LEAD

By Gerald R. Smith

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Domestic lead mine production increased for the fifth straight year, increasing by about 7% compared with that of 1997. Alaska and Missouri were the dominant producing States with a 91% share. Other appreciable lead mine production was in Colorado, Idaho, and Montana. Lead was produced at 17 mines employing about 1,200 people. The value of domestic mine production was about $480 million. The lead concentrates produced from the mined ore were processed to primary metal at two smelter-refineries in Missouri and a smelter in Montana.

Secondary lead, derived principally from scrapped lead-acid batteries, accounted for 77% of refined lead production in the United States. Nearly all the secondary lead was produced by 9 companies operating 17 smelters.

During 1998, one U.S. Government agency issued several proposed and final rules on matters affecting the lead industries. These rules included establishing national emission standards for hazardous air pollutants at primary lead smelters, and amendments to national emission standards at secondary lead smelters. In addition, standards were announced for identification of lead-contaminated soil and lead-based paint hazards in housing, as well as for the management and disposal of lead-based paint debris generated in conducting lead-based paint abatement activities. Another agency also published notices of funding availability to support State and community-based lead-hazard control programs, and another issued a guidance document pertaining to lead in consumer products.

Lead was consumed in about 160 plants in the manufacture of end-use products, including batteries, ammunition, covering for power and communication cable, building construction materials, and solders for motor vehicles, metal containers, and electrical and electronic components and accessories.

Lead-acid batteries, including starting-lighting-ignition (SLI) and industrial types, continued to be the overwhelmingly dominant use of lead, accounting for about 88% of reported lead consumption. The Battery Council International (BCI) reported SLI battery production of 105 million units. This total included original equipment and replacement automotive-type batteries. An estimated 1.1 million metric tons of lead was consumed in SLI batteries.

Monthly sales of lead from the National Defense Stockpile (NDS) continued during 1998. Sales totaled about 50,400 metric tons (55,600 short tons), leaving about 312,000 tons (344,000 short tons) in the NDS at yearend.

Lead prices exhibited a generally declining trend throughout the year. The average London Metal Exchange (LME) and North American Producer prices were down by $0.043 per pound and $0.013 per pound, respectively, in 1998, from the average prices of $0.283 per pound and $0.465 per pound, respectively, in 1997.

Of the 44 countries in which lead was mined, the top 5 accounted for 68% of the world's total production of 3.10 million tons. Australia was the largest producer, with 20% of the world total, followed by China, 18%; the United States, 16%; Peru, 8%; and Canada, 6%.

Worldwide reserves of lead contained in demonstrated resources from producing and nonproducing deposits at yearend were estimated to be 66 million tons by the U.S. Geological Survey (USGS). Reserves for the two largest producers in the world, Australia and China, were about 18 million and 9 million tons, respectively. The United States, the third largest producer in the world, had reserves of 6.5 million tons. The reserve base (reserves plus measured and indicated resources in marginal economic deposits) for Australia and China was 33 million and 30 million tons, respectively. The reserve base for the United States was 20 million tons. The total world reserve base at the end of 1998 was estimated to be 140 million tons.

Legislation and Government Programs

Monthly sales of lead from the NDS continued during 1998. As a result of these sales, lead disposal from stockpile inventory totaled about 50,400 tons (55,600 short tons). The Defense National Stockpile Center's (DNSC) Annual Materials Plan (AMP) approved by the U.S. Congress for fiscal year 1998 (October 1, 1997-September 30, 1998) included a maximum disposal authority for lead of 54,400 tons (60,000 short tons). Under this authority, disposal of lead from NDS inventory during the first 9 months of calendar year 1998 was 39,500 tons (43,500 short tons). The AMP approved by the U.S. Congress for fiscal year 1999 (October 1, 1998-September 30, 1999) also included a maximum disposal authority for lead of 54,400 tons (60,000 short tons). Under the fiscal year 1999 authority, disposal of lead from NDS inventory during the last 3 months of 1998 amounted to 10,900 tons (12,000 short tons), leaving about 312,000 tons (344,000 short tons) of lead at yearend. Two solicitations were issued by the DNSC in late 1998 for the sale of lead from the NDS in negotiated long-term contracts. These solicitations totaled approximately 14,200 tons (15,700 short tons). The DNSC also proposed the disposal of an additional 54,400 tons (60,000 short tons) of excess lead from the NDS in its fiscal year 2000 (October 1, 1999-September 30, 2000) AMP.

During 1998, U.S. Government agencies issued several proposed and final rules, announced funding availability, and approved a guidance document on matters affecting the lead industries. In April, the U.S. Environmental Protection Agency

(EPA) published notice of proposed rulemaking to establish national emission standards for hazardous air pollutants for new and existing primary lead smelters, pursuant to section 112 of the Clean Air Act as amended in 1990. The proposed rule requires that all primary lead smelters meet emission standards that reflect the application of maximum achievable control technology (MACT), as determined by the EPA. In establishing the MACT, the EPA would take into consideration the cost of achieving such emission reduction and any non-air-quality health and environmental impacts and energy requirements. The proposed standards would establish a plantwide limit for emission of lead compounds from principal process sources, as well as process fugitive sources. Process sources would include the stack emissions from the sinter machine, blast furnace, and dross furnace. Process fugitive sources would include sinter machine charging and discharging, sinter crushing and sizing, blast furnace tapping, and dross furnace charging and tapping. The proposed aggregated lead emissions from the process and process fugitive sources would be limited to 500 milligrams per kilogram (1 pound per short ton) of lead produced (U.S. Environmental Protection Agency, 1998g, p. 19200-19204). In June, the EPA proposed a regulation to establish standards for lead-based paint hazards in most pre-1978 housing and child-occupied facilities. The EPA's proposed regulation is in accordance with section 403 of the Toxic Substances Control Act (TSCA), as amended by the Residential Lead-Based Paint Hazard Reduction Act of 1992, also known as Title X. The proposed regulation was intended to support the implementation of regulations already promulgated and others under development, which deal with worker training and certification, lead hazard disclosure in real estate transactions, requirements for lead cleanup under State authorities, lead hazard evaluation and control in federally owned and federally assisted housing, and U.S. Department of Housing and Urban Development (HUD) grants to assist in lead hazard abatement. In addition, under the authority of TSCA, section 402, the EPA proposed residential lead dust cleanup level requirements and amendments to dust and soil sampling requirements and, under the authority of TSCA, section 404, amendments to State program authorization requirements. With specific regard to Tribal lead cleanup programs associated with TSCA, section 404, the EPA announced in October its intent to enter into cooperative agreements with Indian tribes to provide financial assistance for purposes of developing EPA-authorized training, accreditation, and certification programs for professionals engaged in activities to remove the hazards of lead-based paint (U.S. Environmental Protection Agency, 1998b). Under TSCA, section 403, the EPA is required to promulgate regulations that "identify....(1) lead-based paint hazards, (2) lead-contaminated dust, and (3) lead-contaminated soil" for purposes of the entire Title X. Lead-based paint hazards, under TSCA, are defined as conditions of lead-based paint and lead-contaminated dust and soil that "would result" in adverse human health effects (15 United States Code 2681 (10)). The EPA's proposed standard for lead-based paint was defined as more than 0.93 square meter (10 square feet) of deteriorated paint on exterior components with large surface areas, more than 0.19 square meter (2 square feet) of deteriorated paint on interior components with large surface areas, for example, walls, ceilings, and floors, or deteriorated paint that is more than 10% of the total surface area of exterior or interior components with small surface areas, for example, trim, and baseboards. The proposed standards for lead-contaminated dust are the average levels of lead in dust that equal or exceed 538 micrograms per square meter on uncarpeted floors and 2,690 micrograms per square meter on interior window sills. The proposed standard for lead-contaminated soils would be the total lead that equals or exceeds an average concentration of 2,000 parts per million. With respect to lead-contaminated soils, the EPA further proposed to identify an average soil-lead level of concern of 400 parts per million, which represents a level at which risk should be communicated to the public as compared to the more active risk reduction measures recommended for soils exceeding 2,000 parts per million lead. The proposal regarding soil-lead level of concern will not be included in the regulation and thus will not impose any legally recognizable requirements on any individuals or entities. The EPA planned to develop a guidance document to accompany the final regulation that will explain in greater detail the recommended responses to lead-based paint hazards and to soil-lead level of concern (U.S. Environmental Protection Agency, 1998d, p. 30301-30304). In November, the EPA announced its intention to hold several public meetings on its proposed revisions to regulations governing renovation or remodeling activities that create lead-based paint hazards in target housing. Section 402 (c) (3) of The Toxic Substances Control Act directs the EPA to revise the final rules promulgated for the particular issue, Lead—Requirements for Lead-Based Paint Activities in Target Housing and Child-Occupied Facilities, codified at 40 CFR part 745, subpart L, so as to apply to the specific lead concerns in renovation and remodeling activities. Issues to be discussed included establishing which contractors would be affected by the revisions in the final rule, which activities would present the most significant potential hazard, and which practices could be implemented by contractors to achieve safe renovation and remodeling in a nonregulatory manner (U.S. Environmental Protection Agency, 1998i). In December, the EPA proposed a rule, authorized under TSCA, Title IV, sections 402 and 404 (15 U.S.C. 2682 and 2684), to provide standards for the management and disposal of lead-based paint debris generated by individuals or firms conducting lead-based paint activities. This rule was in addition to the training and certification rules for conducting lead-based paint activities that already have been promulgated in TSCA, sections 402 and 404. The rule on lead-based paint debris would apply to persons who generate, store, transport, reuse, transfer for reuse, reclaim, and/or dispose of lead-based paint from the following structures and activities: (1) abatement, demolition, renovation and remodeling in target housing (generally, pre-1978 structures) and child-occupied facilities; and (2) deleading, demolition, renovation, and remodeling in public buildings and commercial buildings. The proposed rule would not apply to lead-based paint debris generated by persons conducting abatement, renovation, or remodeling activities in target housing in which they reside (U.S. Environmental Protection Agency, 1998f, p. 70189-70195). Consistent with the EPA's proposal under

TSCA to provide new standards for the management and disposal of lead-based paint debris, the EPA also proposed to suspend temporarily the applicability of the toxicity characteristic regulations that currently apply to lead-based paint debris under the Resource Conservation and Recovery Act (RCRA), Subtitle C. The suspension of the latter was deemed necessary to avoid inconsistent or duplicative Federal requirements under RCRA and TSCA. Furthermore, it would allow the agency sufficient time to assess whether any RCRA requirements, in addition to TSCA, Title IV requirements, are necessary to assure proper management and disposal of lead-based paint debris (U.S. Environmental Protection Agency, 1998j, p. 70233-70234).

