

Minerals Yearbook

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Lead

By Donald E. Moulds

World production and consumption of lead increased to record levels in 1970. But although free world mine production increased about 5 percent, mainly in Canada and the United States, and metal production increased about 2 percent, the increase in metal consumption was modest and failed to use all of the available new supply. As production increases continued and a slackening of general business activity began to affect consumer purchasing, the market underwent a sharp reversal from the one of short supply that persisted through most of 1969 and into the first half of 1970. Free world producer stocks, which had trended upward from a low of 152,000 tons at the end of September 1969 to 185,000 tons at the start of 1970, increased rapidly, except in September and October, to 303,000 tons at yearend. A downward pressure on world price began in April 1970. The trend thereafter continued with a resultant drop of 2.4 cents per pound (U.S. equivalent) in the London Metal Market monthly average price from the December 1969 high to December 1970.

The domestic lead industry again achieved major production increases in spite of difficulties in marketing lead during the second half of the year. Mine production increased 12 percent to 571,800 tons, mainly due to larger output from the new Missouri mines despite production curtailments at some mines in the second half of the year to reduce inventories. The production of 678,000 tons of primary lead was the largest output since 1929, and domestic mines contributed 84 percent of the primary lead metal. Secondary lead output of 597,000 tons was second only to the record 1969 output. The domestic supply of lead—primary, secondary, and imports—amounted to 1.52 million tons, 21,000 above that of 1969.

The demand for lead declined in essentially all uses except transportation where

battery and increased about prior growth of lead was 28,800 tons amounted to gasoline add

The surplus dent early shipments by and, as stock month excess inventories of the year 87,100 tons too large, a Minerals Co. max Inc.

however, cost total of 97, plus situation crease in cost from 126,000 Sales from commercial accounts tons sold at offers to Government ammunition available domestic including price and change ment stocks sumption of tion to the million tons

The world the London age, declined cember 1969 to an average 1970 and 13 domestic price held at the lished on D

¹ Physical stocks.

to 15.5 cents on July 8. Three successive reductions during the second half of the year brought the price to 13.5 cents on December 21. All of the producers did not follow immediately the reductions initiated by American Smelting and Refining Co. (ASARCO), and the actual pricing was confused by the indicated quotation range during most of the second half of the year.

Legislation and Government Programs.

—The domestic small lead and zinc mine assistance program, authorized under Public Law 89-239, was terminated on December 31, 1969. Government participation in exploration, primarily for lead, had been withdrawn in June 1962. The program under the Office of Minerals Exploration, Geological Survey, U.S. Department of the Interior, continued to be active in exploration for other base-metal deposits often in association with lead and, also, in managing repayments on production from previously certified discoveries resulting from Government participation in projects authorized prior to June 1962.

Sales of Government surplus lead from the strategic stockpile to commercial users under Public Law 91-46 decreased to 22 tons from the 22,698 tons sold in 1969. Lead authorized for sale on an off-the-shelf basis to commercial users amounted to 77,290 tons at the end of 1970. Transfers for Government use under authorization of Public Law 89-9 amounted to 12,064 tons in 1970, which was used primarily at Government-owned ammunition plants. The remaining tonnage in the authorization was 28,562 at yearend. Actual depletion of the Government stocks during 1970 was 12,117 tons leaving a total inventory of 1,140,620 tons, of which 610,620 tons is in excess of the 530,000-ton stockpile objective.

In February legislation was introduced in the House and Senate to dispose of 498,000 tons of surplus lead in Govern-

ment stocks. Hearings were held, but no further action was taken.

In May, the Administration proposed a tax on lead used as a gasoline additive, which amounted to \$4.25 per pound of lead. The levy on antiknock producers would amount to 2.3 cents per gallon of fuel containing 2.5 grams of lead. The tax was designed to encourage the public to use low-lead or unleaded gasoline to curtail air pollution. The proposed legislation was tabled by the House Ways and Means Committee. All Federal vehicles were, however, ordered in late October to use unleaded or low-lead gasoline whenever practical.

The International Lead and Zinc Study Group convened in Geneva, Switzerland, for its 14th session on November 16. The Study Group sessions during November 16-20 were preceded by meetings of the various subcommittees during the period November 11-15. A review at the statistical subsessions of the member Governments indicated that the continued expansion of lead production in 1970 and 1971 was well above anticipated consumption, with an indicated supply surplus of 220,000 tons in 1970 and 150,000 tons in 1971. The Study Group also discussed liberalization of lead-zinc trade and environmental problems, especially in use of lead and the need for increased attention to marketing and use development. Special groups were designated to implement further study of the problems pointed out in the discussions.

The International Lead-Zinc Research Organization, incorporated in 1965 by producers and consumers of lead and zinc, continued to sponsor a broad program of cooperative research on a worldwide basis. The program provides a global approach to ecological problems, process and material improvements, development of new products, and additional basic information.

LEAD

Table 1.—Salient lead
(Short tons unless otherwise stated)

	1966
United States:	
Production:	
Domestic ores, recoverable lead content.....	327,368
Value.....thousands..	\$98,964
Primary lead (refined):	
From domestic ores and base bullion.....	318,646
From foreign ores and base bullion.....	122,089
Antimonial lead (primary lead content).....	11,182
Secondary lead (lead content).....	672,834
Imports, general:	
Lead in ore and matte.....	143,991
Lead in base bullion.....	2,012
Lead in pigs, bars, and old.....	293,085
Exports of lead materials excluding scrap.....	6,435
Stocks December 31 (lead content):	
At primary smelters and refineries.....	115,478
At consumer plants.....	90,306
Consumption of metal, primary and secondary.....	1,323,877
Price: New York, common lead, average, cents per pound.....	15.12
World:	
Production:	
Mine.....	8,138,779
Smelter.....	8,026,266
Price: London, common lead, average, cents per pound.....	11.87

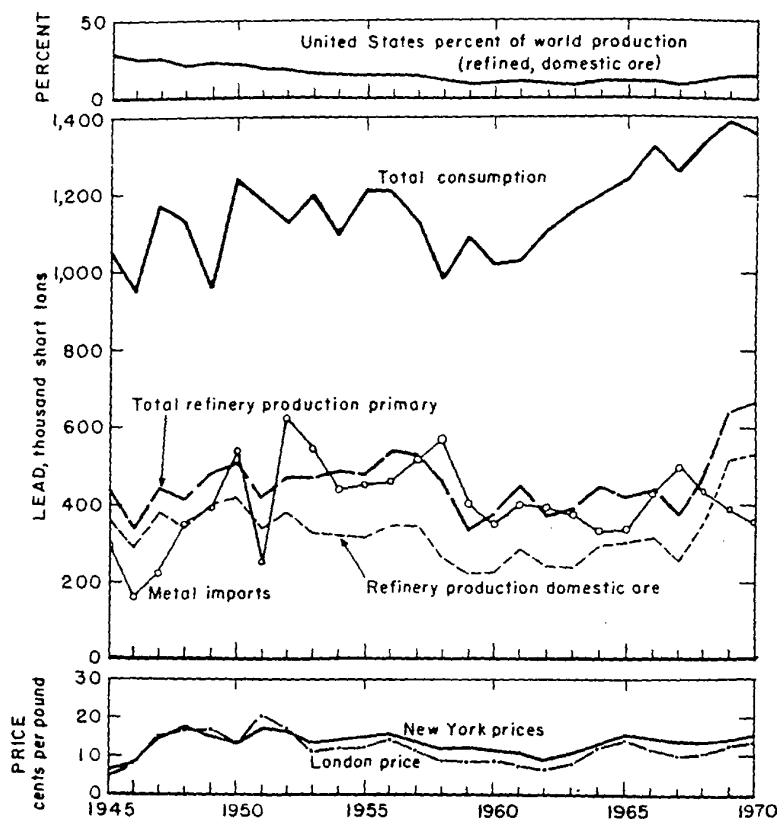


Figure 1.—Trends in the lead industry in the United States.

DOMESTIC PRODUCTION

MINE PRODUCTION

Domestic mine production of recoverable lead reached a monthly peak of 51,800 tons in March and held at a high level throughout the year. The 571,800 tons produced in 1970 was the largest total since 1929, and the 47,600-ton monthly average indicated a 12-percent increase compared with 1969. Production from Missouri mines registered a gain of 66,300 tons compared with 1969, a 19-percent increase, as uninterrupted operations continued. The 421,800 tons from Missouri represented 74 percent of total domestic lead in ore.

Idaho, the second largest producer, provided 11 percent; Utah, 8 percent; and Colorado, 4 percent. These four States combined supplied 97 percent of domestic primary lead.

The "New Lead" belt in southeastern Missouri has more than tripled Missouri's lead production during the past 5 years, even though the 1970 total was reduced. During the second half of the year, St. Joe Minerals Corp. and Missouri Lead Operating Co., a joint venture of American Metal Climax Inc. and Homestake Mining Co. curtailed production in order to reduce metal inventories. Due to a strike at

ASARCO's concentrate processing smelter that began on September 1 and continued through the remainder of the year, production at Ozark Lead Co., a subsidiary of Kennecott Copper Corp., also was reduced.

The Fletcher mine of St. Joe Minerals Corp. was the leading lead producer in 1970, and the five leading mines, all in Missouri, contributed 64 percent of the total domestic mine production. The 10 leading mines produced 86 percent, and 25 mines contributed 97 percent.

Although production was curtailed about 14 percent during the second half of the year, St. Joe Minerals Corp. produced 318,400 tons of lead concentrate and 206,300 tons of lead and lead alloy during the year, essentially all from company mines. Portions of the old Federal mines were closed during the year owing to depletion of reserves. The first phase of the new Brushy Creek development was completed, and the mine shaft was down the initial 550 feet of the planned 1,391 feet.² The plant when completed in January 1973 will be a duplicate of the efficient Fletcher mine and will cost about \$19 million.

The Ozark Lead Co. produced 66,900 tons of lead, compared with 41,200 tons in 1969. The strike at the Glover smelter necessitated the stockpiling of concentrates and reduction of mining operations during the last 4 months of the year. The total production of lead by Kennecott from both Missouri and Utah mines was 83,700.³

According to the 1970 annual report of American Metal Climax, Inc.,⁴ the first full year of production at the Missouri Lead Operating Co.'s Buick mine resulted in the mining and milling of 941,000 tons of ore from which 75,000 tons of lead concentrate was produced. Lead output was more than triple the 1969 output, although a production cutback of 10 percent was in effect during the fourth quarter.

