at Trail, British Columbia. An estimated 2 million tons of zinc-lead-silver ore reserves were reportedly available in the upper levels. The Star-Morning Mine last operated in 1985.

Two long-closed zinc mines in Washington were being evaluated and could open in late 1990 or in 1991. Equinox Resources Ltd. was completing a feasibility study on the Van Stone Mine near Coville, WA. The mine last produced in 1970. The infrastructure and a 900-ton-per-day mill were reportedly adequate for rapid commissioning. Ore reserves, identified in the late 1970's, totaled about 7 million tons averaging 3.7% zinc and 0.6% lead. Within the reserve was 1.4 million tons of readily minable higher grade ore averaging 6.5% zinc and 1.5% lead.

Resource Finance Co. (RFC) was evaluating the Pend Oreille lead-zinc mine near Metaline Falls, WA, for possible reopening. The Pend Oreille Mine last operated in 1977. RFC estimated ore reserves to be 5.5 million tons averaging 8.8% zinc and 1.9% lead using a 5% zinc cutoff. Reserves were adequate for a 9-year mine life at anticipated production rates.

TABLE 2

MINE PRODUCTION OF RECOVERABLE ZINC IN THE UNITED STATES, BY MONTH

(Metric tons)

Month	1988	1989
January	16,837	21,994
February	18,327	20,794
March	22,462	24,038
April	21,531	23,315
May	22,187	24,816
June	22,563	24,130
July	19,006	20,605
August	21,710	25,068
September	20,095	22,868
October	20,107	24,864
November	20,058	22,643
December	19,431	20,746
Total	244,314	[1]275,883

[1]Data do not add to total shown because of independent rounding.

Smelter and Refinery Production

Refined metal production was up substantially and was the highest since 1981. Three companies, ZCA, JMZ, and Big River Zinc Co., operated four primary zinc refineries in 1989. Secondary zinc metal was produced at nine secondary

TABLE 3

MINE PRODUCTION OF RECOVERABLE ZINC IN THE UNITED STATES, BY STATE

(Metric tons)

State	1985	1986	1987	1988	1989
Alaska	—	—	—	—	W
Colorado	W	W	W	W	W
Idaho	W	351	W	W	W
Illinois	W	W	W	W	W
Kentucky	W	—	10	W	—
Missouri	49,340	37,919	34,956	41,322	50,790
Montana	—	—	W	18,935	W
New Jersey	W	W	—	—	—
New Mexico	—	—	—	—	W
New York	W	W	W	W	W
Tennessee	104,471	102,118	115,699	119,954	W
Total	226,545	202,983	216,327	244,314	275,883

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

TABLE 4

LEADING ZINC-PRODUCING MINES IN THE UNITED STATES IN 1989, IN ORDER OF OUTPUT

Rank	Mine	County and state	Operator	Source of zinc
1	Elmwood-Gordonsville	Smith, TN	Jersey Miniere Zinc Co.	Zinc ore.
2	Pierrepont	St. Lawrence, NY	Zinc Corporation of America	Do.
3	Young	Jefferson, TN	ASARCO Incorporated	Do.
4	Balmat	St. Lawrence, NY	Zinc Corporation of America	Do.
5	Greens Creek	Admiralty Island, AK	Greens Creek Mining Co.	Do.
6	Buick	Iron, MO	The Doe Run Co.	Lead-zinc ore.
7	Montana Tunnels	Jefferson, MT	Montana Tunnels Mining Inc.	Zinc ore.
8	Jefferson City Div.	Jefferson, TN	Union Zinc Co.	Do.
9	New Market	do.	ASARCO Incorporated	Do.
10	Immel	Knox, TN	do.	Do.
11	West Fork	Reynolds, MO	do.	Lead-zinc ore.
12	Leadville Unit	Lake, CO	do.	Zinc ore.
13	Coy	Jefferson, TN	do.	Do.
14	Bunker Hill	Shoshone, ID	Bunker Hill Mining Co. (U.S.) Inc.	Do.
15	Magmont	Iron, MO	Cominco American Incorporated	Lead-zinc ore.
16	Fletcher	Reynolds, MO	The Doe Run Co.	Do.
17	Sunnyside	San Juan, CO	Washington Mining Co.	Do.
18	Sweetwater	Reynolds, MO	ASARCO Incorporated	Do.
19	Viburnum No. 29	Iron, MO	The Doe Run Co.	Do.
20	Rosiclare	Hardin and Pope, IL	Ozark-Mahoning Co.	Fluorspar.
21	Pinos Altos	Grant, NM	Cyprus Sierrita Corp.	Copper ore.
22	Lucky Friday	Shoshone, ID	Hecla Mining Co.	Lead-zinc ore.
23	Butte Hill	Silver Bow, MT	New Butte Mining Co. Inc.	Do.
24	Casteel[1]	Iron, MO	The Doe Run Co.	Copper-lead ore.
25	Viburnum No. 28	do.	do.	Do.

[1] Includes Brushy Creek Mill.

plants from scrap materials; however, the largest producer of metal from secondary zinc was ZCA at its primary electrothermic smelter at Monaca, PA. A substantial part of the plant's secondary feed was crude zinc calcine recovered from steelmaking electric arc furnace (EAF) dusts by a sister company, Horsehead Resource Development Co. (HRD), at Palmerton, PA, and Calumet, IL. The largest producers of zinc metal at secondary plants were Huron Valley Steel Corp., Interamerican Zinc Co., and Gulf Metals Corp.

ZCA installed two new furnaces as part of an expansion program at its 103,000-ton-per-year Monaca plant in 1989. Other furnace units and a new sinter plant were expected to be constructed in 1990 and 1991, gradually leading to 45,000 tons of new capacity. Most of this new capacity was expected to be dedicated to the processing of EAF zinc calcine.