In other action taken by the EPA, a final rule was issued regarding the requirements for lead hazard education before renovation of housing constructed prior to 1978. This rule requires certain persons who perform renovations of this housing for compensation to provide a lead hazard information pamphlet to owners and occupants of such housing prior to beginning the renovation, as stipulated by TSCA, section 406 (b). In addition to outlining the health effects and symptoms of lead exposure, TSCA, section 406 (a), also requires that this pamphlet contain information on the potential hazards of renovating dwellings containing lead-based paint; recommend that an inspection or risk assessment for lead-based paint be performed before beginning renovations; suggest precautionary measures for protecting occupants during renovation; and identify Federal, State, and local sources of information on lead and lead-based paint (U.S. Environmental Protection Agency, 1998e).

In August, the EPA proposed two amendments to its final rule on national emission standards for hazardous air pollutants from secondary lead smelting. In one, the EPA proposed to revise the section outlining requirements for dryer transition equipment (i.e., junctions between the rotary dryer and the conveyer, feed chute, or hopper to the smelting furnace) to allow for the use of pressurized seals on such equipment as an alternative to enclosure hoods and ventilation. In the other, the EPA proposed to revise the total hydrocarbon emission limit for blast furnace charging hoods from 0.20 kilogram per hour as propane to 20 parts per million by volume on a dry basis as propane. The agency included these amendments in a direct final rule without prior proposal, viewing them as noncontroversial and anticipating no significant adverse comments (U.S. Environmental Protection Agency, 1998h).

The EPA also issued a 90-day extension until November 26, 1998, for secondary lead smelters to comply with the land disposal treatment standards applicable to slags from secondary processing that exhibit toxicity characteristics. The specific action was taken by the EPA to accommodate short-term logistical difficulties encountered by the secondary smelters, involving crushing of the slag and its subsequent stabilization treatment. The treatment standard for such slag was included in a final rule issued by the EPA in May 1998. In that rule, toxicity characteristic metal-bearing waste from thermal recovery of secondary lead was determined to be subject to a Universal Treatment Standard of 0.75 milligram per liter lead, prior to land disposal. Toxicity characteristic waste (5.0 milligrams per liter for lead) is determined by using a standard test procedure that measures the possibility of a particular waste leaching toxic metals above a designated concentration level (U.S. Environmental Protection Agency, 1998a). In further EPA action, the agency announced the withdrawal of a final rule, issued in early September 1998, that would have established fees for accreditation of training programs and certification of contractors with respect to lead-based paint activities, under the authority of TSCA, section 402 (a) (3). The EPA planned to issue another final rule on this subject in early 1999, which would address the public comments that prompted the withdrawal of the rule (U.S. Environmental Protection Agency, 1998c).

In 1998, HUD announced a Notice of Funding Availability for fiscal year 1998 to conduct further research on residential lead-based paint hazards. The grants, totaling about $2 million, were to be awarded on a competitive basis to selected applicants to fund research activities that address critical gaps in the knowledge of residential lead hazard identification and control. Allocation of such grants is authorized under the Residential Lead-Based Paint Hazard Reduction Act of 1992 (U.S. Department of Housing and Urban Development, 1998a). In October, HUD also published additional information and analysis, reaffirming the agency's determination that the proposed regulatory requirements for notification, evaluation, and reduction of lead-based hazards in federally owned residential property and housing receiving Federal assistance, published in June 1996, would not have a significant economic impact on a substantial number of the affected small entities. The proposed requirements effectively implemented the notification, evaluation, and hazard reduction directives contained in the Residential Lead-Based Paint Hazard Reduction Act, Title X, sections 1012 and 1013, of the Housing and Community Development Act of 1992. As part of the continuing process to issue a final rule on sections 1012 (Federal assistance housing) and 1013 (federally owned housing) of Title X, further written comments from the public on the proposed regulatory requirements were to have been received by HUD on or before November 9, 1998 (U.S. Department of Housing and Urban Development, 1998b).

The National Highway Traffic Safety Administration (NHTSA) of the U.S. Department of Transportation issued a notice of proposed rulemaking for a new Federal motor vehicle safety standard that would establish requirements and test procedures which address safety issues exclusive to electric vehicles (EV's). Issues to be considered in the proposed rule included electrolyte spillage, postcrash retention of batteries in their mounts, and electrical shock hazard. The safety standards would apply to EV's with a maximum speed of more than 40 kilometers per hour (25 miles per hour). Comments on the proposed rule were to have been received by the NHTSA by November 27, 1998 (National Highway Traffic Safety Administration, 1998).

In January, the U.S. Consumer Product Safety Commission issued a document providing guidance to manufacturers, importers, distributers, and retailers to protect children from hazardous exposure to lead in consumer products. This guidance, not a rule, was intended to highlight certain industry obligations issued under the Federal Hazardous Substances Act (FHSA). Under the FHSA, household products that expose

children to hazardous quantities of lead in reasonably foreseeable conditions of handling or use are classified as "hazardous substances." In evaluating the potential hazard associated with products that contain lead, the Commission considered several major factors on a case-by-case basis. These factors included the total amount of lead contained in the product, the bioavailability of the lead, the accessibility of the lead to children, the age and foreseeable behavior of the children exposed to the product, the foreseeable duration of the exposure, and the marketing, patterns of use, and life cycle of the product. In this document, the Commission urged manufacturers to eliminate lead in consumer products. In cases where lead is used, however, the manufacturer was encouraged to perform the necessary analysis before distribution of the product to determine whether the product is a hazardous substance. By conducting such analysis to establish that it is not a hazardous substance, the manufacturer could avoid future action by the Commission that might ban the product or require that it bear a warning label (U.S. Consumer Product Safety Commission, 1998).

Production

Primary.—In 1998, domestic mine production of lead increased for the fifth straight year and was up by about 33,000 tons, or 7%, compared with that of 1997. Increases in production were reported at several mines in Alaska, Idaho, and Missouri. The major share of the U.S. mine output of lead was derived from production in Alaska and Missouri. Appreciable lead mine production also was reported in Colorado and Montana. Domestic mine production data were collected from a voluntary survey on lode-mine production of gold, silver, copper, lead, and zinc by the USGS. All the major lead-producing mines responded to this survey. The lead concentrates produced from the mined ore were processed to primary metal at two smelter-refineries in Missouri and a smelter in Montana. (See tables 1-4.)

The Doe Run Co., St. Louis, MO, finalized the purchase of ASARCO Incorporated's Missouri lead business at the end of August. Included in the sale were Asarco's Sweetwater and West Fork Mines and its Glover refinery, all in southern Missouri. The acquisitions will be folded in to Doe Run's existing southeast Missouri mining and milling division (SEMO) (The Doe Run Co., September 16, 1998, Doe Run acquires Asarco, accessed June 23, 1999, at URL http://www.doerun.com/ENGLISH/news releases/091698.htm). The SEMO operations consisted of five lead mines and four mills that supplied concentrates to its smelter and refinery at Herculaneum, MO. Doe Run is owned by The Renco Group, a New York-based, privately held company with investments in natural resources and industrial operations.

Asarco continued to operate its custom lead smelter in East Helena, MT, during the year. Its custom lead business depends on an available supply of precious-metal-bearing lead concentrates from mines in the United States and South America. Lead bullion produced at East Helena was sold to refineries located outside of the United States. Operation of the smelter was not profitable in 1998. However, work rule changes and processing improvements were being implemented to improve operating results. Asarco permanently closed its Omaha, NE, refinery in 1997 and continued to work during 1998 with the city and the State to convert the former plant site into a recreational park (ASARCO Incorporated, 1998, p. 14).

Cominco Alaska Inc., a wholly owned subsidiary of Cominco Ltd., Toronto, Canada, operated the Red Dog zinc-lead mine in northwestern Alaska under a leasing agreement with NANA Regional Corp., owner of 100% interest in the property. NANA is a corporation organized under the provisions of the Alaska Native Claims Settlement Act. The construction program initiated in 1996 to increase production at Red Dog was completed on schedule in September. As a result, although the average mill recovery of lead at Red Dog declined to 57% in 1998 from 62% in 1997, overall production of lead in concentrate increased owing to a nearly 30% increase, to 2.5 million tons, in the quantity of ore milled, an 8% increase, to about 123,000 tons, in lead concentrate production, and a 6% increase, to 59.3%, in the average grade of lead in concentrate. The construction program included the lead preflotation project in which additional lead flotation cells were installed in an expanded mill building to improve concentrate quality. Approximately 125,000 tons of lead concentrate was shipped to markets around the world. In 1998, Red Dog's exploration drilling program identified a potential new resource zone lying beneath the recently discovered Paalaaq deposit to the north of Red Dog. The estimate of resource at the Paalaaq deposit is 13 million tons, at a grade of 15% zinc, but the grade of lead in the new zone has not been stated, and the boundaries of the zone have yet to be defined on the northern and western sides. An aggressive drilling program to identify new resources in the Red Dog area was planned for 1999. Cominco continued the development of the Pend Oreille zinc-lead mine near Metaline Falls, WA. During the year, infill drilling was carried out to define the deposit for purposes of establishing appropriate mining objectives. In addition, extensive metallurgical and engineering studies were conducted. The process to obtain mining permits was well underway and was expected to be completed in 2000 (Cominco Ltd., 1998, p. 13-19).

Hecla Mining Company, Coeur d'Alene, ID, operated the Lucky Friday Mine in Mullan, ID, throughout 1998. The "Lucky Friday Expansion Project" for the development of the Gold Hunter ore body was completed in the second quarter, yielding 73% of the milled ore in 1998. Ore was milled at the rate of about 1,000 tons per day to produce silver-lead concentrate and zinc concentrate. About 95% of the lead was economically recovered by using conventional flotation methods. Production of lead in concentrates totaled about 25,000 tons in 1998. As to further mine development, Hecla's policy was to develop new levels of the current ore bodies at a minimum rate consistent with the requirements for uninterrupted and efficient ore production. Ore reserves at the Lucky Friday and the Gold Hunter deposits total about 1.1 million tons at a grade of 10.5% lead.