The Magmont mine at Bixby, Mo., a joint venture of Cominco American Inc. and Dresser Industries Inc., also increased lead production by approximately 37 percent compared with 1969.

Idaho, the second largest State in output, posted a 4,400-ton reduction compared with 1969. The Page mine, which produced 3,600 tons in 1969, was closed in October of that year. Production at the Bunker Hill and Star mines increased, and

a new mining method utilizing ramps and trackless equipment was initiated at the Bunker Hill mine. Output of the Lucky Friday mine owned by the Hecla Mining Co., continued at a stable rate; however, output by Day Mines, Inc., decreased owing to the closure of the mine in July and August for mine development and repair. A great effort continued in deep and lateral development of the Coeur d'Alene mining district by ASARCO, Bunker Hill Co., Hecla Mining Co., and Day Mines, Inc.

Lead output in Utah increased slightly in 1970. The Mayflower mine of Hecla Mining Co., United Park City Mines Co., and the mines of United States Smelting Refining & Mining Co. all reported reduced lead production compared with 1969. The Tintic Division of Kennecott Copper Corp., however, approximately doubled the metal output of 1969 despite continuing adverse mining conditions and a shortage of qualified miners at the Burgin and Trixie mines. Development work at the Trixie and Ball Park areas continued, and installation of additional pumping capacity at the Burgin mine continued to lower the ground water table.⁵

ASARCO and The Anaconda Company in a joint venture with United Park City Mines Co. have agreed to spend at least \$2.5 million in the next 2 years to explore the mineral potential of this famous old Park City, Utah, silver-lead-zinc mining district.

Colorado also reported a slight increase in lead output, despite some reverses. Ore mined by the Idarado Mining Co. decreased from 403,500 tons in 1969 to 349,200 tons with a corresponding decrease in metal produced. A continuing and worsening shortage of skilled and semiskilled manpower was the major cause of the decline. In the last quarter of 1970 a sub-level stopping method was initiated in certain areas using multidrill jumbos and trackless equipment in an effort to improve productivity. Construction and development was continued throughout 1970 at the Leadville Unit, a joint venture of Newmont Mining Corp. and ASARCO at Leadville, Colo. Completion of the 700-ton-per-day plant is scheduled early in

² St. Joe Minerals Corp. Annual Report. 1970, pp. 5, 24.

³ Kennecott Copper Corp. Annual Report. 1970, p. 13.

⁴ American Metal Climax, Inc. Annual Report. 1970, p. 7.

⁵ Page 13 of work cited in footnote 3.

1971. Ore reserves are estimated at 2.4 million tons averaging 5.13 percent lead, 9.95 percent zinc, and 2.64 ounces of silver per ton.⁶ The New Jersey Zinc Co., Rico Argentine Mining Co., Homestake Mining Co., Keystone Mines Co., and Federal Resources Corp. operated mines in Colorado that supplied lead concentrates during the year.

The Van Stone mine of ASARCO at Northport, Wash., was closed in December upon exhaustion of ore reserves. The Ground Hog mine near Silver City, N. Mex., and the flotation mill at Deming, N. Mex., was reopened in 1969 by ASARCO and produced 3,174 tons of lead in concentrates during the year. Eagle-Picher Industries, Inc. closed its operations in the Tri-State area, including the Central Mill in November. The Illinois-Wisconsin operations of Eagle-Picher continued during the year, although lead output was reduced compared with 1969. The Illinois operation of Ozark-Mahoning Co. more than doubled lead output in 1970. In the eastern area, the Balmat mine of St. Joe Minerals Corp. in New York and the Virginia operation of The New Jersey Zinc Co. were the large producers of lead.

SMELTER AND REFINERY PRODUCTION

The increased availability of primary lead in domestic and foreign ores provided the base for a 4-percent increase in refined lead output, in spite of a curtailment in production of lead in concentrates at some domestic mines. St. Joe Minerals Corp., Missouri Lead Operating Co., Ozark Lead Co. and ASARCO, although that was due to a labor strike that was due to closure of the Glover smelter on September 1. The 666,700 tons of primary refined lead was the largest total since 1929 and the seventh largest in the history of the domestic industry. Over 79 percent was derived from domestic ores, compared with 80 percent in 1969. An additional 4,400 tons was refined from scrap. Production of antimonial lead was reduced for the second successive year with only 19,300 tons of lead recovered, of which 7,600 tons originated from scrap, 8,800 tons from domestic ores, and 2,800 tons from foreign ores. Of special interest was the reduction of the antimony in the antimonial lead from 8.4 percent in 1969 to 5.8 percent, thus confirming the industrial trend of using

less antimony in batteries and other antimonial lead uses.

The Herculaneum smelter of St. Joe Minerals Corp. produced 196,600 tons of lead metal and alloys from 318,420 tons of lead concentrates produced from company mines and 52 tons of purchased raw materials. Output was 12 percent below the 1969 total because of scheduled production reductions. A wide variety of technical and equipment improvements were made during the year to improve the efficiency and environmental aspects of smelter operation.⁷

The Missouri Lead Operating Co. smelter at Buick, Mo., owned jointly by Amax and Homestake Mining Co., produced 115,000 tons of refined lead, of which 50,000 tons originated at the company's mine and 65,000 tons was refined on toll for other producers.⁸

ASARCO's Glover, Mo., smelter and refinery operated until September 1 when closed by a labor stoppage which continued into 1971. The East Helena, Mont., smelter of ASARCO, one of the largest custom lead smelters, processed crude ores and concentrates coming from approximately 60 small Montana mines, as well as from mines in Canada, Idaho, Utah, Colorado, Australia, and South America. The firm's Omaha refinery processed lead bullion from the East Helena and El Paso smelters. In July ASARCO announced that its Selby, Calif., smelter-refinery would be closed after 85 years of continuous operation, and production was phased out in an orderly fashion by the end of the year. Selby produced over 3 million tons of lead, 40 million ounces of gold, and 100 million ounces of silver during its many years of operation. Extensive efforts in the environmental field were made by ASARCO at all their plants during the year to improve stack emissions and meet local air purity regulations. Production at ASARCO refineries during 1970 amounted to almost 226,000 tons of lead, compared with 207,300 tons in 1969.⁹

The Bunker Hill lead smelter-refinery of Gulf Resources & Chemical Corp. at Kellogg, Idaho, produced 123,000 tons of lead during the year; this amount was slightly below the 1969 level. The new updraft sin-

⁶ Newmont Mining Corp. Annual Report, 1970, pp. 7-9.

⁷ Pages 8-24 of work cited in footnote 2.

⁸ Page 7 of work cited in footnote 4.

⁹ The American Smelting and Refining Co. Annual Report, 1970, pp. 11-18.

ter machine for lead ores was placed in operation in the fourth quarter of the year and replaces 10 downdraft machines that had been in service for almost 50 years. The new updraft machine will improve both sinter quality and sulfur recovery from stack gases.¹⁰

International Smelting & Refining Co., a subsidiary of The Anaconda Company, processed custom lead concentrates, of which about 12,000 tons of lead came from Anaconda and 26,100 tons of lead in bullion from other mines under contract.¹¹ The lead bullion was refined by the United States Lead Refinery, Inc. in East Chicago, Ind. A relatively small tonnage of primary lead was refined by Schuylkill Metals Corp., Baton Rouge, La., primarily a secondary smelter.

Antimonial lead from primary ores and scrap was produced by ASARCO at its Omaha and Selby plants, Bunker Hill Co., St. Joe Minerals Corp., and United States Lead Refinery Inc. The total of 19,800 tons was well below the 1969 output.

Secondary lead production in 1970 decreased 1 percent to 597,400 tons, compared with the record 603,900 tons in 1969. Secondary plants and foundries contributed 585,400 tons, or 98 percent of the total. The type of material produced indicated a decreasing market for various alloys and that only 15 percent of total secondary production is required. Soft lead amounted to 27 percent and antimonial lead 58 percent of the total production.

The expansion in domestic primary lead production has decreased the secondary component of domestic supply from 53 percent in 1968 to 49 percent in 1969 and to 47 percent in 1970. Secondary lead constituted 39 percent of the domestic 1.52 million-ton new supply of lead, including metal imports but excluding all stock changes. The recycling of lead has been significant in the resource utilization area, and, with increasing ecological pressure, collection and utilization of lead scrap has maintained a high position in resource recycling.

RAW MATERIAL SOURCE

Recoverable lead in concentrates delivered by domestic mines to smelters in 1970

contributed 571,800 tons, about 83 percent of the plant production of 690,400 tons of primary refined and antimonial lead, compared with 79 percent in 1969 and 74 percent in 1968. Lead in imported concentrates smelted during the year amounted to 141,500 tons, the largest input of foreign material since 1964 and an increase of 9 percent compared with 1969. The 12,000 tons of lead recovered from lead scrap processed at primary plants was slightly above the 1969 total but constituted less than 2 percent of the total lead from primary plants. Raw material stocks at the beginning of the year at primary plants amounted to 162,400 tons, of which 58,800 tons was in process and 3,600 tons was in secondary materials. Total stocks reached a low of 155,000 tons at the end of June and a high of 179,400 tons at the end of October. At yearend, stocks of primary materials awaiting processing contained 100,200 tons of lead; material in process, 71,500 tons; and secondary materials, 2,600 tons. This makes a total of 174,300 tons of lead.

Scrap materials consumed in 1970 amounted to 786,200 tons, compared with 797,800 tons in 1969. New scrap in the form of purchased drosses and residues from a wide variety of sources amounted to 121,800 tons, 15 percent of the total feed. The remainder, old scrap, was predominantly battery scrap with small amounts of cable lead, babbitt, solder, type metal, and soft and hard lead. The scrap processed was essentially all from domestic sources. Export of scrap by the United States in 1970 amounted to 4,200 tons, compared with 2,300 tons in 1969. General import of reclaimed scrap was 6,900 tons (lead content) mainly from Australia, Canada, and Mexico. Of this amount only 3,000 tons was entered for consumption during the year. Stocks of scrap at smelters held reasonably steady during the year. A low of 67,000 tons occurred at the end of June prior to the seasonal vacation period, but the year ended at 73,300 tons, compared with 73,600 tons at the start of the year.