Florida Steel Corp. and Nucor-Yamato Steel Co. began production of commercial-grade zinc metal directly from EAF dusts in 1989 at their respective steel plants at Jackson, TN, and Blytheville, AR. Both plants utilized plasma furnace technology developed by Tetronic Research and Development Co. and Bethlehem Steel Corp. Plans called for annual zinc metal production of 1,400 tons and 1,800 tons, respectively.

ZCA temporarily reopened its DePue,

TABLE 5

PRIMARY AND SECONDARY SLAB ZINC PRODUCED IN THE UNITED STATES

(Metric tons)

	1985	1986	1987	1988	1989
Primary:					
From domestic ores	198,005	191,079	205,275	196,476	166,424
From foreign ores	63,204	62,290	56,070	44,818	96,652
Total	261,209	253,369	261,345	241,294	263,076
Secondary:					
At primary smelters	39,720	49,852	W	W	W
At secondary smelters	32,843	13,060	W	W	W
Total	72,563	62,912	82,589	88,492	95,133
Grand total (excludes zinc recovered by remelting)	333,772	316,281	343,934	329,786	358,209

W Withheld to avoid disclosing company proprietary data.

8/9 of 1989 capacity

IL, zinc dust plant at midyear to produce special grades of zinc dust products not produced at other ZCA facilities. The plant had been scheduled for permanent closure when shut down in January 1988.

Two other companies, Zia Technology of Dallas and Laclede Steel Co., planned to build EAF dust processing facilities at Caldwell, TX, and St. Louis, MO, respectively. Zia was scheduled to have a plant capable of treating 54,000 tons per year of EAF dusts in operation by mid-1990. It planned to use an inclined rotary reduction system to extract a crude zinc product that will then be fed into a top-feed vertical retort for metal reduction, vaporization, and capture in a conventional splash condenser.

Laclede Steel planned an on-site facility to treat about 36,000 tons of EAF dusts per year. The company planned to use an electric-slag-resistance reduction furnace developed by Elkem Technology/AS to produce a crude zinc oxide product suitable for metal recovery.

U.S. Zinc Co., a subsidiary of Gulf Metals, and Meteor Investments formed Plasmet Inc. to produce 7,200 tons of PW zinc metal annually from zinc drosses, wastes, and residues from

TABLE 6

PRODUCTION OF ZINC AND LEAD IN THE UNITED STATES IN 1989, BY STATE AND CLASS OF ORE, FROM OLD TAILINGS, ETC., IN TERMS OF RECOVERABLE METALS

(Metric tons)

State	Zinc ore			Lead ore			Zinc-lead ore		
	Gross weight (dry basis)	Zinc	Lead	Gross weight (dry basis)	Zinc	Lead	Gross weight (dry basis)	Zinc	Lead
Alaska	W	W	W	—	—	—	—	—	—
Arizona	—	—	—	—	—	—	—	—	—
Colorado	—	—	—	W	W	W	201,322	6,115	4,389
Idaho	W	W	W	—	—	—	W	W	W
Illinois	—	—	—	—	—	—	—	—	—
Missouri	—	—	—	—	—	—	5,707,891	49,941	335,243
Montana	W	W	W	—	—	—	W	W	W
New Mexico	—	—	—	—	—	—	—	—	—
New York	W	W	W	—	—	—	—	—	—
South Dakota	—	—	—	—	—	—	—	—	—
Tennessee	W	W	W	—	—	—	—	—	—
Total	9,106,176	179,850	18,682	W	W	W	6,069,436	58,299	354,381
Percent of total zinc or lead	XX	65	5	XX	W	W	XX	21	86

State	Copper-zinc, copper-lead copper-zinc-lead ores			All other sources[1 2]			Total		
	Gross weight (dry basis)	Zinc	Lead	Gross weight (dry basis)	Zinc	Lead	Gross weight (dry basis)	Zinc	Lead
Alaska	—	—	—	—	—	—	W	W	W
Arizona	—	—	—	W	—	W	W	—	W
Colorado	—	—	—	12,791	108	254	W	W	W
Idaho	—	—	—	W	W	W	W	W	W
Illinois	—	—	—	—	W	W	—	W	W
Missouri	[3]1,126,298	[3]849	[3]31,689	—	—	—	6,834,189	50,790	366,931
Montana	—	—	—	2,457,102	—	28	W	W	W
New Mexico	W	W	W	W	—	W	W	W	W
New York	—	—	—	—	—	—	W	W	W
South Dakota	—	—	—	92	—	4	92	—	4
Tennessee	—	—	—	—	—	—	W	W	W
Total	W	W	W	W	W	W	28,415,671	275,883	410,915
Percent of total zinc or lead	XX	W	W	XX	W	W	XX	100	100

W Withheld to avoid disclosing company proprietary data; included in "Total." XX Not applicable.
[1] Includes zinc and lead recovered from copper, gold, gold-silver, and silver ores from fluorspar and from mill tailings.
[2] Excludes tonnages of fluorspar in Illinois from which zinc and lead were recovered as byproducts.
[3] Includes Brushy Creek Mill.

galvanizing and die-cast operations. The plant was under construction in Houston, TX, and was expected to be operational by the second quarter of 1990. Plasma-furnace technology, licensed from Tetronic, was to be used.

Zinc Oxide

Domestic American- and French-process zinc oxide was produced entirely from zinc metal and scrap by eight companies in 1989. All but one company, Eagle Zinc Co. of Hillsboro, IL, produced French-process zinc oxide. Some impure oxide produced at secondary plants was sold directly for animal feed and agricultural purposes. The principal zinc oxide producers in 1989 were Asarco, Pasco Zinc Corp., and ZCA.

In 1989, Asarco produced 15,650 tons of zinc oxide at its 27,500-ton-per-year Hillsboro, IL, plant. Modifications and the addition of a new furnace were underway to increase the efficiency and plant capacity in 1990.

North American Oxide, Inc., an affiliate of the Rogers Group Inc., planned to build an 18,000-ton-per-year French-process zinc oxide plant at Clarksville, TN. Startup was expected in mid-1990.