Hecla Mining also held a 29.7% interest in the Greens Creek Mine on Admiralty Island, near Juneau, AK, through a joint venture arrangement with Kennecott Greens Creek Mining Co., the manager of the mine and a wholly owned subsidiary of Kennecott Minerals Corp. At Greens Creek, about 1,500 tons per day of ore was mined from the underground Southwest and

West ore zones, and milled onsite to yield lead and zinc concentrates, as well as a gold/silver dore. Total production of lead in concentrate was about 20,000 tons in 1998. Definition drilling during 1998 on the newly discovered South ore zone resulted in additions to Greens Creek's ore reserves. Estimated reserves at the Greens Creek Mine are 8.8 million tons at a grade of 4.5% lead (Hecla Mining Company, 1998, p. 8-11).

In August, the Greens Creek joint-venture company and the U.S. Department of Agriculture completed a land exchange agreement in Alaska. As authorized by the U.S. Congress in the Greens Creek Exchange Act of 1995 and signed by the President in April 1996, the joint-venture company purchased approximately 139 acres of private inholdings in the Admiralty Island National Monument and 50 acres of private inholdings in Misty Fiords National Monument for inclusion in the Tongass National Forest. As a result, the inholdings will become a permanent part of the National Monuments. In exchange for these purchases, the company will receive subsurface rights to 7,500 acres of land adjacent to its existing patented claims at the Greens Creek Mine. The U.S. Government will retain the surface rights to these 7,500 acres and upon completion of mining, this land, as well as all lands currently owned or yet to be acquired by the company on Admiralty Island, will, after reclamation, revert to the U.S. Government and be included in the National Monuments. In addition, the company will pay the U.S. Government a royalty from profits obtained from mineral sales that arise as a result of this land exchange (Mining Record, 1998d).

Pegasus Gold Inc., Spokane, WA, reported the production of about 4,500 tons of lead through the first 9 months of 1998 at its Montana Tunnels gold-silver-lead-zinc mine in central Montana (Pegasus Gold Inc., 1998, p. 30). The company sought protection under U.S. bankruptcy laws in January and by yearend had been reorganized to form a new company, Apollo Gold Co. As part of the reorganization, Pegasus and 13 of its subsidiaries were to be dissolved, with Apollo taking control of the Montana Tunnels Mine, as well as two other former Pegasus mines (American Metal Market, 1999).

Grayd Resource Corp., Vancouver, Canada, initiated a drilling program at the company's wholly owned Dry Creek property in the Bonnifield District, south of Fairbanks, AK. Drill results revealed significant volcanogenic massive sulfide mineralization containing up to 6% lead (Northern Miner, 1998). In addition, Grayd began drilling on the nearby Glacier Creek property in a joint venture with Canada's Inmet Mining Corporation. The Glacier Creek property exhibits the same geologic units that host volcanogenic massive sulfides at the Dry Creek property (Mining Record, 1998c). Grayd also maintained a significant interest in the Delta joint-venture property near Tok, AK. Results of a 1998 drilling program reported by Grayd's joint-venture partner, American Copper & Nickel Company, Inc., a wholly owned subsidiary of Inco United States, Inc., revealed a total inferred resource of 17.3 million tons, averaging 4.7% zinc and 2.0% lead, at the Delta property (Mining Record, 1998b).

Camnor Resources Ltd., Vancouver, Canada, signed a letter of intent with Golden Phoenix Minerals Inc. to earn up to a 100% interest in seven properties, also located in the Bonnifield District of Alaska. Significant base metal mineralization has been documented at six of the properties, all of which are underlain by the same terrane as that of the properties owned by Grayd Resource (Mining Record, 1998a).

Royal Silver Mines Inc., Spokane, WA, announced that a lease with purchase option was signed on the historic Simon silver-lead mine in the Bell Mining District, Mineral County, NV. The Simon Mine was operated sporadically after its discovery (1879) through its last year of production (1960). Historic information available on the rich sulfide mineralization at the Simon Mine reportedly indicated ore grades of 9.2% lead, 6.5% zinc, and appreciable quantities of copper and silver. Royal Silver intended to begin work on the property in April, beginning with surface geologic, geochemical, and geophysical surveys and followed by a combination core and reverse circulation drilling program (Mining Record, 1998e).

Clifton Mining Co., Alpine, UT, a small producer of lead and silver, reportedly was planning to expand mining operations and output at its property in western Utah. The company began mining at two previously mined sites on the property during late 1997 and early 1998, and expected to bring a third mine into operation in late 1998. At midyear, Clifton was milling ore at a rate of about 2,500 tons per year. The ore contained an average of 5.5% lead. Proven and probable reserves on the Clifton property were estimated to be about 450,000 tons (Metal Bulletin, 1998q).

Secondary.—Domestic secondary production increased by about 1% in 1998. Secondary lead accounted for 77% of domestic lead refinery production compared with 76% in 1997. Lead recovered from scrap lead-acid batteries continued at a high level and accounted for 90% of all lead produced from secondary sources. The domestic secondary statistics were derived by the USGS from a combined secondary producer and consumer survey that included data from monthly and annual surveys. Of the 20 companies producing secondary lead, exclusive of that produced from copper-based scrap, to which a survey request was sent, 18 responded, representing more than 99% of the total production of secondary lead. Of the total lead recycled in 1998, about 98% was produced by 9 companies operating 17 plants in Alabama, California, Florida, Georgia, Indiana, Louisiana, Minnesota, Missouri, New York, Pennsylvania, Tennessee, and Texas. Production and consumption for the nonrespondents were estimated by using prior-year levels as a basis. (See tables 1, 5, and 9.)

New Jersey-based Metalico Inc. initiated reconstruction and expansion of the secondary-lead-processing facilities it acquired from General Smelting and Refining Co., College Grove, TN, in December 1997. Metalico reportedly planned to move and rebuild General Smelting's existing single-blast-furnace smelter and to increase its production capacity from the current 11,500 tons per year to 32,000 tons per year. The new two-furnace smelter will be constructed near the old plant, utilizing the current blast furnace and adding a reverbatory furnace. Spent industrial lead-acid batteries and discarded wheel weights were used as a principal feed for the smelter. A battery breaker will be added to the new facility in order to diversify its feed sources (Ryan's Notes, 1997).

Exide Corp. temporarily closed its secondary lead smelter in Memphis, TN, in order to upgrade the facility. Improvements

to the plant were expected to begin in early 1999. Under plans released by Exide, the company anticipated that the facility would be reopened upon completion of the upgrading work. Exide had purchased the smelter from Refined Metals Co., Longview, TX, in early 1998. The smelter, capable of producing about 23,000 tons per year of secondary lead, requires about 2.5 million spent lead-acid batteries as feedstock to operate each year (American Metal Market, 1998a).

Quexco Inc., the Texas-based holding company whose assets included RSR Corp., Dallas, TX, a secondary lead producer, continued its efforts during the year to complete the purchase of GNB Technologies Inc., a secondary lead and lead-acid battery producer owned by Australia's Pacific Dunlop Ltd. Reportedly, before the sale can be completed, questions pertaining to Quexco's ownership of two large secondary smelters on the U.S. west coast must be resolved. GNB and RSR currently operate smelters in Vernon, CA, and City of Industry, CA, respectively (Ryan's Notes, 1998).

Consumption

Reported consumption of lead increased by about 0.5% as the demand for lead in storage batteries continued to increase. The demand for lead declined in a number of other end uses, including bearing metals, casting metals, brass and bronze, cable covering, and sheet lead. Consumption of lead in SLI- and industrial-type lead-acid storage batteries represented 88% of the total reported consumption of lead. Industrial-type batteries included stationary batteries, such as those used in uninterruptible power-supply equipment for hospitals, computer and telecommunications networks, and load-leveling equipment for commercial electrical power systems, as well as traction batteries, such as those used in industrial forklifts, airline ground equipment, and mining vehicles. Of the 125 consuming companies to which a survey request was sent, 118 responded, representing about 94% of the total reported U.S. lead consumption.

BCI reported an SLI-type battery production of 105 million units in 1998 compared with 100 million units in 1997. The totals include original equipment and replacement automotive-type batteries. By using an estimate of 10.6 kilograms (23.3 pounds) per unit, the SLI offtake for 1998 was about 1.1 million tons of lead. SLI batteries included those used for automobiles, buses, trucks, tractors, motorcycles, and marine craft. (See tables 6-13.)

World Review

World production of refined lead increased to 5.88 million tons in 1998 from 5.82 million tons in 1997. Other statistics for 1998, as reported by the International Lead and Zinc Study Group, are as follows: world consumption remained at about 5.99 million tons; commercial stocks of refined lead in industrialized countries were 550,000 tons, or 4 weeks of consumption, at yearend 1998 compared with 600,000 tons at yearend 1997 and 560,000 tons at yearend 1996; and significant exports of refined lead to industrialized countries from developing Asian countries, notably China, continued during 1998, increasing by about 16%, to 336,000 tons, compared with those of 1997.

Lead prices exhibited a generally declining trend throughout the year. The average LME and North American Producer prices were down by $0.043 per pound and $0.013 per pound, respectively, in 1998, from the average prices of $0.283 per pound and $0.465 per pound, respectively, in 1997.

The structure of the lead mining and refining industries was affected by a number of changes, including the opening and development of new facilities, as well as the closing, reopening, expanding, selling, and modernizing of existing facilities. (See tables 14 and 15.)

New Mines, Plants, Properties, and Resources.—Malaysia's Metal Reclamation (Industries) Sdn Bhd continued its plans to construct another secondary lead alloy plant on the island of Pulau Indah, near Port Klang, in 2000, despite an economic recession in Malaysia. The new plant will have a rated capacity of 35,000 tons per year of lead alloys. Coupled with the company's Selayang plant, the annual output will be about 70,000 tons, making Metal Reclamation one of Southeast Asia's leading lead alloy producers. Most of the company's feedstock was obtained locally, and more than 90% of its production generally was consumed in domestic markets. As a result of declining domestic demand during the recession, however, Metal Reclamation ventured into new markets in South Asia and the Middle East (Metal Bulletin, 1998n).