¹⁰ Gulf Resources & Chemical Corp. Annual Report. 1970, p. 12.

¹¹ The Anaconda Company. Annual Report. 1970, p. 6.

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CONSUMPTION AND USES

Lead requirements during the first 6 months of 1970 continued at the record levels of 1969, and the January-June total of 701,300 tons was about 1.6 percent above the 690,200 tons used in the same period in 1969. The second 6 months, however, was disappointing; only 659,300 tons was reported consumed. The total reported consumption for 1970 was therefore 1.36 million tons, a 2-percent drop from the record 1.39 million tons reported during 1969. All products except batteries and antiknock additives required lesser amounts of lead. The 10,900-ton increase in battery lead and 7,400-ton increase in antiknock additive requirements represented the only significant growth areas for lead in recent years. The growth in battery requirements was 1.9 percent, and growth in antiknock additives was 2.7 percent. However, 1970 was disappointingly below the 1969 growth of 13.4 percent for batteries and 3.5 percent for antiknock additives. The downward trend in requirements for all of the other metal products, pigments, and miscellaneous and other uses continued in varying degrees in 1970.

Requirements exceeded 100,000 tons during each month. The high occurred in March instead of the usual peak in October; as usual, the low occurred in July. The daily average of 3,728 tons was 78 tons below the record 3,806 tons in 1969. Soft refined lead represented 67 percent of the total, and hardened antimonial lead represented 28 percent. Lead in other alloys, mainly solder and bearing metals, was 4 percent. Lead in copper-base scrap, 1 percent, is recovered from old material and returned as marketable brass and bronze. About 35,200 tons of lead in scrap was recovered and used directly at foundries in end products and 1,200 tons of lead was consumed in leaded zinc oxide and other pigments.

The domestic supply of lead metal from all sources—production, imports for consumption, stock changes, and stockpile shipments—totaled 85,000 tons above the amount accounted for by reported consumption and exports. The unaccounted for supply in 1970, amounting to 6 percent of the reported consumption, compares with 108,000 tons in 1969 and annual average of 63,500 tons for the 1963-69 period. The difference in totals is presumed to be

in unreported consumption and stock buildup especially at small users and dealers who do not report to the Bureau of Mines.

Consumption of lead during the 10-year period 1961-70 has presented a shifting growth pattern. The total average annual growth of 2.9 percent resulted primarily from the large-tonnage transportation sector, which showed a growth of 5.3 percent per year for batteries and gasoline antiknock compounds. Ammunition, solder, casting metals, collapsible tubes, and foil have also shown growth during the period. The communication and construction use of lead in cable covering, type metal, calking, plumbing, and sheet have declined significantly in tonnage. In the pigment area the use of lead in decorative paints (such as white lead and colors) has declined, but in anticorrosive and highway safety use (as red lead and lead chromates) a modest growth has occurred. Lead used for ballast and weights averaged a 5.9-percent growth, mainly in shipbuilding. The use of lead in products in terms of percentage of the total in 1960 was as follows: Ammunition, 4 percent; metal products, 32 percent; batteries, 35 percent; pigments, 10 percent; chemicals including antiknocks, 16 percent; and miscellaneous, 3 percent. During 1970 the comparative percentages were as follows: Ammunition, 5 percent; metal products, 21 percent; batteries, 44 percent; pigments, 7 percent; chemicals including antiknocks, 20 percent; and miscellaneous, 3 percent.

LEAD PIGMENTS

Production of lead oxides and pigments required 386,200 tons of lead in 1970, a 2-percent increase compared with that of 1969. All of the lead used was derived from refined pig lead except for the lead in leaded zinc oxide which was derived directly from foreign and domestic ores. The requirements, for lead in making pigments, mainly white lead and red lead, decreased almost 13 percent and comprised only 7 percent of the lead consumed in this category. White lead in all products in 1970 amounted to about one-half the quantity used in 1960. Use of red lead has been slightly more stable, remaining at about the 1960 consumption level of 22,600

tons. Litharge requirements for ceramic glazes and in oil refining increased slightly. The largest use of litharge is in battery manufacture included in "Other." This category has increased from 75,700 tons in 1960 to 118,000 tons in 1970.

Shipments of white lead and red lead were again below production, indicating reduced demand for lead-base paints. Shipments of litharge were, however, 14,000 tons above production and indicated a continued drawdown of stock.

Prices.—The quoted price of lead pigments was relatively stable during the year compared with the downward trend in the price of lead which decreased 3 cents per pound during the second half of the year. The price of basic carbonate white lead was reduced on January 5 from 22.3 cents per pound to 21.5 cents per pound in carload lots, freight allowed, and continued at that price for the remainder of the year. The price of red lead, 95 percent red-lead oxide (Pb_3O_4) in carload lots, at works, was reduced on July 20 from 19.75 cents per pound to 18.75 cents and again to 17.75 cents on September 14. Commercial grade litharge, powdered, in carload lots, at works, quoted at 19 cents per pound at the beginning of 1970 was reduced to 18 cents on July 20 and remained at that level for the rest of the year.

The value of shipments of white lead, red lead, and litharge amounted to \$60.7 million, an average of \$348 per ton in 1970, compared with \$57.6 million and \$342 per ton, respectively, in 1969.

Foreign Trade.—Exports of pigment-grade lead oxides amounted to 1,516 tons valued at \$649,000, and exports of lead oxides other than pigment grade was 363 tons valued at \$303,000. Shipments were made to more than 50 countries. South Vietnam, France, Republic of South Africa, Canada, and the United Kingdom were the leading importers of pigment-grade lead oxide, accounting for 53 percent of the total. South Vietnam and West Germany together imported 64 percent of the 363 tons of nonpigment-grade oxide.

Imports for consumption of lead oxides and compounds decreased 30 percent to 22,600 tons. Value decreased 27 percent, \$2.1 million down from last year's total. The only increase was in the amount of red lead received; the major decrease was as litharge, which showed nearly a 10,300-ton drop. Import of lead alloys, while posting a significant decrease in gross weight and value, posted an increase of 169 tons in lead content. Mexico was the largest supplier with 87 percent of the tonnage, mainly as red lead and litharge. Canada, the United Kingdom, and West European countries provided essentially all of the remaining tonnage. Imports of lead nitrate amounted to 323 tons; lead acetate, 14 tons; white lead, 985 tons; lead sulfate, 120 tons; red lead, 6,909 tons; lead suboxide, 69 tons; litharge, 13,703 tons; orange mineral, 1 ton; leaded zinc oxide, 149 tons; and other lead compounds 318 tons.

STOCKS

Primary plant inventories of refined and antimonial lead at the end of 1969 totaled 25,700 tons, of which 21,300 tons was refined pig lead. Production exceeded shipments during each month of 1970 except September, and a buildup of stocks reached 97,900 tons by the end of the year. Of the total, 90,900 tons was refined pig lead. Stocks of base bullion decreased about 1,000 tons during the year, but ore and matte stocks increased about 20,000 tons. In addition to concentrate stocks at smelters, concentrate stocks were held at some Missouri mines owing to the labor

stoppage at the Glover smelter of ASARCO.

Stocks of lead in all forms at consumer and secondary smelting plants gradually increased during the year. One reporting consumer revised the stock figure in December for the period from September 1968 to December 1970. Revised inventories indicated an increase from 126,400 tons at the beginning of the year to 133,500 tons at yearend, of which 88,100 tons was located at consumers. Refined soft lead constituted 62 percent of the inventory, compared with 53 percent of the revised total in 1969.

PRICES

The high level demand for lead at the beginning of 1970 was drastically altered by the uncertainty created early in the year, resulting from environmental actions related to the use of lead in gasoline and design proposals for automotive engines to operate on lead-free or low-lead gasolines. The uncertainty was reflected in a downward drift in London Metal Exchange price from a high of 15.77 cents per pound on February 19 to 11.86 cents on December 30.

The domestic market was also affected by the general slowdown in industrial activity and accompanying reduction in consumer inventories. The expanded domestic output of refined lead thus began accumulating at producer plants in the second quarter and on July 8 ASARCO reduced

the price of common lead at New York from 16.5 cents per pound to 15.5 cents per pound. This action was followed by all domestic producers. On August 7, ASARCO initiated a price of 15 cents, which was confirmed by all producers by August 11. On September 2, ASARCO announced a price of 14.5 cents per pound. Other producers, however, did not confirm the lower price and a book price range of 14.5 to 15 cents was in effect until December 21 when ASARCO announced a price of 13.5 cents per pound. Other producers again took no public action. Most of the domestically produced lead was sold at the Metals Week average published by McGraw-Hill, and the lower ASARCO price was the top consumer bid for lead. Discounting below that average was reported for some sales.

FOREIGN TRADE

Exports of lead materials during 1970 aggregated almost 12,000 tons valued at \$5.8 million, compared with 7,300 tons valued at \$4.4 million in 1969. Exports of metal averaged slightly over 300 tons monthly for the period January-April. A large tonnage, 2,400 tons, was shipped in May, and shipments averaged 580 tons monthly during the June-December period. Unwrought lead and lead alloys amounted to 5,000 tons shipped principally to Spain, Canada, and India. Wrought lead and lead alloys amounted to 2,800 tons delivered mainly to the Netherlands, Turkey, Canada, Venezuela, and Mexico. Exports of scrap during 1970 was over 4,200 tons valued at more than \$1 million. Shipments reached a high of 1,000 tons in November, and Italy, Canada, Belgium-Luxembourg, and the United Kingdom were the principal purchasers of scrap.