Byproduct Sulfur

Production of sulfur in byproduct sulfuric acid at primary zinc plants was 134,000 tons, down slightly from the 136,000 tons produced in 1988. Acid production at zinc plants in 1989 was valued at $17.4 million.

CONSUMPTION AND USES

Zinc is found in all sectors of the economy, but its role is less obvious to the public because zinc tends to lose its identity in the end products. Zinc-containing products were extensively used by the military, industry, and general public for construction, transportation, electrical, machinery, and chemical purposes. Zinc-coated steel sheet, structural shapes, fencing, storage tanks, fasteners, nails, and wire rope were widely used in all types of construction, including transmission and radar towers, industrial plants, culverts, roads, bridges, and airfields. Zinc sacrificial anodes were used to protect ship hulls, offshore drilling rigs, and submerged and buried steel

TABLE 7

DISTILLED AND ELECTROLYTIC ZINC, PRIMARY AND SECONDARY, PRODUCED IN THE UNITED STATES, BY GRADE

(Metric tons)

Grade	1985	1986	1987	1988	1989
Special High	98,282	78,979	85,010	90,034	113,819
High	98,979	84,737	88,952	74,870	79,145
Continuous Galvanizing	26,139	20,589	38,751	44,890	48,252
Controlled Lead	20,952	18,883	W	W	W
Prime Western	89,420	113,093	131,221	119,992	116,993
Total	333,772	316,281	343,934	329,786	358,209

W Withheld to avoid disclosing company proprietary data, included in "Prime Western."

TABLE 8

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

Type of plant and company	Slab zinc capacity (metric tons) 1988	1989
Electrolytic:		
Big River Zinc Corp., Sauget, IL[1]	76,000	76,000
Jersey Miniere Zinc Co., Clarksville, TN	95,000	95,000
Zinc Corporation of America, Bartlesville, OK	51,000	51,000
Electrothermic:		
Zinc Corporation of America, Monaca, PA[2]	101,000	103,000
Total available capacity	323,000	325,000
Total operating capacity	323,000	325,000

[1] Sold by AMAX Inc. in August 1988.
[2] Includes secondary capacity.

TABLE 9

SECONDARY ZINC PLANT CAPACITY IN THE UNITED STATES, BY COMPANY

Company	Plant location	Capacity (metric tons) 1988	1989
Arco Alloys Corp.	Detroit, MI		
W.J. Bullock Inc.	Fairfield, AL		
T.L. Diamond & Co. Inc.	Spelter, WV		
Florida Steel Co.	Jackson, TN[1]		
Gulf Reduction Corp.	Houston, TX		
Hugo Neu-Proler Co.	Terminal Island, CA		
Huron Valley Steel Corp.	Belleville, MI	55,000	58,000
Interamerican Zinc Inc.	Adrian, MI		
New England Smelting Works, Inc.	West Springfield, MA		
Nucor Yamato Steel Co.	Blytheville, AR[1]		
Pasco Zinc Corp.	Memphis, TN		
Zinc Corporation of America	Palmerton, PA		

[1] Opened in 1989.

TABLE 10

STOCKS AND CONSUMPTION OF NEW AND OLD ZINC SCRAP IN THE UNITED STATES IN 1989, BY TYPE OF SCRAP

(Metric tons, zinc content)

Type of scrap	Stocks, Jan. 1	Receipts	Consumption			Stocks, Dec. 31
			New scrap	Old scrap	Total	
Diecastings	363	5,363	—	5,368	5,368	358
Flue dust	W	5,190	2,759	2,755	5,514	W
Fragmentized diecastings	W	28,352	—	28,217	28,217	W
Galvanizer's dross	4,863	69,172	72,038	—	72,038	1,997
Old zinc[1]	150	2,494	—	2,561	2,561	83
Remelt die-cast slab	563	W	—	16,731	16,731	W
Remelt zinc[2]	22	W	303	—	303	W
Skimmings and ashes[3]	4,288	30,258	30,125	—	30,125	4,421
Steelmaking dust	2,722	39,557	18,690	18,690	37,380	4,899
Other[4]	5,496	24,503	4,910	2,924	7,834	5,527
Total	18,467	204,889	128,825	77,246	206,071	17,285

W Withheld to avoid disclosing company proprietary data; included in "Total."
[1] Includes engraver's plates and rod and die scrap.
[2] Includes new clippings.
[3] Includes sal skimmings and die-cast skimmings.
[4] Includes chemical residues and electrogalvanizing anodes.

TABLE 11

PRODUCTION OF ZINC PRODUCTS FROM ZINC-BASE SCRAP IN THE UNITED STATES

(Metric tons)

Product	1985	1986	1987	1988	1989
Redistilled slab zinc	72,563	62,912	82,589	88,492	95,133
Zinc dust	30,754	26,682	28,620	r24,205	24,908
Electrogalvanizing anodes	—	—	—	—	W
Other metal alloys	982	99	163	317	272
Remelt die-cast slab	3,651	2,564	825	907	3,804
Other zinc metal products	6,695	7,098	6,741	8,016	W
Secondary zinc in chemical products	44,598	44,891	79,361	r55,972	57,572

rRevised. W Withheld to avoid disclosing company proprietary data.

works, tanks, and pipes. Brass was used as shell casings in ammunition and tubes, valves, radiators, and fittings in vehicles, motors, refrigeration equipment, heat exchangers, communication units, and electronic devices. Zinc die-cast parts, such as handles, grilles, bezels, brackets, locks, hinges, gauges, pumps, mounts, and housings, were used extensively in vehicles, machinery, business machines, appliances, scientific equipment, and electronic equipment. Zinc dust was used in primers and paints; in alkaline dry cell batteries; in the sherardizing process to protectively coat nuts, bolts, and small parts; for the precipitation of noble metals from solution; and in the zinc industry for the removal of impurities, such as copper, cadmium, and lead, before electrolysis. Zinc oxide was a necessary ingredient in the vulcanization of rubber and as pigment in paints. The metal casings of zinc-carbon dry cell batteries were zinc. In 1989, about 30,700 tons of Special High Grade (SHG) in rolled zinc was used by the U.S. Mint to produce 12.8 billion pennies.