In May, BHP Minerals shipped the first concentrates from its new Cannington underground lead-zinc-silver mine in northeast Australia. 1998 was its first full year of production following the initiation of production in October 1997. By July, ore was being processed at a full production rate of 1.5 million tons per year. In 1998, the mine was expected to yield 50,000 tons of lead. The Cannington ore body contains an estimated 43 million tons of mineralization at an average grade of 11.5% lead, 4.5% zinc, and 540 grams per ton silver (Metal Bulletin, 1998b).

Ivernia West PLC and Minorco Lisheen, joint-venture partners in the Lisheen zinc-lead mining project in County Tipperary, Ireland, continued development work during the year but were delayed for several weeks in August and September because two areas of waterlogged rock were encountered. Despite the setback, development of the mine was on schedule in certain aspects. The tailings pond, foundation work, and infrastructure, as well as the explosives magazine, were completed. The mine was scheduled for completion by late 1999 and was expected to produce 1.5 million tons per year of ore when in full production (Platt's Metals Week, 1998a). Total production of lead and zinc concentrates was expected to be about 1.6 million tons during the first 5 years of operation. The projected life span of the mine will be about 20 years. Estimated reserves at Lisheen were 18 million tons at a grade of 12.75% zinc and 2.2% lead (Platt's Metal's Week, 1998d).

Australia's MIM Holdings Ltd. announced in April its decision to proceed with the development of the company's George Fisher zinc-lead-silver mine in Queensland. Preliminary work began in mid-1998, and initial construction was expected to begin in 2000. When in full operation, the new facilities were expected to treat 2.5 million tons per year of ore, producing 170,000 tons per year of zinc, about 100,000 tons per year of lead, and about 5 million ounces per year of

silver in concentrates. The mine's reported proven reserves of 24 million tons, at a grade of 9.1% zinc, 5.6% lead, and 128 grams per ton silver, were considered to be sufficient for 10 years of production. The current reserves, however, are contained in only 2 of the 11 ore bodies identified by exploration at the George Fisher site. An additional 70 million tons of resources could be available to support an even longer mine life (Mining Journal, 1998c).

Minco Mining and Metals Corp., Vancouver, Canada, signed cooperative agreements with Baiyin Non-Ferrous Metal Co., the Chinese base metals producer, to develop two base metal projects in China's Gansu Province. In the first agreement, Minco was entitled to gain a 75% interest in the Changba-Lijiagou zinc-lead property through the development of a 3,500-ton-per-day underground mining operation. This property encompasses three deposits including Lijiagou, Changba, and an unnamed "joint area." Resources at Lijiagou were reported to be 13.5 million tons at a grade of 11% zinc and 1.9% lead. Resources and grades for each of the other two deposits were estimated to be in a range similar to that of Lijiagou. Minco's second agreement with Baiyin covered the White Silver Mountain project that surrounds polymetallic massive sulfide deposits near the city of Baiyin and includes the Xiaotieshan Mine. Minco could acquire an 80% interest in this project by funding all exploration work and completing a prefeasibility study. Xiaotieshan reportedly has reserves of 10.7 million tons at a grade of 5.1% zinc, 3.3% lead, and appreciable quantities of copper, gold, and silver. The infrastructure at Xiaotieshan includes a 1,500-ton-per-day lead-zinc concentrator, and a 50,000-ton-per-year lead and zinc smelter (Metal Bulletin, 1998m).

Closings and Curtailments.—Canada's Anvil Range Mining Corp. closed its Faro zinc-lead mine, Yukon Territory, in mid-January, citing falling metal prices. A company spokesperson stated that cash resources had been "substantially depleted" since mining was resumed in November 1997. At that time, Anvil had secured sufficient short-term financing from Cominco and Glencore International AG, the Swiss metals trading company, to restart the mine. As part of the agreement, Glencore had gained the rights to market all zinc and lead concentrates produced at Faro until March 1998. In late 1997, a successful test period was completed at the mill with concentrate grades reaching target levels. As a result of Anvil's depletion of financial resources, the company sought court protection under Canada's Companies Creditors Arrangement Act and began the process of formulating a restructuring plan with its shareholders (Metal Bulletin, 1998i).

Australia's Melbourne-based Denehurst Ltd. closed its Woodlawn Mine in New South Wales early in March, citing financial difficulties. The mine had been scheduled to be closed during 1999 as a result of declining reserves, although an extensive exploration program had been conducted with the hope of discovering additional reserves at the mine. Annual production at the Woodlawn Mine was about 42,000 tons of zinc and 9,400 tons of lead, as well as significant quantities of copper, gold, and silver (Metal Bulletin, 1998a).

Canada's Breakwater Resources Ltd. decided to continue indefinitely the shutdown of its Caribou zinc-lead mine in New Brunswick, citing high operating costs and low metal prices as principal reasons. The mine was closed in August for maintenance and construction but had been scheduled to resume operations in early September. A company spokesperson indicated that recovery rates had been increasing steadily prior to the shutdown. In addition, the average grade of ore being fed to the mill also had risen, reaching a level of 7.3% zinc and 4.5% lead. During the extended closure, the company planned to conduct additional pilot plant work that was expected to require several months to complete (Metal Bulletin, 1998g).

In late April, production was halted at Boliden Ltd.'s Los Frailes lead-zinc mine near Seville, Spain, after a tailings dam failed, flooding a significant portion of the neighboring land. As a result, Boliden declared force majeure with respect to obligations to its customers and suppliers. Results of a detailed study made by an independent firm of geotechnical engineers revealed that the dam failure had been triggered primarily by a movement in the bedrock formation well below the surface of the dam. The engineers determined further that the movement was a result of the tremendous pressures exerted by the weight of the dam and its tailings content. The Los Frailes Mine remained closed throughout the remainder of the year. Reopening the mine was contingent upon the company obtaining the necessary mining and milling permits from the Spanish authorities. A return to full mining and milling operations was likely to take an additional few months. The production capacity at Los Frailes is 125,000 tons per year zinc and 48,000 tons per year lead (American Metal Market, 1998b; Metal Bulletin, 1998d, e).

Bulgaria's Minister of Finance announced that Gorubso Zlatograd, the state-owned lead-zinc miner, would discontinue operations in late November as a result of a wage dispute with striking miners. Gorubso is the largest mining company in Bulgaria, producing about 30,000 tons per year of lead in concentrate (Platt's Metals Week, 1998b).

In July, the Russian lead concentrate producer, Dalpolimetall, announced that it was seriously considering closing its operations in Dalnegorsk, eastern Russia, as a result of continuing economic difficulties. Despite an increase in concentrate production in 1997, Dalpolimetall continued to operate at a loss. Although the net loss decreased by 60% compared with 1996, the company had expected to break even in 1997, according to a spokesperson for Switzerland's Glencore International, which owns a 53% interest in Dalpolimetall. Reportedly, the regional government preferred to shift the plant production from concentrate to refined metal, thus providing a direct source of lead for use by regional lead-acid battery manufacturers. Disputes over the costs of waste treatment and supply requirements, however, stalled agreement on this conversion. Consequently, the Dalpolimetall facilities were closed temporarily in September 1998, but company officials were hopeful that production would be resumed by the end of 1998. Dalpolimetall expected to export any remaining concentrate production to Asian countries including China, Japan, the Republic of Korea, and Thailand (Platt's Metals Week, 1998h).

In mid-April, Gold Fields Namibia Ltd. ceased operations at its Tsumeb lead smelter because of unfavorable financial results. Company officials had been optimistic that most of the

earlier technological problems had been resolved when the facility was reopened in January and had intended to increase production gradually during the year. Instead, the company submitted an application for seqestration to be heard by the high court. If approved, a liquidator then was expected to be appointed for the company. Gold Fields, however, had not ruled out the possibility that the company could still be sold. Reportedly, several potential buyers had expressed interest in purchasing Tsumeb. Some industry sources had suggested that Tsumeb might be profitable if it were to develop an alliance with, for example, Namibia's Rosh Pinah lead-zinc mine or Zambia's Kabwe lead-zinc mine. The production capacity at Tsumeb was 30,000 tons per year of refined lead, but only 1,300 tons were produced in 1997 (Metal Bulletin, 1998j).

Production at Mexico's lead-acid battery recycling plant, owned and operated by Acumuladores Mexicanos SA de CV at Tlaxcala, was decreased to about 80% of plant capacity starting in April. Company officials cited low prices for secondary lead, continued high prices for spent lead-acid batteries, and the inability to obtain sufficient quantities of spent batteries. About 3 million batteries have been processed each year at the Tlaxcala plant, yielding nearly 30,000 tons of recycled lead (Platt's Metals Week, 1998e).

India's secondary lead production came to a virtual standstill during the year as a result of the ban on imports of battery scrap, according to an official of one of the country's largest private sector secondary lead producers. Supplies of lead scrap have become progressively more scarce since the ban was imposed in 1997, owing to the fact that legislation to increase the collection of domestically available battery scrap had not been forthcoming. India's environmental minister stated that the country firmly supported recycling but permitted only genuine recovery by those who had the requisite pollution control equipment and had been approved by the central and state pollution control boards. India's annual supply deficit for mined lead was expected to reach 41,700 tons by 2001-02, making the recovery of secondary lead increasingly more urgent (Metal Bulletin, 1998k).

Reopenings and Expansions.—Mexico's Industrias Peñoles, S.A. de C.V. announced plans to expand and improve its lead operations from 1998 to 2002. Mine production of lead would be increased from 69,300 tons per year in 1998 to 104,000 tons per year by 2002. Output of refined lead would be increased from about 160,000 tons per year up to 169,000 tons per year. To accomplish the increase, Peñoles expected to place into production two new lead-zinc mines that were being developed. Lead reserves at these new mines, the Francisco Madero Mine in Zacatecas State and the Rey de Plata Mine in Guerrero State, were reported to be 278,000 tons and 60,000 tons, respectively (Platt's Metals Week, 1998f).

In Tunisia, production was resumed at the Société Minière de Bougrine zinc-lead mine and mill in May, and full capacity was reached in June, according to its new owner, Breakwater Resources Ltd., Toronto, Canada. Total production in 1998 was expected to be 50,000 tons of zinc concentrate and 6,000 tons of lead concentrate. Annual production in 1999 and thereafter was expected to average 88,000 tons of zinc concentrate and 12,000 tons of lead concentrates. At this production rate, reserves at Bougrine were estimated to be sufficient for 10 years of operation. Breakwater had purchased the Bougrine mine and mill in September 1997. The mine was first opened in 1994, but was closed in 1996 because of declining metal prices (Metal Bulletin, 1998f; Mining Journal, 1998a).