Imports of lead materials continued to decrease in tonnage and totaled 364,200 tons in 1970. Owing to the higher average price however, value increased to \$99.8 million. Receipts of lead in ores was about 3,000 tons above the 1969 total, but metal receipts decreased to 244,600 tons, compared with 338,000 tons in 1968 and 278,400 tons in 1969. Essentially all of the metal was entered duty-paid for consump-

tion. Delivery of lead in ore and bullion, however, exceeded lead ore and bullion entered duty-paid for consumption by 68,900 tons, indicating a major buildup of lead ores in bond. During the supply shortage period of 1967-69, duty-paid entries of ore exceeded general deliveries by 35,200 tons, thus demonstrating the drawdown of bonded stocks accumulated, especially in 1966. Canada continued to be the leading supplier of lead in ore with 37 percent of the total, followed by Australia, Peru, and Honduras. Canada was also the leading metal supplier with 26 percent of the total, followed by Peru, 21 percent; Australia, 21 percent; Mexico, 16 percent; and Yugoslavia, 8 percent. Australia, Canada, and Mexico were also the significant suppliers of lead-bearing scrap material.

It is noteworthy that during the 1957-61 period imports for consumption averaged 186,709 tons per year of lead in ore and 279,400 tons of lead metal for an average total of 466,100 tons. The 1966-70 average was 92,600 tons of lead in ore and 302,100 tons of lead metal for a total of 394,700 tons. The decrease in lead ore imports reflects the rising availability of domestic ores for smelting and also the rising self-sufficiency of the domestic lead industry.

WORLD REVIEW

Published statistics on the world lead industry differ in reporting base, reporting source, and scope of estimating. The Bureau of Mines reports indicate the basis, insofar as possible, used for each country; Bureau reports also depend largely on Governmental information. The International Lead and Zinc Study Group reports also use Governmental data but ore-content is the base used. The American Bureau of Metal Statistics (ABMS) relies to a large extent on company and industry association sources. Therefore, free world¹² mine production of lead ranged from the Bureau of Mines total of 2.81 million tons and through the Lead and Zinc Study Group preliminary total of 2.80 million tons, to the ABMS total of 2.74 million tons. In addition, the Bureau of Mines estimated production in Communist countries, excluding Yugoslavia, at 934,000 tons, and the world total, 3.75 million tons. Smelter output of lead is reported by the Bureau of Mines as primary output, insofar as possible, whereas the Lead and Zinc Study Group reports metal output from both primary and secondary sources. Free-world smelter output in 1970 thus ranged from the Study group preliminary total of 3.64 million tons through the ABMS total of 3.0 million tons to the Bureau of Mines total of 2.72 million tons. In addition the Bureau of Mines estimated 914,000 tons of metal produced in the Communist countries, (excluding Yugoslavia), to provide a world total of 3.64 million tons of primary lead.

The United States continued to be the leader in mine production of lead, with 15 percent of the world total, followed by Australia and the U.S.S.R. Canada, Mexico, Peru, and Yugoslavia were other leading world producers with over 100,000 tons of lead in ore mined; these seven countries produced 65 percent of the world total. The increase in free world output of 5.1 percent came mainly from mines in the United States and Canada. The North America area increase amounted to 13 percent, and the 1.18 million tons represented 42 percent of the free world total and 32 percent of the estimated world total.

The United States also continued to be the leading producer of primary lead

metal as well as secondary lead. The U.S.S.R. was again in second place followed by Australia, Japan, Canada, Mexico, France, West Germany, Yugoslavia, and Belgium. These 10 countries each produced over 100,000 tons and together accounted for 72 percent of the world total. The North America area accounted for 38 percent of the free world metal output and 29 percent of the estimated world output (excluding U.S. secondary production). The increase in free world output amounting to 2 percent was mainly in the United States, Canada, France, Japan, and Australia. Secondary production in the free world was estimated at 800,000 tons, of which the United States accounted for almost 580,000 tons. This secondary output is included in the smelter output of some countries, particularly France, Japan, and West Germany.

Consumption of lead metal, including primary and secondary, as indicated by the Lead and Zinc Study Group preliminary totals for the free world, amounted to 3.5 million tons, an increase of 2.9 percent or 99,200 tons above the 1969 total. Europe and Asia accounted for the increase; Australia and North America posted a decrease. The Lead and Zinc Study Group free world comparative statistics on metal production and consumption reflect a supply surplus of 95,000 tons in 1970 and 122,000 tons in 1969. This was reflected in a rise in producer stocks of 22,000 tons in 1969 and 118,000 tons in 1970.

Argentina.—Comp  nia Minera Aguilar, S.A., a subsidiary of St. Joe Minerals Corp., completed a major expansion of mine and mill facilities and produced 46,662 tons of lead concentrates during the year, essentially at the 1969 level of output.¹³

Australia.—Sixty-two percent of the lead mined in Australia originates at Broken Hill area mines, which are operated by four major companies, and 33 percent comes from Mount Isa Mines, Ltd. The remainder comes from mines in Tasmania, 3 percent, and the remainder from several small scattered mines.

¹² As used throughout this chapter, "free world" implies all noncommunist countries plus Yugoslavia.

¹³ Page 12 of work cited in footnote 2.

Mount Isa Mines Ltd., 52.7-percent owned by ASARCO, continued to expand production. During the fiscal year ending June 28, 1970, the quantity of ore treated increased almost 20 percent. The mine achieved an 18,000-ton-per-day rate, and annual lead output reached 168,400 tons, an increase of 28 percent compared with the prior 12 months. Ore reserves were increased to 58.2 million tons of primary silver-lead-zinc ore compared with the previously reported 50.4 million tons. In addition, 134.4 million tons of 3-percent copper ore was estimated as reserves. Further expansion at Mount Isa is planned for the lead smelter, and additional refining facilities to process ore from the Hilton mine are being provided. Starting in 1976, production from the Hilton mine, is expected to bring the annual lead output from Mount Isa Mines' two properties to 313,000 tons per year. Reserves at the Hilton mine have been estimated at 39.2 million tons of silver-lead-zinc ore averaging 7.7 percent lead.¹⁴

Operations at Broken Hill area mines improved slightly during the fiscal year ending June 30 as the labor situation permitted increased working time. Production of lead from these mines with the exception of the New Broken Hill Consolidated Ltd. is smelted at the Port Pirie plant of the Broken Hill Associated Smelters Ltd.; production of metal amounted to 180,000 tons, slightly above that of previous years.

St. Joe Minerals Corp. and Phelps Dodge Corp. announced discovery of a deposit of massive sulfides with a substantial lead-zinc-silver-copper content at their joint venture in New South Wales.

Expansion at the Electrolytic Zinc Co. of Australasia Ltd. mines and mill in Tasmania was underway with the expectation of doubling production by mid-1971.

Burma.—Almost all metal production comes from mines run directly by the Government's Myanma Bawdwin Corp., whose central operation is the Bawdwin mine at Namtu, Northern Shan State. Significant production also is reportedly coming out of the Bawsaing mines and the Yadana Theingi mines in Northern Shan State. Lead concentrates produced in 1970 amounted to 16,200 tons, yielding 10,000 tons of refined and antimonial lead.

Canada.—Mine production of lead in 1970 increased over 19 percent to almost 395,000 tons; this was due mainly to the

first full year of operation by Anvil Mining Corp. Ltd. in the Yukon Territory. Reserves at the Anvil mine have been calculated at 63 million tons, averaging 3.4 percent lead and 5.7 percent zinc. The remainder of the increase came largely from expanded operations at the Heath Steele Mines, Ltd., in New Brunswick. The Anvil mine and the startup of production at Venus Mines Ltd. provided the Yukon Territory with a lead output of about 69,000 tons. Northwest Territories was the leading Canadian lead-producing area, with 110,000 tons. Pine Point Mines, Ltd., was again the leading producer in the Northwest Territories, with an increase in output comparable to that of 1969. Exploration in the Nahanni Mining District by Cadillac Explorations Ltd. reportedly indicated reserves of about 2 million tons of lead-zinc-silver ore averaging 11 percent lead and 13 percent zinc.

Cominco Ltd. operating the Sullivan mine at Kimberley and the Bluebell mine at Riondel, both in British Columbia, provided 110,200 tons of lead in concentrates during 1970. Cominco also operates the Trail smelter and refinery, treating company and custom ores from several western mines.

Brunswick Mining and Smelting Corp. Ltd. continued to be the leading lead producer in New Brunswick, accounting for about 65 percent of that Province's estimated 62,000 tons of lead. Heath Steele Mines, Ltd., began operation of its expanded facilities early in 1970. East Coast Smelting and Chemical Co. Ltd. at Belledune, New Brunswick, a subsidiary of Brunswick Mining and Smelting Corp., continued operation of its Imperial smelter and associated refining facilities.

The ASARCO Buchans Unit in Newfoundland produced about 20,200 tons of lead. Byproduct lead from Hudson Bay Mining and Smelting Co. Ltd., Ecstall Mining Ltd., a subsidiary of Texas Gulf Sulphur Co., Nigadoo River Mines Ltd., and other small mines provided about 20,000 tons of Canada's total lead output.

Output of primary refined lead showed about a 10-percent increase to 205,000 tons. Export of lead in ores and concentrates principally to Japan, United States, West Germany, and Belgium were almost doubled in 1970.

¹⁴ Page 14 of work cited in footnote 9.

France.—Output of lead and zinc have shown opposing trends with lead increasing and zinc decreasing. Closure of the high-zinc Pierrefitte mine in May 1969 and expansion of the high-lead Largentière mine caused the change in the output pattern.

Honduras.—The El Mochito mine of New York and Honduras Rosario Mining Co. increased ore output 9.2 percent above the 1969 level. The lead content of lead and zinc concentrates amounted to 16,568 tons, a record for the mine. The increase resulted from completion of major expansion projects at the mine and mill. Additional mill and mine improvement was in progress at yearend. Exploration and development increased ore reserves by 16 percent during the year and marked the sixth consecutive year of increase in ore reserves at the mine.¹⁵

ASARCO Exploration Co. of Canada in a joint venture with New York and Honduras Rosario Co. began driving a 2-mile tunnel to reach projections of ore shoots at the old Rosario mine.

India.—India, with only one domestic producer, is dependent on imports of lead. Hindustan Zinc may build a new 10,000-ton-per-year lead smelter in the Sundergarh District of Orissa State following location of an ore deposit at Sargipalli estimated to contain 4.6 million tons of ore, averaging 5 to 6 percent lead. These reserves would supply the smelter for nearly 20 years. The Orissa Industrial Development Corp. is making a detailed study of the district potential. Hindustan Zinc was studying the possibility of modernizing and expanding its Tundoo lead smelter. Currently annual production is about 2,500 tons of lead, well below the 6,000-ton rated capacity, owing to obsolete equipment and low-lead content of the concentrates from its Zawar mines at Debari in Rajasthan.