Zinc compounds were used in corrosion-inhibiting paint primers, chemical catalysts, welding and soldering fluxes, fungicides and pharmaceuticals, phosphors for cathode tubes and radar scopes, chemical smoke, and additives to lubricating oils and greases. Zinc ferrites were used in electrical devices in transformers, coils, amplifiers, motors, and tuners, and in electronic devices in radio, television, and computers.

In 1989, domestic consumption of slab zinc for galvanizing and light metal alloying purposes and oxide manufacture increased, whereas other use categories were lower than in 1988. Galvanizing and electrogalvanizing, mainly for sheet and strip, continued to be the principal use of zinc metal consuming an estimated 52%, followed by zinc-based die-cast alloys, 21%; brass alloys, 12%; and other uses,

TABLE 12

ZINC RECOVERED FROM SCRAP PROCESSED IN THE UNITED STATES, BY KIND OF SCRAP AND FORM OF RECOVERY

(Metric tons)

	1988r	1989
KIND OF SCRAP		
New scrap:		
Zinc-base	105,935	105,203
Copper-base	133,569	124,426
Magnesium-base	122	163
Total	239,626	229,792
Old scrap:		
Zinc-base	74,632	93,919
Copper-base	22,166	22,703
Aluminum-base	349	338
Magnesium-base	180	176
Total	97,327	117,136
Grand total	336,953	346,928
FORM OF RECOVERY		
Metal:		
Slab zinc	88,492	95,133
Zinc dust	24,205	24,908
Other[1]	8,016	15,733
Total	120,713	135,774
In zinc-base alloys	907	3,804
In brass and bronze	159,045	149,506
In other metal alloys	317	272
In chemical products:		
Zinc oxide (lead free)	34,527	37,027
Zinc sulfate	12,962	12,317
Zinc chloride	8,482	7,269
Miscellaneous	—	959
Total	216,240	211,154
Grand total	336,953	346,928

rRevised.
[1] Includes electrogalvanizing anodes and zinc content of slab made from remelt die-cast slab.

15%. SHG accounted for about 52% of the reported slab zinc consumed, followed by PW, 24%; HG, 14%, and other grades, 10%.

Overall, the construction sector of the economy was the largest consumer of zinc, accounting for an estimated 46%, followed by transportation, 20%; machinery, 11%; electrical, 11%; and other, 12%. Zinc metal accounted for about three-fourths of consumption and zinc chemicals about one-fourth in 1989.

According to the American Iron and Steel Institute, shipments of galvanized sheet and strip totaled 9.7 million tons, up 0.4 million tons from 1988. Of the total shipments, electrogalvanized sheet accounted for 20% compared with 21% in 1988. In the first half of the year, the galvanized sheet and strip market was strong, being characterized by near-capacity production, extended delivery schedules, and premium prices. In the second half, domestic prices, delivery times, and production declined in response to falling automobile production and an easing in construction activity. Concurrent with the slowdown in demand were falling zinc prices, especially in the last quarter of the year.

According to the Bureau of the Census, zinc-base alloy die and foundry casting shipments totaled about 200,000 tons, down from 223,000 tons reported in 1988. The decline was attributable to reduced demand by die-cast manufacturers in the second half of the year and partly to the high price of zinc relative to substitute materials. Zinc die-cast shipments by weight were estimated to have been equally distributed between automotive, hardware, and other uses.

Zinc consumption in the production of copper-base alloys by brass mills, ingot makers, and foundries was down slightly from 1988 according to the Copper Development Association Inc. (CDA). The brass and bronze industries were estimated to have consumed about 280,000 tons of zinc, the source of which was about equally divided between refined zinc metal and brass and bronze scrap metal. According to CDA data, brass mills accounted for 85% of the total zinc consumed as metal and scrap.

The zinc content in typical U.S.-manufactured automobiles was estimated to average about 40 pounds in 1989, about the same as in 1988. Diecastings accounted for about 21 pounds; corrosion protection via galvanizing and coatings, 16 pounds; and other, including rubber, brass, and zinc solder, 3 pounds.

The apparent domestic consumption of zinc oxide was about 176,000 tons, down from 190,000 tons in 1988. Domestic production was up substantially, but so were exports. Imports fell for the first time since 1981. Because the Bureau of Mines information on zinc oxide consumption by industry sector reflects only shipments as reported by the domestic producers, the consumption data listed in table 20 only accounts for about two-thirds of the apparent market. Of the reported amounts, the rubber industry continued to be the principal consumer followed by chemicals and paint.

TABLE 13

U.S. CONSUMPTION OF ZINC

(Metric tons)

	1985	1986	1987	1988	1989
Slab zinc, apparent (rounded)	961,000	999,000	1,052,000	1,089,000	1,060,000
Ores and concentrates (zinc content)	39,886	19,236	2,536	2,412	2,107
Secondary (zinc content)[1]	256,455	255,752	r327,944	r248,461	251,795
Total (rounded)	1,257,000	1,274,000	r1,383,000	r1,340,000	1,314,000

r Revised.
[1] Excludes secondary slab and remelt zinc.

TABLE 14

ESTIMATED[1] APPARENT CONSUMPTION OF SLAB ZINC, ACCORDING TO INDUSTRY USE AND PRODUCT

(Metric tons)

Industry and product	1988r	1989
Galvanizing:		
Sheet and strip	395,000	402,000
Other	154,000	150,000
Total	549,000	552,000
Brass and bronze	146,000	130,000
Zinc-base alloys	249,000	220,000
Zinc oxide	65,000	71,000
Other uses[2]	80,000	87,000
Estimated apparent consumption	1,089,000	1,060,000

r Revised.
[1] Based on reported slab zinc consumption.
[2] Includes zinc used in making zinc dust, wet batteries, desilverizing lead, powder, alloys, anodes, chemicals, castings, light metal alloys, rolled zinc, and miscellaneous uses not elsewhere specified.