China reportedly planned to increase production of electrolytic lead by 8% in 1998 at its Shaoguan smelter in Guangdong Province. In 1997, the company produced about 51,000 tons of lead. Production capacity at Shaoguan was about 60,000 tons per year, but a shortage of raw material kept production below capacity, according to a company spokesman. Shaoguan exported about 50% of its lead mainly to Japan and Southeast Asia and to a lesser extent to Europe and the United States (Platt's Metals Week, 1998i).

China's electrolytic lead producer Hanjiang, Hubei Province, reported plans to produce 30,000 tons of lead in 1998, an increase of 15% compared with that of 1997. Construction of an additional production line also was underway, which was expected to increase annual capacity at Hanjiang to 50,000 tons by the end of 1998. According to a company official, most of the plant's output was exported to Japan and the Republic of Korea, and export sales remained relatively stable despite the economic difficulties in Asia during the year (Platt's Metals Week, 1998c).

Australian metals producer Pasminco Ltd. expected its Port Pirie lead refinery to reach its expanded capacity of 255,000 tons per year by the end of 1998. In midyear, the plant was being operated at about 70% of its previous capacity of 225,000 tons per year, but output was expected to be increased gradually to the expanded level by yearend (Platt's Metals Week, 1998g).

In September, India's Binani Industries Ltd. announced plans to expand significantly its output of lead and zinc. Contract negotiations reportedly were conducted with Australia's Western Metals Ltd. to supply concentrate for a new lead and zinc smelter to be constructed in Gujarat. Lead and zinc production capacities at this new facility will be 70,000 tons per year and 100,000 tons per year, respectively. Construction of the facility could require at least 3 years to complete (Metal Bulletin, 1998c).

Transfers of Ownership, Sales Offerings, and Mergers.– Mytilineos Holding SA, a Greek trading company, agreed to purchase a 60% interest in Romania's Sometra Copsa Mica primary lead and zinc smelter-refinery. The lead and zinc production capacities at the facilities are 30,000 tons per year and 60,000 tons per year, respectively (Metal Bulletin, 1998o).

In November, Glencore International announced that it expected to complete the purchase of the Porto Vesme lead and zinc smelter-refinery facilities and the nearby San Gavino lead refinery from Ente Nazionale Indrocarburi, Italy's state-owned energy group, in early 1999. Porto Vesme and San Gavino are located on the island of Sardinia. Lead production capacities at Porto Vesme and San Gavino were placed at about 150,000 tons per year and 110,000 tons per year, respectively (American Metal Market, 1998c).

Glencore also was reported to have sold its controlling interest in Russia's Dalpolimetall lead and zinc complex to the Dalnegorsk municipal property committee, located within the Primorye region of Russia. Under the sales agreement, Glencore would retain the exclusive right to market

Dalpolimetall's lead and zinc concentrates for a period of 5 years. The new board of directors at Dalpolimetall would include representatives from Glencore, the Primorye Administration, the Dalnegorsk Administration, and principal shareholders who together own 20% of the stock. In 1997, Dalpolimetall produced 25,000 tons of lead concentrate, 40,000 tons of zinc concentrate, and 8,000 tons of refined lead (Metal Bulletin, 1998h).

In further activity by Glencore, the company was expected to increase its investment in Kazakhstan's Kazzink polymetallic complex as part of a reconstruction program at the facilities, according to a Kazzink official. Kazzink, of which Glencore holds a 62.4% stake, includes the Grekhovsky, the Maleyevsky, and the Zyryanovsk Mines, as well as the Tekeli lead-zinc combine, which consists of three mines and two mills. Specific aims of the investment were to increase capacity at the Zyryanovsk beneficiation plant from 1.2 million tons per year up to about 2.5 million tons per year, and to increase output at the Maleyevsky Mine from 550,000 tons per year up to 1.5 million tons per year by the end of 1999. Investment at Tekeli will be used mainly for stripping and capital construction. The Tekeli mining and milling operations have a design capacity of 850,000 tons per year of ore, capable of yielding 15,600 tons per year and 29,600 tons per year of lead and zinc concentrates, respectively. About 360,000 tons per year of ore was being processed at Tekeli at yearend (Metal Bulletin, 1998l).

Bulgaria's privatization agency reported that efforts to sell a 57% share of the Olovno-Tsinkov Kompleks lead-zinc smelter were unsuccessful. The tender failed to attract any bidders by the November 10 deadline, prompting agency officials to consider other options, including extension of the bid deadline or setting a lower sale price for the facilities (Mining Journal, 1998b).

In Namibia, negotiations resolving the ownership and operation of the Rosh Pinah lead-zinc mine were completed at yearend. The agreement between P.E. Minerals Namibia, the holder of the mining license, and South Africa's Iscor Ltd. granted Iscor the right to operate the mine in return for a royalty payment to P.E. Minerals. A provision in the agreement also allowed Namibian citizens to earn a 50% equity interest in the mine. The involved parties intended to register the operation under a new company name, Rosh Pinah Zinc Corp. Ltd. An Iscor official stated that the company planned to increase combined lead and zinc output in concentrate from the current level of 39,000 tons per year to 50,000 tons per year during the next 18 months to 2 years (Metal Bulletin, 1998p).

Outlook

According to an Australia Mineral Economics report, world lead consumption is expected to increase by a compound annual average of 1.7% during the 10-year period to 2008, although net mine capacity is expected to rise only 0.2% per year during this same medium-term period. The average compound rate of lead price increase during the 10-year period is projected to be 2.1% per year. The most significant increase in price is likely to take place after 2004 when it is anticipated that new mine capacity will be insufficient to fill the void left by the declining capacity at existing mines and to keep pace with the steadily increasing demand for lead. Use of primary smelter capacity will continue to rise during the 10-year period from 70% in 1998 to about 85% in 2008 (Platt's Metals Week, 1999).

Consumption of lead in the industrialized nations will likely grow only marginally in 1999, but growth will begin to accelerate in 2000, leading to a return to a 2% to 3% growth per year between 2001 and 2003. Lead-acid battery demand, dominated by automotive-type replacement batteries, will continue to drive consumption higher as it continues to increase its share of total consumption (CRU International Ltd., 1999, p. 1).

Worldwide production of secondary lead is forecast to increase modestly through 2000, despite the continuation of low lead prices. The pool of potential lead scrap feed for the secondary smelters worldwide will continue to expand during this period, likely easing some of the operating difficulties experienced by the smelters in 1998 that were associated with low lead prices and the high cost and shortage of available lead scrap (SG Global Research, 1998).

Mine production in the United States should increase by about 2% to 3% per year through 2000 as a result of continued higher production at some of the larger facilities and the resumption of mining at a few currently closed operations that have undergone new ownership in recent years. Total metal production from primary and secondary refineries is expected to increase by about 2% in 1999.

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TABLE 1
SALIENT LEAD STATISTICS 1/

(Metric tons, unless otherwise specified)

		1994	1995	1996	1997	1998
United States:						
Production:						
Mine, recoverable lead content 2/		363,000	386,000	426,000	448,000	481,000
Value	thousands	$298,000	$359,000	$459,000	$460,000	$480,000
Primary lead (refined):						
Domestic ores and base bullion		351,000 3/	374,000 3/	326,000 3/	343,000 3/	337,000
Foreign ores and base bullion		23,400	W	W	W	W
Secondary lead (lead content)		931,000	1,020,000	1,070,000	1,110,000	1,120,000
Exports (lead content):						
Lead ore and concentrates		38,700	65,500	59,700	42,200	72,400
Lead materials, excluding scrap		74,200	65,300	121,000	104,000	100,000
Imports for consumption:						
Lead in ore and concentrates		473	2,600	6,570	17,800	32,700
Lead in base bullion		577	31	5	25	464
Lead in pigs, bars, and reclaimed scrap		231,000	264,000	268,000	265,000	267,000
Stocks, December 31:						
Primary lead		9,270 3/	14,200 3/	8,140 3/	11,900 3/	10,900
At consumers and secondary smelters		68,800	79,400	72,100	89,100 r/	77,300
Consumption of metal, primary and secondary		1,450,000	1,560,000	1,540,000	1,620,000 r/	1,630,000
Price: North American Producer average, delivered, cents per pound 4/		37.17	42.28	48.83	46.54	45.27
World:						
Production:						
Mine	thousand metric tons	2,790	2,820	3,110 r/	3,140 r/	3,100 e/
Refinery 5/	do.	2,840 r/	2,800 r/	2,780 r/	2,910 r/	2,820 e/
Secondary refinery	do.	2,340 r/	2,660 r/	2,720 r/	2,790 r/	2,930 e/
Price: London Metal Exchange, pure lead, cash average, cents per pound 4/		24.83	28.60 r/	35.10 r/	28.29	23.96

e/ Estimated. r/ Revised. W Withheld to avoid disclosing company proprietary data; included with "Domestic ores and base bullion."

1/ Data are rounded to three significant digits, except prices.

2/ Lead recoverable after smelting and refining. Number in table 14 represents lead in concentrate.

3/ American Bureau of Metal Statistics Inc.

4/ Platt's Metals Week.

5/ Primary metal production only; includes secondary metal production, where inseparable.

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

(Metric tons)

State	1997	1998
Alaska and Missouri	412,000	439,000
Montana	9,230	7,310
Other States 2/	26,600	35,100
Total	448,000	481,000

1/ Data are rounded to three significant digits; may not add to totals shown.
2/ Includes Colorado, Idaho, New York, and Tennessee.