Ireland.—The two large mines in Ireland supplied over 65,000 tons of lead in 1970. Continued exploration by subsidiaries of Northgate Explorations, Ltd., and Silvermines, Ltd., has encountered mineralization in County Meath and County Tipperary. Smelter Corp. of Ireland, a subsidiary of Northgate Exploration, Ltd., was studying the feasibility of building a \$36 million smelter in Ireland to process the lead-zinc concentrates now being shipped to smelters on the European continent.

Japan.—Refined lead production in Japan

has almost doubled since 1965: The 1970 output at 230,000 tons. The gain of 5 percent, however, was well below the prior growth rate of 11 percent. Because of stringent air-quality standards, the seven lead-zinc smelting companies are faced with major capital investment for antipollution controls. Nippon Mining Co. Ltd. discovered a promising vein deposit of silver-lead-zinc ore in its Toyoha mine near Hokkaido. A 5-year development plan will be undertaken to produce 60,000 tons of crude ore per month, thus doubling the Toyoha output.

Mexico.—Cia. Industrial Peñoles S.A. was modernizing its lead smelter at Torreón, Coahuila State, to add over 20,000 tons in annual bullion capacity, bringing total capacity to over 130,000 tons. Development of the La Negra mine in Querétaro State was in progress. It will have a capacity of 14,000 tons of silver-lead ore monthly.

Asarco Mexicana, S.A., 49-percent owned by ASARCO, continued a mine expansion and modernization program and produced 83,300 tons of refined lead, slightly above the 1969 tonnage. The new 660-ton-per-day mill at the San Martin unit began operation at midyear; the new 350-ton-per-day mill at the Santa Eulalia unit was under construction, and major mine development works continued at the Santa Barbara and Taxco units. A new updraft sintering plant was under construction at the Chihuahua lead smelter; together with other improvements at the smelter and the Monterrey lead refinery, it will provide added concentrate capacity.¹⁶

Morocco.—A new deposit discovered in 1968 near the Zellidja mine is being developed to produce at an estimated rate of 25,000 tons per year beginning in 1971. Reserves were estimated at 11 million tons averaging 2.75 percent lead. The concentrates will be smelted by Fonderies Peñaroya-Zellidja, in a 30,000-ton-per-year plant at Oued El Heimer.

Peru.—The Cerro de Pasco base metal complex of Cerro Corp. was adversely affected by sporadic labor disturbances during the year which reduced lead output about 7 percent to 79,300 tons. About 32 percent of the lead was derived from purchased ores. The principal mine at Cerro

¹⁵ New York and Honduras Rosario Mining Co. Annual Report, 1970, pp. 4-11.

¹⁶ Page 15 of work cited in footnote 9.

de Pasco dates back to the Incas who worked it for gold and silver. Cerro Corp. began operations in 1902, principally for copper. Presently the mine is operated chiefly for lead and zinc, by both open pit and underground methods. Expansion of the open pit presently involves a major construction and town moving project.¹⁷

Spain.—Peñarroya's lead smelting plant at Cartagena was modernized and its capacity increased from 30,000 to 100,000 tons per year. The company's 20,000-ton plant at Córdoba will be dismantled. It was estimated that Peñarroya produced

about 50,000 tons of Spain's 76,000-ton lead output in 1970.

Yugoslavia.—The Yugoslav lead-zinc industry is planning to increase production significantly in 1971 as a result of developments during 1970. Lead-zinc ore is expected to reach 3.2 million tons, of which 1.75 million tons will be supplied by the Trepca combine of mines 580,000 tons by the Zletovo-Sase mines in Macedonia, and 400,000 tons by Mezica deposits in Slovenia. Lead concentrate production in 1971 is expected to be 157,000 tons compared with 131,000 tons in 1970.

TECHNOLOGY

Technological activity in the lead industry was directed not only to research and development related to new and expanded markets for lead, but significantly greater efforts were directed to solving, economically, the increasingly strict air and water quality standards and other environmental problems. Research aiming toward improving methods and equipment to control smelter-stack emission, improvement in concentration methods to alleviate water pollution and land beautification problems, and development of automotive exhaust controlling devices was intensified by industry and Government. Technical assistance was also devoted to improving solid waste reclamation and metal recycling.

The International Lead Zinc Research Organization (ILZRO) coordinates research and development on an international basis. Incorporated in 1965, the or-

ganization now has 34 supporting companies in 14 countries and is conducting about 55 lead research projects. The Environmental Health program involved many projects conducted jointly by ILZRO, other involved industries, and Government agencies.

The Library and Abstracting Service, Zinc Development Association and Lead Development Association (London) ZDA/LDA, which exists for the service of lead and zinc users throughout the world and financed by the various international lead and zinc research and development associations, provides abstracts of current world literature and published research upon inquiry to Lead Industries Association Inc., 292 Madison Avenue, New York, N.Y. 10017.

¹⁷ Cerro Corp. Annual Report, 1970, pp. 6-7.

Table 2.—Mine production of recoverable lead in the United States, by State

State	1966	1967	1968	1969	1970
Alaska	14		W	2	
Arizona	5,211	4,771	1,704	217	285
California	1,976	1,735	4,001	2,518	1,772
Colorado	23,082	21,923	19,778	21,767	21,855
Idaho	72,334	61,387	54,790	65,597	61,211
Illinois	2,285	2,384	1,467	791	1,532
Kansas	1,109	1,031	1,227	395	80
Kentucky	484	845	W		
Missouri	132,255	152,649	212,611	355,452	421,764
Montana	4,409	898	1,870	1,753	996
Nevada	3,581	1,500	863	1,420	364
New Mexico	1,596	1,827	1,363	2,368	3,550
New York	1,097	1,653	1,396	1,686	1,280
Oklahoma	2,999	2,727	2,387	605	797
Oregon			W	(1)	(1)
South Dakota				1	3
Tennessee	181				
Utah	64,124	53,813	45,205	41,332	45,377
Virginia	3,078	3,430	3,573	3,358	3,356
Washington	5,859	2,762	5,655	8,649	6,784
Wisconsin	1,694	1,596	1,126	1,102	761
Other States			140		
Total	327,368	316,931	359,156	509,013	571,767

W Withheld to avoid disclosing individual company confidential data; included in "Other States."

¹ Less than 1/2 unit.

Table 3.—Production of lead and zinc in the United States in 1970, by State and class of ore, from old tailings, etc.
in terms of recoverable metals

(Short tons)

State	Lead ore			Zinc ore			Lead-zinc ore	
	Gross weight (dry basis)	Lead content	Zinc content	Gross weight (dry basis)	Lead content	Zinc content	Gross weight (dry basis)	Lead content
Arizona.....	360	81	2	450	1	68	2,010	8
California.....	.....	.....	.....	.....	.....	.....	(1)	(1)
Colorado.....	1,429	37	2	295,321	2,390	31,456	357,247	10,837
Idaho.....	36,085	3,225	509	(2)	(2)	(2)	* 927,449	* 56,118
Kansas.....	.....	.....	.....	61,654	71	1,173	634	8
Missouri.....	* 8,815,880	* 421,764	50,721	.....	.....	.....	.....	.....
Montana.....	11,390	636	39	4,994	147	1,361	26	2
Nevada.....	3,697	266	78	.....	.....	.....	556	27
New Jersey.....	.....	.....	.....	168,723	.....	28,683	.....	.....
New Mexico.....	.....	.....	.....	(2)	(2)	(2)	* 162,190	* 3,544
New York.....	.....	.....	.....	175,965	.....	15,810	565,306	1,280
Oklaahoma.....	.....	.....	.....	64,367	427	1,865	.....	.....
Oregon.....	.....	.....	.....	.....	.....	.....	.....	.....
Pennsylvania.....	.....	.....	.....	622,499	.....	29,654	.....	.....
South Dakota.....	.....	.....	.....	.....	.....	.....	.....	.....
Tennessee.....	.....	.....	.....	4,156,482	.....	107,922	.....	.....
Utah.....	(1)	(1)	(1)	.....	.....	.....	* 456,676	* 40,100
Virginia.....	.....	.....	.....	670,395	3,356	18,063	.....	.....
Washington.....	.....	.....	.....	(2)	(2)	(2)	* 661,872	* 6,780
Wisconsin.....	.....	.....	.....	749,488	761	20,634	.....	.....
Other States.....	.....	.....	.....	325,094	536	11,205	.....	.....
Total.....	8,868,841	425,959	51,351	7,295,432	7,689	267,789	3,134,966	118,240
Percent of total lead-zinc.....		75	10		1	50		2

See footnotes at end of table.

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Table 3.—Production of lead and zinc in the United States in 1970, by State and class of ore, from old tailings, etc., in terms of recoverable metals—Continued

(Short tons)

State	Copper-lead, copper-zinc, and copper-lead-zinc ores			All other sources ¹			Total	
	Gross weight (dry basis)	Lead content	Zinc content	Gross weight (dry basis)	Lead content	Zinc content	Gross weight (dry basis)	Lead content
Arizona.....	130,953	210	9,402	40,314,819	7	51	40,448,592	286
California.....	.....	.....	.....	104,215	1,772	3,514	104,215	1,772
Colorado.....	361,002	7,180	10,553	118,078	1,911	1,368	1,138,077	21,855
Idaho.....	.....	.....	.....	574,392	1,873	936	1,537,326	61,211
Kansas.....	.....	.....	.....	.....	.....	.....	62,238	80
Missouri.....	.....	.....	.....	.....	.....	.....	8,815,880	421,764
Montana.....	.....	.....	.....	31,037	210	55	47,447	996
Nevada.....	673	28	13	103,384	43	12	108,310	364
New Jersey.....	.....	.....	.....	.....	.....	.....	168,723	.....
New Mexico.....	.....	.....	.....	1,127,137	4	647	1,289,327	3,550
New York.....	.....	.....	.....	.....	.....	.....	742,271	1,280
Oklahoma.....	.....	.....	.....	8,297	370	785	72,664	797
Oregon.....	.....	.....	.....	300	(²)	.....	300	(²)
Pennsylvania.....	.....	.....	.....	.....	.....	.....	622,499	.....
South Dakota.....	.....	.....	.....	49	3	1	49	3
Tennessee.....	1,650,070	.....	10,336	.....	.....	.....	5,896,552	.....
Utah.....	115,762	5,117	3,101	11,322	155	58	583,760	45,377
Virginia.....	.....	.....	.....	(³)	(³)	(³)	670,395	3,856
Washington.....	.....	.....	.....	.....	.....	.....	651,872	6,784
Wisconsin.....	.....	.....	.....	.....	.....	.....	749,488	761
Other States.....	214,148	.....	9,114	348,171	996	9,781	887,413	1,532
Total.....	2,502,608	12,535	42,521	42,741,201	7,344	17,107	64,543,048	571,767
Percent of total lead-zinc.....	.....	2	8	.....	1	3	.....	100

¹ Lead-zinc ore and ore from "Other Sources" combined to avoid disclosing individual company confidential data.