STOCKS

Metal stocks held at yearend by domestic producers, consumers, and merchants rose for the first time after 7 straight years of decreases, but were the second lowest in the 1980's. Domestic stock levels tended to rise through mid-year, before declining in line with declining demand. Merchant stocks tended to rise at the end of the year, accounting for the modest rise in domestic stock levels. At any given time in 1989, slightly less than 1 month domestic consumption was available as stocks. Metal stock levels in the market economy countries (MEC), according to the International Lead and Zinc Study Group (ILZSG), were relatively stable in the first half of the year, averaging about 515,000 tons but rose

TABLE 15

U.S. REPORTED CONSUMPTION OF SLAB ZINC, BY INDUSTRY AND PRODUCT

(Metric tons)

Industry and product	1988r	1989
Galvanizing:		
Sheet and strip	303,050	323,684
Other	95,768	120,919
Total	398,818	444,603
Brass and bronze	91,043	95,798
Zinc-base alloy	205,566	189,676
Zinc oxide	61,367	70,417
Other uses[1]	76,679	86,709
Grand total	833,473	887,203

r Revised.
[1] Includes zinc used in making zinc dust, wet batteries, desilverizing lead, powder, alloys, anodes, chemicals, castings, light metal alloys, rolled zinc, and miscellaneous uses not elsewhere specified.

TABLE 16

U.S. REPORTED CONSUMPTION OF SLAB ZINC IN 1989, BY INDUSTRY AND GRADE

(Metric tons)

Industry	Special High Grade	High Grade	Prime Western	Remelt and other grades	Total[1]
Galvanizing	102,374	71,551	201,117	77,925	444,603
Zinc-base alloys	187,338	W	—	W	189,676
Brass and bronze	44,382	38,328	W	W	95,798
Zinc oxide	W	W	W	—	70,417
Other	W	W	W	W	86,709
Total[1]	458,020	120,433	214,410	94,340	887,203

W Withheld to avoid disclosing company proprietary data, included in "Total."
[1] Data may not add to totals shown because of withheld figures.

TABLE 17

U.S. REPORTED CONSUMPTION OF SLAB ZINC IN 1989, BY STATE[1]

(Metric tons)

State	Galvanizers	Brass mills[2]	Die-casters[3]	Other[4]	Total
Alabama	W	W	—	—	9,867
California	21,814	481	—	1,273	23,568
Connecticut	W	2,188	W	W	8,262
Florida	5,971	—	—	—	5,971
Illinois	69,124	W	35,216	W	137,589
Indiana	46,756	W	W	W	51,330
Michigan	W	W	39,375	W	66,618
Nebraska	7,724	—	—	W	7,724
New York	3,364	W	71,276	W	100,915
Ohio	80,612	4,853	31,529	W	116,994
Pennsylvania	97,736	W	W	W	169,595
Tennessee	4,052	—	—	56,762	60,814
Texas	12,385	—	—	W	12,385
Undistributed	88,221	88,158	12,245	88,166	97,649
Total	437,759	95,680	189,641	146,201	869,281

W Withheld to avoid disclosing company proprietary data; included with "Total" and "Undistributed."
[1] Excludes remelt zinc.
[2] Includes brass mills, brass ingot makers, and brass foundries.
[3] Includes producers of zinc-base alloys for diecastings, stamping dies, and rods.
[4] Includes slab zinc used in rolled zinc products and in zinc oxide.

to about 592,000 tons at yearend. The stock rise in the second half of 1989 was mainly attributable to increased world metal production, in part because of fewer strikes rather than any substantial fall off in demand.

The London Metal Exchange (LME) planned to terminate its HG contract in March 1990 in favor of the SHG contract that was introduced in September 1988. As a result, LME zinc metal stocks of HG fell from 14,400 tons to 5,800 tons during the year, whereas SHG stocks rose from 26,100 tons to 74,800 tons in the same period.

Inventories of zinc in concentrate at domestic primary smelters totaled 35,500 tons at yearend compared with 49,400 tons at the end of 1988, according to the American Bureau of Metal Statistics Inc. Concentrate stocks were at their lowest level at yearend.

TABLE 18

ROLLED ZINC PRODUCED AND QUANTITY AVAILABLE FOR CONSUMPTION IN THE UNITED STATES

(Metric tons)

	1988	1989
Production[1]	49,771	52,475
Exports	3,814	16,515
Imports for consumption	4,100	3,066
Available for consumption	50,436	37,222

[1] Includes other plate more than 0.375 inch thick and rod and wire.

PRICES

Zinc metal prices rose sharply to record-high levels in the first 3 months of the year, continuing a 17-month price uptrend that began in November 1987. The North American producers' quote for HG was raised to a record-high 95 cents per pound at the end of February. By late March, the tightness in world zinc supply began to ease and prices on the LME trended downward, in turn lowering domestic prices to the

TABLE 19

ZINC CONTENT OF PRODUCTION AND SHIPMENTS OF ZINC PIGMENTS AND COMPOUNDS[1] IN THE UNITED STATES

(Metric tons)

	1988		1989	
	Production	Shipments	Production	Shipments
Zinc oxide	93,527	98,031	103,642	102,515
Zinc sulfate	r15,374	r16,201	14,427	13,671
Zinc chloride[2]	8,482	8,552	7,269	7,076

r Revised.
[1] Excludes leaded zinc oxide and lithopone.
[2] Includes zinc content of zinc ammonium chloride.

TABLE 20

ZINC CONTENT OF ZINC PIGMENTS AND COMPOUNDS[1] PRODUCED BY DOMESTIC MANUFACTURERS, BY SOURCE

(Metric tons)

	1988				1989			
	Zinc in pigments and compounds produced from			Total	Zinc in pigments and compounds produced from			To
	Ore	Slab zinc	Secondary material		Ore	Slab zinc	Secondary material	
Zinc oxide	—	59,000	34,527	93,527	—	66,615	37,027	103,
Zinc sulfate	W	—	r15,374	r15,374	W	—	14,427	14,
Zinc chloride[2]	—	—	8,482	8,482	—	—	7,269	7,

r Revised. W Withheld to avoid disclosing company proprietary data; included with "Secondary material."
[1] Excludes leaded zinc oxide, zinc sulfate, and lithopone.
[2] Includes zinc content of zinc ammonium chloride.