TABLE 3
LEADING LEAD-PRODUCING MINES IN
THE UNITED STATES IN 1998, IN ORDER OF OUTPUT

Rank	Mine	County and State	Operator	Source of lead
1	Red Dog	Northwest Arctic, AK	Cominco Alaska Inc.	Lead-zinc ore.
2	Casteel 1/	Iron, MO	The Doe Run Co.	Lead ore.
3	Buick	do.	do.	Do.
4	Fletcher	Reynolds, MO	do.	Do.
5	Sweetwater	do.	do.	Do.
6	West Fork	do.	do.	Do.
7	Lucky Friday	Shoshone, ID	Hecla Mining Company	Silver ore.
8	Greens Creek	Admiralty Island, AK	Kennecott Greens Creek Mining Co.	Zinc ore.
9	Viburnum #28	Iron, MO	The Doe Run Co.	Lead ore.
10	Viburnum #29	Washington, MO	do.	Do.
11	Montana Tunnels	Jefferson, MT	Pegasus Gold Corp.	Zinc ore.
12	Sunshine	Shoshone, ID	Sunshine Mining Company	Silver ore.
13	Leadville Unit	Lake, CO	ASARCO Incorporated	Lead-zinc ore.
14	Balmat	St. Lawrence, NY	Zinc Corporation of America	Zinc ore.
15	Galena	Shoshone, ID	Silver Valley Resources Corp.	Silver ore.
16	Coy	Jefferson, TN	ASARCO Incorporated	Zinc ore.
17	Pierrepont	St. Lawrence, NY	Zinc Corporation of America	Do.

1/ Includes Brushy Creek Mill.

TABLE 4
REFINED LEAD PRODUCED AT PRIMARY REFINERIES
IN THE UNITED STATES, BY SOURCE MATERIAL 1/

(Metric tons, unless otherwise specified)

Source material		1997 2/	1998 3/
Refined lead:			
Domestic ores and base bullion		343,000	337,000
Foreign ores and base bullion		W	W
Total		343,000	337,000
Calculated value of primary refined lead 4/	thousands	$352,000	$336,000

W Withheld to avoid disclosing company proprietary data; included with "Domestic ores and base bullion."
1/ Data are rounded to three significant digits; may not add to totals shown.
2/ Total refined lead, American Bureau of Metal Statistics Inc.; foreign ores and base bullion, U.S. Geological Survey (USGS) calculations.
3/ USGS data.
4/ Value based on average quoted price.

TABLE 5
LEAD RECOVERED FROM SCRAP PROCESSED IN THE UNITED STATES,
BY KIND OF SCRAP AND FORM OF RECOVERY 1/

(Metric tons)

		1997	1998
Kind of scrap:			
New scrap:			
Lead-base		54,000	45,800
Copper-base		9,650	9,440
Tin-base		--	--
Total		63,700	55,200
Old scrap:			
Battery-lead		991,000	1,010,000
All other lead-base		43,100	46,600
Copper-base		7,840	7,360
Tin-base		--	--
Total		1,040,000	1,060,000
Grand total		1,110,000	1,120,000
Form of recovery:			
As soft lead		663,000	667,000
In antimonial lead		411,000	417,000
In other lead alloys		14,200	16,100
In copper-base alloys		17,500	16,800
Total		1,110,000	1,120,000
Value 2/	thousands	$1,130,000	$1,110,000

1/ Data are rounded to three significant digits; may not add to totals shown.
2/ Value based on average quoted price of common lead.

TABLE 6
U.S. CONSUMPTION OF LEAD, BY PRODUCT 1/

(Metric tons)

SIC code	Product	1997	1998
	Metal products:		
3482	Ammunition, shot and bullets	52,400 r/	52,800
	Bearing metals:		
35	Machinery except electrical	W	W
36	Electrical and electronic equipment	W	W
371	Motor vehicles and equipment 2/	1,850	1,700
37	Other transportation equipment	W	W
	Total	2,490	2,210
3351	Brass and bronze, billets and ingots	4,410	3,460
36	Cable covering, power and communication	4,930	4,630
15	Calking lead, building construction	1,390	1,350
	Casting metals:		
36	Electrical machinery and equipment	W	W
371	Motor vehicles and equipment	W	W
37	Other transportation equipment	4,240	3,420
3443	Nuclear radiation shielding	1,750	1,570
	Total	34,000 r/	32,600
	Pipes, traps, other extruded products:		
15	Building construction	1,860	3,130
3443	Storage tanks, process vessels, etc.	(3/)	(3/)
	Total	1,860	3,130
	Sheet lead:		
15	Building construction	14,000	11,700
3443	Storage tanks, process vessels, etc.	(3/)	(3/)
3693	Medical radiation shielding	5,020	3,860
	Total	19,100	15,500
	Solder:		
15	Building construction	1,890	1,700
	Motor vehicles, equipment, metal cans and shipping containers	W	W
367	Electronic components and accessories	1,890	3,180
36	Other electrical machinery and equipment	W	W
	Total	9,580	10,900
	Storage batteries:		
3691	Storage battery grids, post, etc.	634,000	685,000
3691	Storage battery oxides	761,000	744,000
	Total	1,390,000	1,430,000
371	Terne metal, motor vehicles and equipment	(4/)	(4/)
27	Type metal, printing and allied industries	(5/)	(5/)
34	Other metal products 6/	7,570	8,150
	Total	1,530,000 r/	1,560,000
	Other oxides:		
285	Paint	W	W
32	Glass and ceramics products	W	W
28	Other pigments and chemicals	10,600	W
	Total	67,000	53,400
	Miscellaneous uses	24,400 r/	15,500
	Grand total	1,620,000 r/	1,630,000

r/ Revised. W Withheld to avoid disclosing company proprietary data; included in appropriate totals.
1/ Data are rounded to three significant digits; may not add to totals shown.
2/ Includes "Terne metal, motor vehicles and equipment."
3/ Included with "Building construction" to avoid disclosing company proprietary data.
4/ Included with "Bearing metals, motor vehicles and equipment."
5/ Included with "Other metal products" to avoid disclosing company proprietary data.
6/ Includes lead consumed in foil, collapsible tubes, annealing, galvanizing, plating, electrowinning, and fishing weights.

TABLE 7
U.S. CONSUMPTION OF LEAD IN 1998, BY STATE 1/ 2/

(Metric tons)

State	Refined soft lead	Lead in antimonial lead	Lead in alloys	Lead in copper-base scrap	Total
California, Oregon, Washington	18,100	24,400	1,760	--	44,200
Florida and Georgia	5,620	4,970	7,700	--	18,300
Illinois	14,600	27,800	11,100	--	53,400
Iowa, Michigan, Missouri	50,400	42,700	24,300	--	117,000
Ohio and Pennsylvania	93,000	45,700	63,700	1,230	204,000
Arkansas and Texas	44,600	16,600	8,940	--	70,200
Alabama, Louisiana, Mississippi, Oklahoma	5,300	1,110	--	--	6,420
Colorado, Indiana, Kansas, Kentucky, Minnesota, Nebraska, Tennessee, Wisconsin	384,000	96,300	72,700	463	554,000
Connecticut, Delaware, Maine, Maryland, Massachusetts, Montana, New Hampshire, New Jersey, New York, North Carolina, Rhode Island, South Carolina, Vermont	51,800	19,800	19,900	--	91,500
Various States	259,000	149,000	65,700	--	474,000
Total	927,000	428,000	276,000	1,690	1,630,000

1/ Data are rounded to three significant digits; may not add to totals shown.
2/ Includes lead that went directly from scrap to fabricated products.

TABLE 8
U.S. CONSUMPTION OF LEAD IN 1998, BY CLASS OF PRODUCT 1/ 2/

(Metric tons)

Product	Soft lead	Lead in antimonial lead	Lead in alloys	Lead in copper-base scrap	Total
Metal products	44,300	82,800	9,440	1,690	138,000
Storage batteries	821,000	345,000	262,000	--	1,430,000
Other oxides	W	--	--	--	W
Miscellaneous	61,300	333	3,790	--	65,500
Total	927,000	428,000	276,000	1,690	1,630,000

W Withheld to avoid disclosing company proprietary data; included in "Miscellaneous."
1/ Data are rounded to three significant digits; may not add to totals shown.
2/ Includes lead that went directly from scrap to fabricated products.

TABLE 9
STOCKS OF LEAD AT CONSUMERS AND SECONDARY SMELTERS
IN THE UNITED STATES, DECEMBER 31 1/

(Metric tons, lead content)

Year	Refined soft lead	Lead in antimonial lead	Lead in alloys	Lead in copper-base scrap	Total
1997	48,800 r/	30,100	10,000 r/	111	89,100 r/
1998	31,700	36,200	9,260	116	77,300

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

TABLE 10
PRODUCTION AND SHIPMENTS OF LEAD PIGMENTS AND OXIDES IN THE UNITED STATES 1/ 2/

(Metric tons unless otherwise specified)

	1997				1998			
	Production		Shipments		Production		Shipments	
Product	Gross weight	Lead content	Quantity	Value 3/	Gross weight	Lead content	Quantity	Value 3/
Litharge, red lead and white lead, dry	1,910	1,570	22,600	$22,200,000	1,830	1,520	18,700	$15,900,000
Leady oxide	712,000	677,000	NA	NA	736,000	699,000	NA	NA
Total	714,000	678,000	NA	NA	738,000	701,000	NA	NA

NA Not available.

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

2/ Excludes basic lead sulfate to avoid disclosing company proprietary data.

3/ At plant, exclusive of container.

TABLE 11
U.S. IMPORTS FOR CONSUMPTION OF LEAD PIGMENTS AND COMPOUNDS, BY KIND 1/

Kind	Quantity (metric tons)	Value (thousands)
1997:		
White lead carbonate	(2/)	3
Red and orange lead	30	193
Chrome yellow and molybdenum orange pigments and lead-zinc chromates	8,880	26,600
Litharge	17,300	13,600
Leady litharge	23	22
Glass frits (undifferentiated)	15,500	19,600
Total	41,800	60,100
1998:		
White lead carbonate	5	38
Red and orange lead	35	248
Chrome yellow and molybdenum orange pigments and lead-zinc chromates	8,610	26,600
Litharge	17,400	11,600
Leady litharge	--	--
Glass frits (undifferentiated)	14,500	19,900
Total	40,600	58,300

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

2/ Less than 1/2 unit.

Source: Bureau of the Census.