² Zinc and lead-zinc ores combined to avoid disclosing individual company confidential data.

³ Includes minor amount of lead tailings commingled with ore at mill; excludes barium sulfate ore.

⁴ Includes lead recovered from barium sulfate ore.

⁵ Lead and lead-zinc ores combined to avoid disclosing individual company confidential data.

⁶ Zinc ore and ore from "Other Sources" combined with lead-zinc ore to avoid disclosing individual company confidential data.

⁷ Lead and zinc recovered from copper, gold, silver, fluorspar, and uranium ores, and from smelter slags, mill tailings, and miscellaneous cleanups.

⁸ Less than 1/2 unit.

Table 4.—Mine production of recoverable lead in the United States, by months

(Short tons)

Month	1969	1970	Month	1969	1970
January.....	36,805	47,151	August.....	45,099	47,495
February.....	34,944	46,339	September.....	48,178	47,940
March.....	38,816	51,771	October.....	46,231	46,167
April.....	42,253	49,098	November.....	42,289	47,840
May.....	43,816	49,640	December.....	46,128	45,842
June.....	45,124	46,797			
July.....	44,380	45,753	Total.....	509,018	571,767

Table 5.—Twenty-five leading lead-producing mines in the United States in 1970, in order of output

Rank	Mine	County and State	Operator	Source of lead
1	Fletcher.....	Reynolds, Mo.....	St. Joe Minerals Corp.....	Lead ore.
2	Magmont.....	Iron, Mo.....	Cominco American, Inc.....	Do.
3	Viburnum.....	Crawford, Iron, and Wash- ington, Mo.....	St. Joe Minerals Corp.....	Do.
4	Ozark.....	Reynolds, Mo.....	Ozark Lead Co.....	Do.
5	Buick.....	Iron, Mo.....	Missouri Lead Operating Co.....	Do.
6	Federal.....	St. Francois, Mo.....	St. Joe Minerals Corp.....	Do.
7	Bunker Hill.....	Shoshone, Idaho.....	The Bunker Hill Co.....	Lead-zinc ore and lead-zinc tail- ings.
8	Lucky Friday.....	do.....	Hecla Mining Co.....	Lead-zinc ore.
9	U.S. and Lark.....	Salt Lake, Utah.....	U.S. Smelting Refining and Mining Co.....	Lead and lead-zinc ores.
10	Burgin.....	Utah, Utah.....	Kennecott Copper Corp.....	Do.
11	Indian Creek.....	Washington, Mo.....	St. Joe Minerals Corp.....	Lead ore.
12	Star-Morning.....	Shoshone, Idaho.....	Hecla Mining Co.....	Lead-zinc ore.
13	Idarado.....	Ouray and San Miguel, Colo.....	Idarado Mining Co.....	Copper-lead-zinc ore.
14	Mayflower.....	Wasatch, Utah.....	Hecla Mining Co.....	Do.
15	Pend Oreille.....	Pend Oreille, Wash.....	Pend Oreille Mines & Metals Co.....	Lead-zinc ore.
16	Sunnyside.....	San Juan, Colo.....	Standard Metals Corp.....	Do.
17	United Park City.....	Summit and Wasatch, Utah.....	United Park City Mines Co.....	Do.
18	Austinville and Ivanhoe.....	Wythe, Va.....	The New Jersey Zinc Co.....	Zinc ores.
19	Ground Hog.....	Grant, N. Mex.....	American Smelting and Re- fining Co.....	Lead-zinc ore.
20	Eagle.....	Eagle, Colo.....	The New Jersey Zinc Co.....	Zinc ore.
21	Van Stone.....	Stevens, Wash.....	American Smelting and Re- fining Co.....	Do.
22	Dayrock.....	Shoshone, Idaho.....	Day Mines, Inc.....	Lead ore.
23	Bulldog Mountain.....	Mineral, Colo.....	Homestake Mining Co.....	Silver ore.
24	Darwin.....	Inyo, Calif.....	Darwin Mines.....	Lead-zinc ore.
25	Emperius.....	Mineral, Colo.....	Emperius Mining Co.....	Do.

Table 6.—Refined lead produced at primary refineries in the United States, by source material

(Short tons)

	1966	1967	1968	1969	1970
Refined lead:					
From primary sources:					
Domestic ores and base bullion.....	318,646	258,507	349,039	513,931	528,086
Foreign ores and base bullion.....	122,089	121,387	118,271	124,724	138,644
Total.....	440,735	379,894	467,310	638,655	666,730
From secondary sources.....	9,004	2,538	2,259	4,966	4,367
Grand total.....	449,739	382,432	469,569	643,621	671,097
Calculated value of primary refined lead (thousands) ¹	\$133,278	\$106,370	\$123,463	\$190,702	\$209,220

¹ Value based on average quoted price, New York, and excludes value of refined lead produced from scrap at primary refineries.

Table 7.—Antimonial lead produced at primary lead refineries in the United States

Year	Production (Short tons)	Antimony content		Lead content by difference (short tons)			
		Short tons	Percent	From domestic ore	From foreign ore	From scrap	Total
1966.....	24,059	2,119	8.8	6,025	5,157	10,758	21,940
1967.....	18,608	1,717	9.2	5,449	3,634	7,808	16,891
1968.....	28,363	2,007	7.1	15,788	3,706	6,862	26,356
1969.....	24,741	2,082	8.4	11,507	4,743	6,409	22,659
1970.....	20,438	1,184	5.8	8,826	2,829	7,599	19,254

Table 8.—Stocks and consumption of new and old lead scrap in the United States in 1970

(Short tons, gross weight)

Class of consumers and type of scrap	Stocks Jan. 1	Receipts	Consumption			Stocks Dec. 31
			New scrap	Old scrap	Total	
Smelters and refiners:						
Soft lead.....	2,672	52,614	-----	52,342	52,342	2,944
Hard lead.....	1,553	19,622	-----	18,930	18,930	2,245
Cable lead.....	621	27,108	-----	26,462	26,462	1,287
Battery-lead plates.....	42,240	506,994	-----	512,030	512,030	37,204
Mixed common babbitt.....	304	3,503	-----	3,372	3,372	435
Solder and tinny lead.....	381	10,659	-----	10,640	10,640	400
Type metals.....	3,279	30,309	-----	32,001	32,001	1,587
Drosses and residues.....	22,310	126,359	121,766	-----	121,766	26,903
Total.....	73,360	777,168	121,766	655,777	777,543	72,985
Foundries and other manufacturers:						
Soft lead.....	-----	129	-----	84	84	45
Hard lead.....	20	82	-----	85	85	17
Cable lead.....	41	88	-----	82	82	47
Battery-lead plates.....	36	44	-----	-----	-----	80
Mixed common babbitt.....	59	8,437	-----	8,427	8,427	69
Solder and tinny lead.....	-----	-----	-----	-----	-----	-----
Type metals.....	-----	-----	-----	-----	-----	-----
Drosses and residues.....	55	-----	-----	-----	-----	55
Total.....	211	8,780	-----	8,678	8,678	313
All consumers:						
Soft lead.....	2,672	52,743	-----	52,426	52,426	2,989
Hard lead.....	1,573	19,704	-----	19,015	19,015	2,262
Cable lead.....	662	27,196	-----	26,544	26,544	1,314
Battery-lead plates.....	42,276	507,038	-----	512,030	512,030	37,284
Mixed common babbitt.....	363	11,940	-----	11,799	11,799	504
Solder and tinny lead.....	381	10,659	-----	10,640	10,640	400
Type metals.....	3,279	30,309	-----	32,001	32,001	1,587
Drosses and residues.....	22,365	126,359	121,766	-----	121,766	26,958
Grand total.....	73,571	785,948	121,766	664,455	786,221	73,298

* Revised.

Table 9.—Secondary metal recovered¹ from lead and tin scrap in the United States in 1970, by type of products
(Short tons, gross weight)

	Lead	Tin	Antimony	Other	Total
Refined pig lead.....	138,890	-----	-----	-----	138,890
Remelt lead.....	20,277	-----	-----	-----	20,277
Total.....	159,167	-----	-----	-----	159,167
Refined pig tin.....	-----	2,686	-----	-----	2,686
Remelt tin.....	-----	197	-----	-----	197
Total.....	-----	2,883	-----	-----	2,883
Lead and tin alloys:					
Antimonial lead.....	348,358	393	16,002	414	365,167
Common babbitt.....	10,312	652	1,073	61	12,098
Genuine babbitt.....	16	113	10	4	143
Soldier.....	33,348	5,486	823	142	39,799
Type metals.....	25,389	1,699	8,477	3	30,568
Cable lead.....	8,110	2	25	-----	8,137
Miscellaneous alloys.....	864	96	14	137	1,111
Total.....	426,397	8,441	21,424	761	457,023
Tin content of chemical products.....	-----	784	-----	-----	784
Grand total.....	585,564	12,108	21,424	761	619,857

¹ Most of the figures herein represent actual reported recovery of metal from scrap.