TABLE 21

REPORTED DISTRIBUTION OF ZINC CONTAINED IN ZINC OXIDE SHIPMENTS, BY INDUSTRY[1]

(Metric tons)

Industry	1985	1986	1987	1988	1989
Agriculture	2,060	3,128	3,477	1,988	1,520
Ceramics	5,829	4,010	4,901	3,302	2,780
Chemicals	17,982	18,163	22,789	21,898	22,462
Paints	6,572	8,638	8,007	3,441	4,695
Photocopying	6,659	W	W	W	W
Rubber	57,259	56,246	63,589	55,213	57,781
Other	12,572	6,999	7,814	12,189	13,277
Total	108,933	97,184	110,577	98,031	102,515

W Withheld to avoid disclosing company proprietary data; included in "Other."
[1] In addition, zinc oxide was imported as follows: 1985—39,375; 1986—43,924; 1987—57,276; 1988—73,042; and 1989—59,557; distribution cannot be distinguished by industry.

TABLE 22

DISTRIBUTION OF ZINC CONTAINED IN SULFATE SHIPMENTS

(Metric tons)

Industry	1985	1986	1987	1988r	1989
Agriculture	13,683	18,616	14,934	13,602	10,922
Other	3,532	3,171	3,096	2,599	2,749
Total	17,215	21,787	18,030	16,201	13,671

r Revised.

80-cent-per-pound level by June. Overall, world demand remained strong in the summer months, and U.S. zinc prices stabilized at about the 80 cents level. In September, LME zinc stocks increased, resulting in downward pressure on prices. In the last quarter of the year, domestic zinc prices fell in response to lower LME prices, stock increases, and reduced demand in the domestic economy, in part, owing to sharp cutbacks in automobile production.

Zinc oxide prices, as quoted in the American Metal Market, followed the price trends of zinc metal. Prices ranged from a high of about 95 cents per pound in March to a low of about 72 cents December, averaging about 90 cents the year. Imported zinc oxide avera 75.4 cents per pound compared with 4 cents in 1988.

The price quoted in Chemical M keting Reporter (CMR) for zinc sulf monohydrate industrial grade, 3 zinc in bags in carload lots, was $30 100 pounds through February and thereafter. Agricultural zinc sulfat bulk was listed by CMR at $460 short ton. Technical-grade zinc c ride, 50% solution in tanks, quoted at $22 per 100 pounds in Ja ary and $24 thereafter.

The LME was the principal basis world zinc pricing in 1989. Not were most of the world's concent sales based on LME prices but most metal sales. Producers' quc including those in North Amer tended to become more responsiv LME price changes in 1989. Becaus this increased price volatility, some companies were considering drop producer quotations altogether in f of basing sales on the LME SHG p

Most custom zinc smelter compa and producers of zinc concent agreed to use the LME SHG cash se ment price as the basis for determi treatment charges in 1989 and in future. This agreement, plus the fact LME zinc contracts were U.S.-dc based, provided a convenient refer price for both metal and concentrate made zinc contracts hedgeable at LME.

Changes in annual U.S. zinc m prices from 1850 through 1988, a

TABLE 23

U.S. PRODUCERS OF ZINC OXIDE AND CAPACITY, BY COMPANY

Company	Plant location	Capacity (metric tons) 1988	1989
Asarco Incorporated	Hillsboro, IL		
Big River Zinc Corp.[1]	Sauget, IL		
Eagle Zinc Co.	Hillsboro, IL		
Hitox Corp. of America	Spokane, WA		
Interamerican Zinc Inc.	Adrian, MI	156,000	156,000
Midwest Zinc Corporation	Chicago, IL		
Pasco Zinc Products Corp.[2]	Memphis, TN		
Zinc Corporation of America	Monaca, PA		
Do.	Palmerton, PA		

[1] Big River Zinc Corp. acquired plant from AMAX in Sept. 1988.
[2] Pigment & Chemical Inc. acquired plant from Pacific Smelting in May 1989.

TABLE 24

U.S. PRODUCERS OF ZINC SULFATE AND CHLORIDE PRODUCTS IN 1989

Company	Plant location	Sulfate production	Chloride production
American Microtrace	Fairbury, NE	X	
B & W Micronutrients	Bartlesville, OK	X	
Bay Zinc Co.	Moxee City, WA	X	
Big River Zinc Corp.	Sauget, IL	X	
The Chemical & Pigment Co.	Pittsburg, CA	X	X
Cozinco Inc.	Denver, CO	X	
Frit Industries Inc.	Ozark, AL	X	
Liquid Chemical Corp.	Hanford, CA	X	
Madison Industries Inc.	Old Bridge, NJ	X	X
Mineral Research & Development Corp.	Harrisburg, NC		X
Zaclon Inc.	Cleveland, OH		X
Zinc Corporation of America	Monaca, PA	X	

TABLE 25

STOCKS OF SLAB ZINC IN THE UNITED STATES, DECEMBER 31

(Metric tons)

	1985	1986	1987	1988	1989
Primary producers	29,030	16,722	13,448	e r6,005	e7,200
Secondary producers	3,362	3,203	3,162	695	1,031
Consumers	60,310	54,079	57,410	r64,864	60,297
Merchants	27,163	26,559	22,352	14,290	22,183
Total	119,892	100,563	96,372	r85,854	90,711

e Estimated. r Revised.

brief analysis of the factors that influenced those changes were included in a Bureau of Mines report on nonferrous metal prices.[2] The average annual zinc price over the 1909–88 period, based on 1987 constant dollars, was 57.2 cents per pound.