TABLE 12
U.S. EXPORTS OF LEAD, BY COUNTRY 1/

(Lead content, unless otherwise specified)

Country	1997 Quantity (metric tons)	1997 Value (thousands)	1998 Quantity (metric tons)	1998 Value (thousands)
Ore and concentrates:				
Belgium	25,900	$10,000	17,400	$3,820
Canada	5,810	2,380	5,300	3,150
China	--	--	5,770	2,130
Italy	--	--	2,020	1,190
Japan	9,720	3,840	18,500	4,340
Mexico	9	3	15,600	10,600
Netherlands	108	63	5,770	1,260
United Kingdom	561	259	2,050	1,100
Other	139 r/	62 r/	34	20
Total	42,200	16,600	72,400	27,600
Ash and residues:				
Belgium	7,770	3,310	4,650	701
Canada	8,850	4,180	2,910	5,130
Sweden	--	--	619	693
United Arab Emirates	192	85	789	278
Other	15	29	69	66
Total	16,800	7,600	9,030	6,870
Base bullion:				
Belgium	113	702	--	--
Canada	24,300	76,400	12,900	34,300
Mexico	9,620	10,800	38,600	43,400
Other	--	--	26	26
Total	34,100	87,900	51,600	77,800
Unwrought lead and lead alloys:				
Belgium	2,420	6,030	--	--
Brazil	23	30	161	183
Canada	9,190	6,730	10,100	6,920
Costa Rica	34	80	29	377
Germany	19	264	54	147
Hong Kong	5	14	86	84
Israel	830	681	909	729
Japan	910	609	545	1,270
Korea, Republic of	9,400	7,120	8,960	6,550
Malaysia	5,430	3,430	--	3
Mexico	301	653	282	296
Singapore	12	39	115	337
Taiwan	2,170	1,670	2,140	2,640
Thailand	41	33	--	--
United Arab Emirates	17	22	63	266
United Kingdom	6,460	4,390	561	133
Other	182 r/	327 r/	128	649
Total	37,400	32,100	24,100	20,600
Wrought lead and lead alloys:				
Australia	58	360	8	148
Belgium	189	202	170	740
Brazil	645	1,030	452	483
Canada	3,110	4,130	5,650	4,600
Chile	167	810	210	1,120
China	39	336	103	319
Costa Rica	33	54	42	70
Dominican Republic	2,470	1,740	11	108
Ecuador	37	48	34	28
France	55	355	28	187
Germany	5	357	45	676
Hong Kong	1,670	3,770	490	2,010
India	472	559	3	173
Japan	225	620	79	493
Korea, Republic of	314	1,060	58	312

See footnotes at end of table.

TABLE 12--Continued
U.S. EXPORTS OF LEAD, BY COUNTRY 1/

(Lead content, unless otherwise specified)

Country	1997 Quantity (metric tons)	1997 Value (thousands)	1998 Quantity (metric tons)	1998 Value (thousands)
Wrought lead and lead alloys continued:				
Kuwait	107	1,880	73	930
Malaysia	108	363	165	1,010
Mexico	2,290	10,700	3,240	12,100
Netherlands	129	$412	64	$233
New Zealand	43	140	16	53
Nicaragua	113	140	--	--
Panama	57	210	3	15
Saudi Arabia	448	8,810	901	7,220
Singapore	1,180	1,800	2,330	2,980
Sweden	42	716	--	28
Taiwan	139	1,640	65	503
Turkey	43	49	3	4
United Arab Emirates	42	376	57	448
United Kingdom	1,350	1,540	256	537
Other	303 r/	1,770 r/	856	3,830
Total	15,900	45,800	15,400	41,300
Scrap (gross weight):				
Brazil	21	211	38	24
Canada	83,900	12,200	92,900	15,100
China	163	99	1,960	738
El Salvador	108	24	214	60
France	9	138	31	301
Guatemala	2	26	147	46
Germany	29	209	101	154
Hong Kong	884	289	749	322
India	552	285	717	619
Japan	25	66	457	757
Korea, Republic of	1,160	746	313	380
Mexico	14	60	340	103
Philippines	93	87	33	104
Singapore	33	125	4	65
Taiwan	147	173	549	456
Thailand	26	170	85	19
United Arab Emirates	384	256	6	5
United Kingdom	2	38	74	105
Venezuela	353	100	154	59
Other	569 r/	300 r/	328	406
Total	88,400	15,600	99,200	19,900

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

Source: Bureau of the Census.

TABLE 13
U.S. IMPORTS FOR CONSUMPTION OF LEAD, BY COUNTRY 1/

(Lead content, unless otherwise specified)

Country	1997 Quantity (metric tons)	1997 Value (thousands)	1998 Quantity (metric tons)	1998 Value (thousands)
Ore and concentrates (lead content): 2/				
Argentina	--	--	2,390	$581
Australia	6,670	$2,280	2,240	770
Canada	753	679	6,540	1,300
Mexico	558	385	--	--
Peru	3,370	1,190	18,500	3,210
South Africa	4,550	1,570	2,630	585
Tunisia	1,910	716	--	--
Other	16	15	409	105
Total	17,800	6,830	32,700	6,560
Base bullion (lead content):				
Dominican Republic	--	--	464	293
Mexico	5	3	--	--
Other	20	13	--	--
Total	25	16	464	293
Pigs and bars (lead content):				
Belgium	47	126	30	24
Canada	187,000	131,000	181,000	119,000
China	--	--	8,010	6,420
Colombia	238	123	1,260	525
Germany	401	618	135	63
India	766	374	--	--
Mexico	70,400	42,000	63,600	32,400
Peru	6,420	4,100	11,400	6,460
United Arab Emirates	72	223	59	242
Other	94	76 r/	808	461
Total	265,000	179,000	267,000	166,000
Reclaimed scrap, including ash and residues (lead content): 3/				
Canada	48	8	(4/)	3
Mexico	20	5	--	--
Other	--	--	--	--
Total	68	13	(4/)	3
Grand total	283,000	186,000	300,000	173,000
Wrought lead, all forms, including wire and powders (gross weight):				
Argentina	63	116	--	--
Canada	2,440	3,870	2,330	4,060
China	119	696	442	1,450
Colombia	61	33	41	24
Dominican Republic	161	106	--	--
El Salvador	676	482	1,150	776
France	372	1,010	238	687
Germany	305	1,470	415	2,260
Hong Kong	159	483	206	554
India	556	272	16	28
Italy	7	19	87	158
Japan	33	389	24	322
Malaysia	61	297	10	45
Mexico	1,150	1,400	1,350	1,480
Netherlands	95	297	337	1,690
New Zealand	60	640	72	736
Peru	20	16	200	160
Philippines	281	186	264	710
Taiwan	365	1,070	710	1,720
United Kingdom	230	984	479	1,450
Other	52 r/	506 r/	112	660
Total	7,310	14,400	8,480	19,000

See footnotes at end of table.

TABLE 13--Continued
U.S. IMPORTS FOR CONSUMPTION OF LEAD, BY COUNTRY 1/

r/ Revised.
1/ Data are rounded to three significant digits; may not add to totals shown.
2/ Also includes other lead-bearing materials containing more than 5 troy ounces per short ton of gold or more than 100 troy ounces per short ton of total precious metals.
3/ Also includes other lead-bearing materials containing more than 10% by weight of copper, lead, or zinc (any one).
4/ Less than 1/2 unit.

Source: Bureau of the Census.

TABLE 14
LEAD: WORLD MINE PRODUCTION OF LEAD IN CONCENTRATES, BY COUNTRY 1/ 2/

(Metric tons)

Country	1994	1995	1996	1997	1998 e/
Algeria	1,100	1,383	1,016	1,000 e/	1,000
Argentina	9,981	10,521	11,272	13,760 r/	15,004 p/
Australia	537,000	455,000	522,000	531,000	618,000 3/
Bolivia	19,679	20,387	16,538	18,608 r/	13,847 3/
Bosnia and Herzegovina e/	200	200	200	200	200
Brazil	1,329	11,611	13,157 r/	14,258 r/	14,300
Bulgaria e/	32,000	33,000	28,000	28,000	25,000
Burma e/	2,300	2,400	2,200	1,900 r/	2,200
Canada	167,584	210,826	257,253	186,234 r/	189,305 3/
Chile	1,008	944	1,374	1,264 r/	337 3/
China e/	462,000	520,000	643,000	712,000 r/	556,000
Colombia e/	290 3/	300	300	300	300
Czech Republic e/	500	--	--	--	--
Ecuador e/	200	200	200	200	200
Georgia e/	400	300	200	200	200
Greece	28,404	20,400	8,400	19,300	18,000
Honduras	2,810	2,619	4,700 r/	5,900 r/	4,900 3/
India	30,500	34,000	35,000	32,000	39,300 3/
Iran 4/	18,300	15,900	15,700 e/	18,200 r/	18,200
Ireland	53,700	69,067	45,344	45,149	46,000
Italy	13,902	13,600	11,100	11,792 r/ 3/	10,000
Japan	9,946	9,659	7,753	5,227	6,198 3/
Kazakhstan	57,000	40,000	35,000 e/	31,000 r/ e/	30,000 3/
Kenya	350	4	5 r/ e/	5 r/ e/	--
Korea, North e/	80,000	80,000	80,000	80,000	80,000
Korea, Republic of	2,173	4,064	5,131	3,632	3,500
Macedonia e/	15,000	15,000	15,000	15,000	15,000
Mexico	170,322	164,348	173,831	174,661	175,000
Morocco	73,164	67,708	71,667	77,056	76,300 3/
Namibia	13,917	16,084	15,349 r/	13,577 r/	5,000
Norway	3,096	1,462	2,083	3,000 e/	3,000
Peru	233,510	237,597	248,787	258,188 r/	259,710 3/
Poland	54,700	58,100	58,700	59,000 e/	60,000
Romania	23,838	23,194	18,712	19,000 e/	20,000
Russia	25,000	23,000	18,000	19,500 e/	18,500
Serbia and Montenegro	2,667	3,342	10,000 r/	11,000 r/	12,000
Slovakia e/	1,800	1,800	1,000	1,000	1,000
South Africa	95,824	88,449	88,613	83,114 r/	84,000
Spain	23,753	30,077	23,826	23,900	24,000
Sweden	112,787	100,070	136,200	146,000 r/	140,000
Tajikistan e/	1,200	1,000	800	800	800
Thailand	7,950	9,680	21,000	5,280 r/	6,000
Tunisia	2,856	6,601	4,764	1,424	4,274 3/
Turkey	11,158	10,376	10,971 r/	12,000 r/ e/	12,000
United Kingdom e/	2,000 3/	1,600	1,800	1,800	1,600
United States	370,000	394,000	436,000	459,000	493,000 3/
Uzbekistan e/	15,000	10,000	10,000	-- r/ 5/	-- 5/
Total	2,790,000	2,820,000	3,110,000 r/	3,140,000 r/	3,100,000

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

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

2/ Table includes data available through July 1, 1999.