Table 10.—Secondary lead recovered in the United States
(Short tons)

	1966	1967	1968	1969	1970
As metal:					
At primary plants.....	9,004	2,538	2,259	4,966	4,367
At other plants.....	147,215	147,806	136,607	149,344	154,800
Total.....	156,219	150,344	138,866	154,310	159,167
In antimonial lead:					
At primary plants.....	10,758	7,808	6,862	6,409	7,599
At other plants.....	272,977	280,911	301,701	336,066	340,759
Total.....	283,735	288,719	308,563	342,475	348,358
In other alloys.....	132,880	114,709	103,450	107,120	89,865
Grand total:					
Quantity.....	572,834	553,772	550,879	603,905	597,890
Value (thousands).....	\$173,225	\$155,056	\$145,542	\$180,326	\$187,461

¹ Value based on average quoted price, New York.

Table 11.—Lead recovered from scrap processed in the United States, by kind of scrap and form of recovery
(Short tons)

Kind of scrap	1969	1970	Form of recovery	1969	1970
New scrap:			As soft lead:		
Lead-base.....	81,672	86,753	At primary plants.....	4,966	4,367
Copper-base.....	5,898	4,144	At other plants.....	149,344	154,800
Tin-base.....	398	307	Total.....	154,310	159,167
Total.....	87,968	91,204	In antimonial lead ¹	342,475	348,358
Old scrap:			In other lead alloys.....	90,582	77,159
Battery-lead plates.....	349,507	350,273	In copper-base alloys.....	16,511	12,690
All other lead-base.....	147,796	139,365	In tin-base alloys.....	27	16
Copper-base.....	18,631	16,546	Total.....	449,595	438,223
Tin-base.....	3	2	Grand total.....	603,905	597,390
Total.....	515,937	506,186			
Grand total.....	603,905	597,390			

¹ Includes 6,409 tons of lead recovered in antimonial lead from secondary sources at primary plants in 1969 and 7,599 in 1970.

Table 12.—Lead consumption in the United States, by products

(Short tons)

Product	1969	1970	Product	1969	1970
Metal products:			Pigments—Continued		
Ammunition.....	79,233	72,726	Pigment colors.....	14,670	14,407
Bearing metals.....	17,406	16,328	Other ¹	1,201	1,178
Brass and bronze.....	21,512	18,927	Total.....	102,386	98,736
Cable covering.....	54,203	50,772	Chemicals:		
Calking lead.....	44,857	34,608	Gasoline antiknock		
Casting metals.....	9,918	7,498	additives.....	271,128	278,505
Collapsible tubes.....	12,484	10,913	Miscellaneous chemicals.....	602	623
Foil.....	5,881	5,521	Total.....	271,730	279,128
Pipes, traps, and bends.....	19,407	17,888	Miscellaneous uses:		
Sheet lead.....	25,818	21,050	Annealing.....	4,252	4,161
Solder.....	72,626	69,707	Galvanizing.....	1,797	1,792
Storage batteries:			Lead plating.....	406	400
Battery grids,			Weights and ballast.....	17,366	16,184
posts, etc.....	280,386	283,451	Total.....	23,821	22,537
Battery oxides.....	302,160	310,002	Other, unclassified uses.....	18,287	15,246
Terne metal.....	1,583	1,088	Grand total².....	1,389,358	1,360,552
Type metal.....	25,660	24,476			
Total.....	973,134	944,905			
Pigments:					
White lead.....	6,617	5,936			
Red lead and litharge.....	79,898	77,215			

¹ Includes lead content of leaded zinc oxide and other pigments.² Includes lead which went directly from scrap to fabricated products.

Table 13.—Lead consumption in the United States, by months

(Short tons)

Month	1969	1970	Month	1969	1970
January.....	118,080	118,444	August.....	112,189	110,486
February.....	105,585	110,497	September.....	123,941	114,215
March.....	117,508	120,832	October.....	131,891	115,419
April.....	115,948	117,797	November.....	112,521	103,401
May.....	117,272	117,547	December.....	117,749	114,889
June.....	115,780	116,137	Total.....	1,389,358	1,360,552
July.....	100,894	100,888			

¹ Includes lead content of leaded zinc oxide and other pigments and lead which went directly from scrap to fabricated products.

Table 14.—Lead consumption in the United States in 1970, by class of products and types of material

(Short tons)

Product	Soft lead	Lead in antimonial lead	Lead in alloys	Lead in copper-base scrap	Total
Metal products.....	173,491	83,366	45,310	14,133	316,300
Storage batteries.....	318,571	274,882			593,453
Pigments.....	97,558				97,558
Chemicals.....	278,843	285			279,128
Miscellaneous.....	9,754	12,546	143		22,443
Unclassified.....	13,939	896	411		15,246
Total.....	892,156	371,975	45,864	14,133	1,324,128

¹ Excludes 35,246 tons of lead that went directly from scrap to fabricated products, and 1,178 tons of lead contained in leaded zinc oxide and other nonspecified pigments.

Table 15.—Lead consumption in the United States in 1970, by States¹

(Short tons)

State	Refined soft lead	Lead in antimonial lead	Lead in alloys	Lead in copper-base scrap	Total
California.....	94,958	37,901	5,777	760	139,396
Colorado.....	1,146	3,135	64	-----	4,345
Connecticut.....	16,664	8,945	8	1,018	26,635
District of Columbia.....	136	-----	-----	-----	136
Florida.....	5,541	6,802	-----	-----	12,343
Georgia.....	44,985	17,121	1,887	-----	63,993
Illinois.....	75,277	38,138	7,185	1,847	122,447
Indiana.....	74,927	39,842	1,838	842	116,949
Kansas.....	11,059	10,095	58	215	21,457
Kentucky.....	3,040	7,726	1	-----	10,767
Maryland.....	1,176	12,918	37	-----	14,131
Massachusetts.....	5,081	722	15	135	5,953
Michigan.....	18,109	18,815	1,517	421	38,862
Missouri.....	36,172	10,606	189	525	47,492
Nebraska.....	3,680	627	44	947	5,298
New Jersey.....	132,984	18,703	10,165	678	162,530
New York.....	38,214	1,984	10,708	878	51,779
Ohio.....	8,575	3,857	3,018	888	16,228
Pennsylvania.....	59,589	40,573	746	2,600	103,508
Rhode Island.....	1,968	174	38	-----	2,176
Tennessee.....	201	13,319	205	130	13,855
Virginia.....	650	1,501	823	1,121	4,095
Washington.....	8,022	742	340	-----	9,104
West Virginia.....	19,233	8,826	-----	-----	23,059
Wisconsin.....	3,530	4,552	44	218	8,344
Alabama and Mississippi.....	1,442	4,293	-----	415	6,090
Arkansas and Oklahoma.....	4,718	2,685	80	-----	7,483
Hawaii and Oregon.....	1,545	4,444	-----	-----	5,989
Iowa and Minnesota.....	4,111	11,709	114	397	16,331
Louisiana and Texas.....	202,828	33,369	926	464	237,587
Montana and Idaho.....	1,344	-----	-----	-----	1,344
New Hampshire, Maine, Vermont, Delaware.....	7,681	10,341	47	144	18,213
North and South Carolina.....	3,501	3,070	-----	-----	6,571
Utah, Nevada, Arizona.....	39	-----	-----	-----	39
Total.....	892,156	371,975	45,864	14,133	1,324,128

¹ Excludes 35,246 tons of lead that went directly from scrap to fabricated products and 1,178 tons of lead contained in leaded zinc oxide and other nonspecified pigments.

Table 16.—Production and shipments of lead pigments¹ and oxides in the United States

Product	1969				1970			
	Production (short tons)	Shipments			Production (short tons)	Shipments		
		Short tons	Value 1			Short tons	Value 1	
			Total	Average per ton			Total	Average per ton
White lead:								
Dry.....	8,551	7,858	\$3,357,280	\$427	6,497	7,287	\$3,037,038	\$417
In oil.....	1,944	2,501	1,776,903	710	2,878	1,351	863,942	639
Total.....	10,495	10,359	5,134,183	496	9,375	8,638	3,900,980	452
Red lead.....	23,583	22,177	8,067,711	364	20,316	19,444	7,585,560	390
Litharge.....	123,395	135,719	44,396,471	327	132,529	146,343	49,206,528	336
Black oxide.....	244,586				247,862			

¹ Except for basic lead sulfate, figures withheld to avoid disclosing individual company confidential data.

² At plant, exclusive of container.

³ Weight of white lead only, but value of paste.

Table 17.—Lead content of lead and zinc pigments¹ and lead oxides produced by domestic manufacturers, by sources
(Short tons)

Product	1969				1970			
	Lead in pigments produced from—			Total lead in pigments	Lead in pigments produced from—			Total lead in pigments
	Ore		Pig lead		Ore		Pig lead	
	Domestic	Foreign			Domestic	Foreign		
White lead.....			8,396	8,396			7,500	7,500
Red lead.....			21,378	21,378			18,416	18,416
Litharge.....			114,757	114,757			123,252	123,252
Black oxide.....			233,312	233,312			236,514	236,514
Leaded zinc oxide.....	367	204		571	304	211		515
Total.....	367	204	377,843	378,414	304	211	385,682	386,197

¹ Excludes lead in basic lead sulfate, figures withheld to avoid disclosing individual company confidential data.

Table 18.—Distribution of white lead (dry and in oil) shipments,¹ by industries
(Short tons)

Industry	1966	1967	1968	1969	1970
Paints.....	8,260	6,968	6,681	5,969	4,460
Ceramics.....	130	96	124	67	26
Other.....	6,486	5,064	4,829	4,323	4,152
Total.....	14,876	12,128	11,634	10,359	8,638

¹ Excludes basic lead sulfate, figures withheld to avoid disclosing individual company confidential data.