FOREIGN TRADE

Exports of basic zinc materials in 1989 were the best in years. Waste and scrap exports rose for the eighth consecutive year and set record highs in both content and value. Exports of slab zinc and zinc oxide increased many-fold over 1988 levels and, respectively, were the highest since 1974 and 1947. Exports of zinc in concentrates were the highest since 1985; most were shipped to Canada from western U.S. zinc producers. Interestingly, U.S. exports of zinc in concentrate in 1989 exceeded imports for the first time since the early 1930's.

General imports of zinc in concentrates totaled 388,566 tons, whereas imports for consumption totaled only 40,947 tons. The disparity was due to shipments of concentrates through Skagway, AK, to world markets from Canada's Faro zinc-lead mine in the Yukon Territory. Imports of slab zinc and zinc oxide both fell substantially from those of 1988; however, they were, respectively, the second and third highest levels ever recorded. According to CDA, 397,000 tons of brass mill products were imported and 133,400 tons exported in 1989, compared with 433,600 imported and 115,000 exported in 1988.

WORLD REVIEW

World zinc metal consumption continued its record-setting pace, exceeding 7 million tons for the third straight year. Smelter output was a record high and mine output was the second highest ever recorded.

Zinc metal consumption was about 7.2 million tons, slightly less than that of 1988. The MEC, according to IL-ZSG, consumed 5.23 million tons, down about 40,000 tons from that of 1988. The MEC accounted for about three-fourths of consumption and the

TABLE 30

U.S. GENERAL IMPORTS OF ZINC, BY COUNTRY

Country	1987		1988		1989	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
ORES AND CONCENTRATES (zinc content)						
Australia	476	$63	458	$61	600	$78
Bolivia	—	—	50	6	28	6
Canada	399,755	61,634	365,175	73,816	366,244	72,346
Chile	12	2	—	—	15	10
China	223	30	—	—	—	—
Germany, Federal Republic of	5,103	3,044	—	—	—	—
Honduras	6,469	869	1,172	614	—	—
Mexico	5,494	1,648	7,218	3,164	16,408	9,114
Peru	7,978	3,001	31,633	11,748	5,301	3,036
Total	425,510	70,291	405,706	89,409	388,596	84,590
BLOCKS, PIGS, OR SLABS[1]						
Algeria	505	389	2,300	2,152	—	—
Argentina	—	—	—	—	3,013	4,490
Australia	51,435	42,451	25,000	26,701	42,766	69,473
Austria	—	—	300	243	—	—
Belgium-Luxembourg[2]	9,769	8,371	11,635	13,993	2,562	4,221
Brazil	—	—	3,997	5,318	8,899	15,158
Canada	360,729	301,773	424,390	474,621	435,254	730,463
China	4,199	3,474	93	105	317	524
Finland	18,336	15,702	14,779	17,591	24,321	41,386
France	10,539	8,575	9,308	9,818	8,110	13,789
Germany, Federal Republic of	15,272	13,065	7,321	7,806	3,512	5,884
Hong Kong	1,289	1,020	—	—	150	252
Italy	16,388	12,752	7,981	8,155	—	—
Japan	11,943	9,892	1,492	1,298	(3)	2
Korea, Republic of	3,868	4,184	18,122	20,702	2,352	3,776
Mexico	53,344	42,368	60,947	70,494	70,817	115,330
Monaco	—	—	—	—	136	231
Netherlands	28,281	23,451	11,097	12,332	4,685	7,532
New Zealand	500	423	—	—	—	—
Norway	17,507	15,440	31,695	30,150	28,801	47,325
Peru	22,383	17,235	11,943	12,213	34,409	54,772
Poland	250	232	4,177	4,909	—	—
South Africa, Republic of	—	—	—	—	201	331
Spain	55,427	42,256	65,231	76,679	26,277	44,747
Sweden	—	—	—	—	8	137
Taiwan	—	—	200	202	220	426
United Kingdom	3,570	2,875	4,311	5,206	1,239	2,114
Yugoslavia	2,035	1,550	792	1,010	—	—
Zaire	17,338	12,870	21,086	22,830	13,155	20,720
Zambia	1,078	873	1,000	1,304	749	1,159
Zimbabwe	—	—	1,663	1,421	—	—
Total	705,985	581,221	740,860	827,253	711,953	[4]1,184,244

[1] In addition, in 1989, 3,250 tons of zinc anodes were imported from Canada, China, the Federal Republic of Germany, Finland, France, Hong Kong, India, Italy, Japan, Mexico, the Netherlands, Norway, the Republic of Korea, Spain, Switzerland, Taiwan, Thailand, and the United Kingdom.

[2] For 1987, Belgium-Luxembourg combined, data not available to separate; 1988 and 1989 data for Belgium only.

[3] Less than 1/2 unit.

[4] Data do not add to total shown because of independent rounding.

Source: Bureau of the Census.