3/ Reported figure.

4/ Year beginning March 21 of that stated.

5/ Mining operations appear to have been sharply curtailed or to have ceased.

TABLE 15
LEAD: WORLD REFINERY PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons, gross weight)

Country	1994	1995	1996	1997	1998 e/
Algeria:					
Primary e/	1,000	800	900	900	1,000
Secondary	6,000 r/	7,500 r/	7,700	6,100 r/	7,100 3/
Total	7,000 r/	8,300 r/	8,600	7,000 r/	8,100
Argentina:					
Primary	7,785	2,430	396	3,282 r/	300
Secondary	17,600 e/	26,298	27,705	28,834 r/	30,057 p/
Total	25,385	28,728	28,101	32,116 r/	30,357 p/
Australia:					
Primary	212,000	215,000	204,000	204,000	175,000
Secondary	25,000	26,000	24,000	34,000	30,000
Total	237,000	241,000	228,000	238,000	205,000
Austria:					
Primary e/	410 3/	--	--	--	--
Secondary	17,165	21,919	22,000 e/	22,000 e/	22,000
Total	17,575	21,919	22,000 e/	22,000 e/	22,000
Belgium:					
Primary	97,200	95,300 e/	94,400 e/	84,400	93,000
Secondary	26,300	26,400 e/	31,000 e/	26,400	27,000
Total	123,500	122,000 e/	125,000 e/	110,800	120,000
Brazil:					
Primary	24,000	13,958	--	--	--
Secondary	60,000	65,000	45,000 r/	44,500 r/	45,000
Total	84,000	78,958	45,000 r/	44,500 r/	45,000
Bulgaria:					
Primary e/	51,950	62,150	64,670 r/	62,580 r/	60,000
Secondary e/	10,000	10,000	10,000	10,000	10,000
Total	61,950	72,150	74,670 r/	72,580 r/	70,000
Burma: Primary	1,797	1,753	1,984	1,760 r/	1,936 3/
Canada:					
Primary	153,035	178,019	194,031	139,736 r/	140,585 3/
Secondary	98,605	103,372	115,348	131,659 r/	124,441 3/
Total	251,640	281,391	309,379	271,395 r/	265,026 3/
China: e/					
Primary	408,000	432,000	562,000	584,000 r/	600,000
Secondary	59,900	176,000	144,000	123,000 r/	133,000
Total	467,900	608,000	706,000	707,000 r/	733,000
Colombia: Secondary	3,500 e/	8,000 r/	10,000 r/	10,000 r/	12,000 3/
Czech Republic: Secondary e/	15,000	15,000	15,000	15,000	15,000
France:					
Primary	105,346 r/	128,708 r/	140,750	131,480 r/	91,000
Secondary	155,200 r/	168,000 r/	162,000 r/	170,820 r/	215,000
Total	260,546 r/	296,708 r/	302,750 r/	302,300 r/	306,000
Germany:					
Primary	189,435	146,750	88,700	164,800 r/	140,400
Secondary	142,249	164,400	149,400	164,400 r/	194,400
Total	331,684	311,150	238,100	329,200 r/	335,000
Hungary: Secondary e/	100	--	--	--	--
India: e/					
Primary	60,000	62,000	67,000	69,000	70,000
Secondary	21,700	28,000	27,000	24,000	25,000
Total	81,700	90,000	94,000	93,000	95,000
Iran:					
Primary e/	10,100	4,000	7,000 r/	8,500 r/	9,000
Secondary	30,000 r/	30,000 r/	23,000 r/	23,000 r/	43,300 3/
Total	40,100 r/	34,000 r/	30,000 r/	31,500 r/	52,300
Ireland: Secondary e/	10,000	10,400	10,000	10,000	8,000
Italy:					
Primary	91,700	84,900	65,900 r/	65,700 r/	71,000
Secondary	114,200	95,500	143,900 r/	145,900 r/	177,000
Total	205,900	180,400	209,800	211,600 r/	248,000

See footnotes at end of table.

TABLE 15--Continued
LEAD: WORLD REFINERY PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons, gross weight)

Country	1994	1995	1996	1997	1998 e/
Jamaica: Secondary e/	800	800	800	800	800
Japan:					
Primary	181,707	148,117	140,531	142,326	144,542 3/
Secondary	110,512	139,461	146,842	154,438 r/	157,503 3/
Total	292,219	287,578	287,373	296,764 r/	302,045 3/
Kazakhstan: Primary and secondary	137,700 r/	88,500 r/	70,000 r/ e/	76,000 r/ e/	90,000
Korea, North: e/					
Primary	75,000	75,000	75,000	75,000	75,000
Secondary	5,000	5,000	5,000	5,000	5,000
Total	80,000	80,000	80,000	80,000	80,000
Korea, Republic of:					
Primary	86,457	129,744	88,556	121,296	120,000
Secondary e/	10,000	10,000	10,000	10,000	10,000
Total e/	96,500	140,000	98,600	131,000	130,000
Macedonia:					
Primary	28,464	28,000	28,000	25,000 e/	20,000
Secondary e/	2,000	2,000	2,000	2,000	5,000
Total e/	30,500	30,000	30,000	27,000	25,000
Malaysia: Secondary e/	33,200	33,600	36,000	42,000 r/	35,000 3/
Mexico:					
Primary 4/	160,734	165,868	150,395	168,164	160,000
Secondary e/	10,000	10,000	10,000	10,000	10,000
Total e/	171,000	176,000	160,000	178,000	170,000
Morocco:					
Primary	60,740	60,363	59,749	64,202	69,500
Secondary	3,100 r/	2,600 r/	3,100 r/	3,000 r/	3,800 3/
Total	63,840 r/	62,963 r/	62,849 r/	67,202 r/	73,300
Namibia: Primary 5/	23,813	26,752	8,588	1,242 r/	--
Netherlands: Secondary	25,000	25,000	22,000 r/	19,500 r/	13,200 3/
New Zealand: Secondary e/	6,000	6,000	6,000	6,000	6,000
Pakistan: Secondary e/	3,000	2,500	2,000	2,000	2,000
Peru:					
Primary	88,071	89,606 r/	94,827 r/	97,882 r/	109,493 3/
Secondary	-- r/	--	--	--	--
Total	88,071 r/	89,606 r/	94,827 r/	97,882 r/	109,493 3/
Philippines: Secondary e/	17,200 3/	17,200	17,200	17,000	17,000
Poland:					
Primary e/	46,300	51,400	51,000	50,000	50,000
Secondary e/	15,000	15,000	15,000	15,000	15,000
Total	61,300	66,400	66,000	65,000 e/	65,000
Portugal: Secondary e/	12,000	7,700 r/	5,900 r/	6,000 r/	6,000
Romania:					
Primary	10,000	14,000	16,000	20,000 e/	20,000
Secondary e/	5,000	4,000	3,000	5,000	5,000
Total e/	15,000	18,000	19,000	25,000	25,000
Russia: Primary and secondary e/	34,000	30,000	30,000	52,000	50,000
Serbia and Montenegro: Primary	4,458	11,468	30,317	23,632	26,000
Slovenia: e/					
Primary	1,000	--	--	--	--
Secondary	5,424 3/	7,425 3/	7,000	7,000	7,000
Total	6,424 3/	7,425 3/	7,000	7,000	7,000
South Africa: Secondary	31,900	32,100	32,200 r/	41,500 r/	50,000
Spain: e/					
Primary	70,400	--	--	--	--
Secondary	69,600	80,000	86,000	74,900 r/	87,000
Total	140,000	80,000	86,000	74,900 r/	87,000
Sweden:					
Primary	46,600	39,700	42,200 r/	34,700 r/	40,600
Secondary	36,000	51,500	41,900 r/	51,500 r/	52,000
Total	82,600	91,200	84,100 r/	86,200 r/	92,600

See footnotes at end of table.

TABLE 15--Continued
LEAD: WORLD REFINERY PRODUCTION, BY COUNTRY 1/ 2/

(Metric tons, gross weight)

Country	1994	1995	1996	1997	1998 e/
Switzerland: Secondary e/	6,350 3/	6,400	6,200 r/	6,000	7,600
Thailand: Secondary	11,953 r/	11,150 r/	12,789 r/	15,000 r/	12,000
Trinidad and Tobago: Secondary e/	1,600	1,600	1,600	1,600	1,600
Turkey: e/					
Primary	4,000	4,000	4,000	7,000 r/	7,000
Secondary	2,100	2,000	2,000 r/	2,000 r/	2,000
Total	6,100	6,000	6,000 r/	9,000 r/	9,000
Ukraine: Secondary e/	9,000	10,000 r/	21,000	11,000 r/	9,000
United Kingdom:					
Primary	191,036	149,706	168,108	215,243	185,000
Secondary	161,430	170,998	177,466	175,783	165,000
Total	352,466	320,704	345,574	391,026	350,000
United States:					
Primary	351,000	374,000	326,000	343,000	337,000 3/
Secondary	931,000	1,020,000	1,070,000	1,110,000	1,120,000 3/
Total	1,280,000	1,390,000	1,400,000	1,450,000	1,450,000 3/
Venezuela: Secondary e/	15,000 3/	16,000	16,000	16,000	16,000
Grand total:	5,360,000 r/	5,580,000 r/	5,590,000 r/	5,820,000 r/	5,880,000
Of which:					
Primary	2,840,000 r/	2,800,000 r/	2,780,000 r/	2,910,000 r/	2,820,000
Secondary	2,340,000 r/	2,660,000 r/	2,720,000 r/	2,790,000 r/	2,930,000
Undifferentiated	172,000	119,000	100,000	128,000	140,000

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

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

2/ Table includes data available through July 2, 1999. Data included represent the total output of refined lead by each country, whether derived from ores and concentrates (primary) or scrap (secondary), and include the lead content of antimonial lead but exclude, to the extent possible, simple remelting of scrap.

3/ Reported figure.

4/ Includes lead content in antimonial lead.

5/ Includes products of imported concentrate.