TABLE 31

U.S. IMPORTS FOR CONSUMPTION OF ZINC, BY COUNTRY

Country	1987		1988		1989	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
ORES AND CONCENTRATES (zinc content)						
Canada	28,960	$7,130	25,463	$10,934	20,161	$11,150
Honduras	6,469	869	1,172	614	—	—
Mexico	5,422	1,639	5,967	2,618	16,408	9,114
Peru	5,613	2,684	30,364	11,580	4,405	2,783
Total[1]	46,464	12,322	62,966	25,746	40,974	23,047
BLOCKS, PIGS, OR SLABS[1]						
Algeria	505	389	2,300	2,152	—	—
Argentina	—	—	—	—	3,013	4,491
Australia	51,435	42,451	25,000	26,701	42,766	69,473
Austria	—	—	300	243	—	—
Belgium-Luxembourg[2]	9,769	8,371	16,739	17,037	2,562	4,221
Brazil	—	—	3,997	5,318	8,899	15,158
Canada	360,729	301,773	427,558	477,855	435,254	730,463
China	4,199	3,474	93	105	317	524
Finland	18,336	15,702	14,780	17,591	24,321	41,386
France	10,539	8,575	9,308	9,818	8,110	13,789
Germany, Federal Republic of	15,272	13,065	7,321	7,806	3,512	5,884
Hong Kong	1,289	1,020	—	—	150	252
Italy	16,388	12,752	7,982	8,155	—	—
Japan	11,943	9,892	1,492	1,298	([3])	2
Korea, Republic of	3,868	4,184	18,122	20,702	2,352	3,776
Mexico	53,344	42,368	60,947	70,494	70,817	115,330
Monaco	—	—	—	—	136	231
Netherlands	28,281	23,451	11,097	12,332	4,685	7,532
New Zealand	500	423	—	—	—	—
Norway	17,507	15,440	31,695	30,150	28,801	47,325
Peru	22,383	17,235	11,943	12,213	34,010	54,051
Poland	250	232	4,176	4,909	—	—
South Africa, Republic of	—	—	—	—	201	331
Spain	55,427	42,256	65,231	76,679	26,277	44,747
Sweden	—	—	—	—	8	137
Taiwan	—	—	200	202	220	426
United Kingdom	3,570	2,875	4,311	5,206	1,239	2,114
Yugoslavia	2,035	1,550	792	1,010	—	—
Zaire	17,338	12,870	21,086	22,830	13,155	20,720
Zambia	1,078	873	1,000	1,304	749	1,159
Zimbabwe	—	—	1,663	1,421	—	—
Total	705,985	581,221	749,133	833,531	711,554	[4]1,183,523

[1] In addition, in 1989, 3,250 tons of zinc anodes were imported from Canada, China, the Federal Republic of Germany, Finland, France, Hong Kong, Italy, Japan, Mexico, the Netherlands, Norway, the Republic of Korea, Spain, Sweden, Switzerland, Taiwan, Thailand and the United Kingdom.
[2] For 1987, Belgium-Luxembourg combined, data not available to separate; 1988 and 1989 data for Belgium only.
[3] Less than 1/2 unit.
[4] Data do not add to total shown because of independent rounding.

Source: Bureau of the Census.

TABLE 32

U.S. IMPORTS FOR CONSUMPTION OF ZINC

Year	Ores and concentrates (zinc content)		Blocks, pigs, slabs[1]		Sheets, plates, strips, other forms	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
1987	46,464	$12,322	705,985	$581,221	960	$1,384
1988	62,966	25,746	749,133	833,531	4,100	5,395
1989	40,974	23,047	711,554	1,183,523	3,066	5,436

	Waste and scrap		Dross, ashes and fume (zinc content)		Dust, powder, flakes		Total value[2]
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)	(thousands)
1987	4,025	$1,928	6,727	$3,461	7,001	$7,940	$608,256
1988	5,727	3,615	6,346	4,279	7,652	11,958	884,524
1989	9,367	6,674	9,031	7,856	7,253	15,123	1,241,659

[1] Unwrought alloys of zinc were imported as follows, in metric tons: 1987—60 ($53,687); 1988—50 ($76,864) and 1989—632 ($952,159).
[2] In addition, the value of manufactures of zinc imported was as follows: 1987—$1,569,545; 1988—$1,415,747; and 1989—$2,080,347.

Source: Bureau of the Census.

Zinc Development Association, London, United Kingdom.

OUTLOOK

U.S. demand for zinc was forecast to rise slowly, increasing from about 1.06 million tons in 1989 to about 1.2 million tons by the year 2000. No major shifts in domestic zinc use were foreseen, although some present uses may yield further to substitution.

Despite having an adequate zinc resource base, imports were expected to continue to account for more than one-half of U.S. zinc demand in the next decade. Mine output was anticipated to reach record-high levels in the 1990's, but smelter capacity was expected to rise only modestly. No new primary zinc smelters will likely be built in the United States during the 1990's owing to permitting delays and economic indecision caused by the uncertainty of environmental regulations and the long-term liability threats posed by Superfund. Ironically, the United States is poised to become a major world exporter of zinc concentrates, and, at the same time, to remain the world's largest importer of refined zinc metal.

Secondary zinc recovery from waste and scrap was anticipated to be a strong growth sector for the zinc industry. Domestic secondary zinc production could increase by more than 50% of present levels in the next decade and constitute 40% of total U.S. zinc metal and compound consumption by the year 2000. Increased secondary recovery was expected to be driven by public policies related to waste recycle, environment, and public health.

World zinc metal consumption was expected to continue upward, rising to about 8.5 million tons by the year 2000 from the 7.2 million tons consumed in 1989. No new major-consuming uses of zinc were on the horizon. Traditional zinc uses in meeting the needs of a rapidly growing and more affluent world population were expected to be the driving force for increased zinc usage in the next decade. No long-term problems with supply were foreseen, although environmental concerns could affect zinc mine and refinery production, especially in developed countries. World zinc resources and reserves were adequate to supply the higher demand through the year 2000, and the industry, historically, has always responded to shortages with increased production.

TABLE 33

U.S. IMPORTS FOR CONSUMPTION OF ZINC PIGMENTS AND COMPOUNDS

	1988		1989	
	Quantity (metric tons)	Value (thousands)	Quantity (metric tons)	Value (thousands)
Zinc oxide	73,042	$79,465	59,557	$93,448
Zinc sulfide	2,487	3,622	1,840	3,178
Lithopone	2,386	1,628	3,365	2,155
Zinc chloride	1,306	1,181	2,578	2,301
Zinc sulfate	3,445	1,784	3,387	1,856
Zinc cyanide	160	307	(1)	(1)
Zinc hydrosulfite	213	391	(1)	(1)
Zinc compounds, n.s.p.f.	5,188	9,076	1,098	2,151

[1] Data not available because of change in tariff codes.

Source: Bureau of the Census.

BACKGROUND

Zinc is the fourth most widely used metal after iron, aluminum, and copper, yet through most of its history, zinc was not known as a distinct metal. Zinc

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