Table 19.—Distribution of red lead shipments, by industries
(Short tons)

Industry	1966	1967	1968	1969	1970
Paints.....	14,480	13,318	11,347	9,191	7,348
Storage batteries.....	W	W	W	9,302	W
Other.....	16,790	12,423	12,464	3,684	11,596
Total.....	31,270	25,741	23,811	22,177	19,444

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

Table 20.—Distribution of litharge shipments, by industries
(Short tons)

Industry	1966	1967	1968	1969	1970
Ceramics.....	23,476	19,491	24,123	21,570	24,578
Insecticides.....	1,166	W	W	W	W
Oil refining.....	1,991	1,835	1,849	1,603	2,016
Rubber.....	2,296	1,928	1,986	1,794	1,663
Varnish.....	1,620	1,228	W	W	W
Other.....	79,754	75,500	103,220	110,752	118,086
Total.....	110,303	99,982	131,178	135,719	146,343

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

Table 21.—U.S. imports for consumption of lead pigments and compounds

Kind	1969		1970	
	Short tons	Value (thousands)	Short tons	Value (thousands)
White lead.....	1,731	\$661	1,105	\$431
Red lead.....	5,517	1,365	6,909	1,827
Litharge.....	23,982	5,542	13,703	3,278
Other lead pigments.....	342	107	219	54
Other lead compounds.....	901	309	655	255
Total.....	32,473	7,984	22,591	5,845

The distribution by grade of slab zinc consumed in 1970 is as follows: Special high grade, 47 percent; high grade, 9 percent; intermediate, 1 percent; brass special, 10 percent; prime western, 33 percent; and remelt, less than one-fourth of 1 percent. Relative to 1969, consumption of special-high-grade zinc dropped 19 percent, but for prime western zinc the decline was only 1 percent, which confirmed the lower quantity for diecastings in the automotive industry.

The slab zinc consumed by rolling mills in 1970 at 41,000 tons was 16 percent lower than that of 1969; the production of rolled zinc products fell from 46,540 tons to 39,234 tons, also a 16-percent drop. The amount of photoengraving plate produced was less than 400 tons under that of 1969, at 10,364 tons; however, the strip and foil rolled was down over 8,000 tons, or 26 percent below that of 1969. In 1970, there was a 16.5 percent increase in the unit value of rolled zinc produced, which almost balanced the loss in quantity of products. Imports of rolled products—plate, sheet, and strip—dropped 18 percent to 692 tons, and exports fell 48 percent to 1,412 tons. The unit values of imports and exports also increased 40 percent and 29 percent, respectively. The total tonnage rolled in 1970, including 18,300 rerolled from scrap, was 57,310 tons, compared with 70,900 tons in 1969.

Consumption of slab zinc by States was headed by Illinois, again with 14 percent of the total, followed by Ohio, Pennsylvania, Michigan, Indiana, and New York. The industries using zinc in these six States accounted for 68 percent of the total slab zinc consumed. The largest uses were for diecastings in Michigan, Illinois, New York, and Ohio and galvanizing in Ohio, Pennsylvania, Indiana, and Illinois. Connecticut, Illinois, and Michigan showed the largest quantities used for brass mill products.

ZINC PIGMENTS AND SALTS

Production.—Production of zinc pigments and compounds at 329,000 tons in 1970 was 4 percent below that of 1969. Total shipments were 6 percent lower than production, which indicated an increase in producers stocks. Production of lead-free zinc oxide was up 3,400 tons over 1969 production, a 1.5 percent increase to

223,770 tons; leaded zinc oxide increased 5 percent to 5,200 tons. The zinc chloride produced was approximately 46,800 tons, or 2 percent less than in 1969; zinc sulfate dropped to 53,170 tons, 15,300 tons below production of the previous year.

Zinc pigments and compounds were made from various zinc-bearing materials including ore, slab zinc, and scrap. Lead-free zinc oxide was made by the following processes: 60 percent was produced from ores by the American process, 24 percent from metal by the French process, and 16 percent was derived from secondary materials and residues. The zinc contained in zinc oxide produced from ore was 107,273 tons and in zinc sulfate, 8,278 tons; 77 percent of the zinc oxide was from domestic ores and 23 percent was from imported ores; 43 percent of the zinc sulfate was from domestic ores and 57 percent was from imported ores. The amount of zinc in pigments produced from the zinc in domestic ores represented 16 percent of the domestic mine production, the same percentage as in 1969. Leaded zinc oxide was produced solely from ores, zinc chloride from slab zinc and scrap, and zinc sulfate from ores and scrap.

Four grades of leaded zinc oxide, classified according to lead content, were produced. Only a very small quantity of 5 percent or less leaded zinc oxide and a minor quantity containing 35 to 50 percent and over were produced; the more than 5 to 35 percent grade made up most of the production. Some lithopone, a coprecipitate of zinc sulfide and barium sulfate, was produced, but quantities are withheld to avoid disclosing individual company confidential data.

Consumption and Uses.—The shipment of zinc oxide for various uses in 1970 was 3 percent lower than that of 1969. Rubber accounted for 52 percent of the total requirement and used approximately 4,500 tons less than in the previous year. The quantities for paints, chemicals, and agriculture were substantially below those of 1969, but for photocopying and other uses major increases were recorded. The 16-percent rise for photosensitive copying paper, to 31,850 tons, reflects almost a threefold expansion of this use in the last 5 years.

Consumption of leaded zinc oxide was almost equal to that of 1969, but the use for paint, which accounted for 75 percent of the total, increased 6 percent, and the

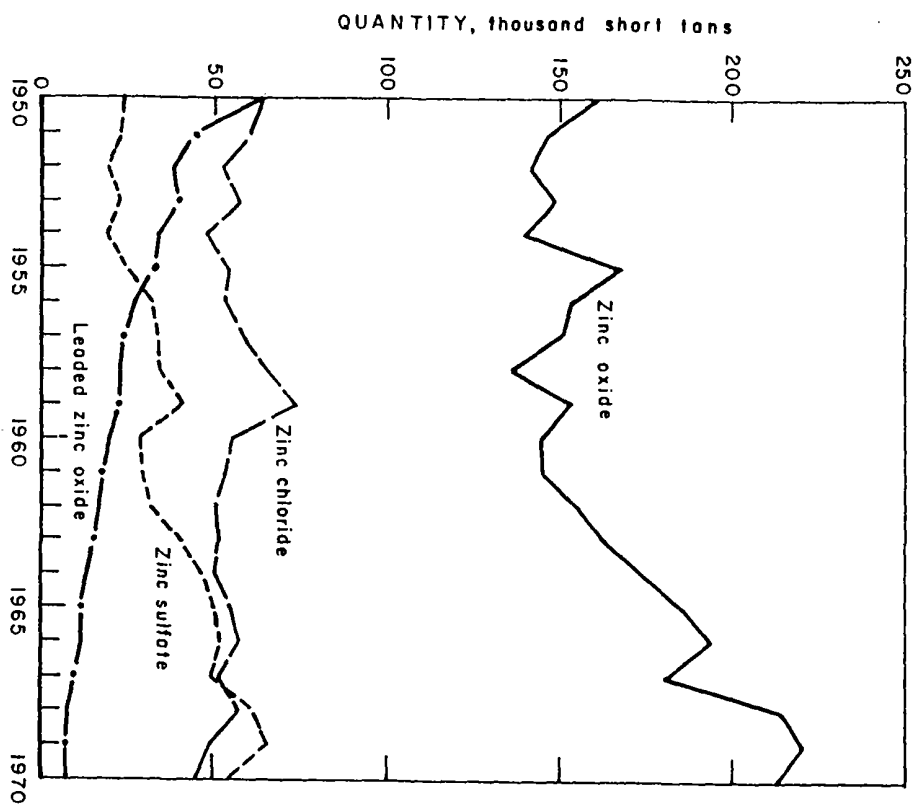


Figure 2.—Trends in shipments of zinc pigments.

balance for other uses dropped 15 percent. The total zinc sulfate shipment was 16 percent lower than that of 1969 because the requirement for agriculture declined 10 percent and for other uses 19 percent.

Prices.—The prices of American-process, lead-free zinc oxide and all other grades were established October 1, 1970, when a 0.5-cent increase raised the quotation for American-process zinc oxide to 17 cents per pound; and for French process lead-free, high-purity, and electrophotographic to 17.5 cents, 18.0 cents, and 19.75 cents per pound, respectively. The prices of leaded zinc oxide were 14 cents per pound for 12 percent grade, 15 cents for 18 percent, and 16.75 cents for 35 percent grade.

Zinc sulfate, granular monohydrate, industrial-grade 36 percent in 100-pound bags was quoted at 10 cents per pound throughout the year. The price of zinc chloride, 50 percent, in tank cars, was increased in the first week of July from 6.20 to 6.40 cents per pound for 100-pound lots, where it remained through December.

Foreign Trade.—Exports of zinc oxide to 41 countries in 1970 amounted to 6,326 tons, a 67-percent increase over 1969. West Germany was the largest customer with 1,308 tons, followed by Canada with 1,298 tons, Australia with 789 tons, and Belgium with 449 tons. Lithopone exports to 36

countries increased 42 percent, to 1,541 tons. The leading recipient was again South Vietnam with 1,392 tons, followed by Canada and Venezuela with 42 tons and 16 tons, respectively. The total value of exported pigments was \$2,866 million, up 75 percent over that of 1969.

Imports of zinc pigments and compounds decreased in 1970 to 20,766 tons, down from 23,518 in 1969. The decline was accounted for principally by the 17-percent drop in receipts of zinc oxide. Zinc oxide accounted for 12,073 tons; 6,200 tons came from Mexico. Canada was the next largest supplier, 4,400 tons; the Netherlands followed with 800 tons; Belgium, 222 tons; Spain, 165 tons; and smaller amounts were supplied by the United Kingdom, West Germany, France, and Poland. Seventy-seven tons of lithopone, down 71 percent from 1969, came from West Germany and the Netherlands. Zinc chloride imports were down 16 percent at 1,151 tons and followed the 1969 pattern; the greater portion came from West Germany, 781 tons; Belgium, 295 tons; and 75 tons from Canada, the Netherlands, and the United Kingdom. Zinc sulfate imports increased slightly to 6,298 tons; Mexico supplied 3,365 tons and Australia supplied 2,813 tons. The total value of imported zinc pigments and compounds was \$4,106 million, compared with \$4,476 million in 1969.

STOCKS

Producer Stocks.—The buildup of stocks of slab zinc at primary smelters and refineries that began in the last quarter of 1969 continued to increase progressively in the early months of 1970, reaching a high at the end of May. The cutbacks of production at smelters and refineries begun in February effected reductions in stocks in June and through September to the lowest for the year. Further slackening in demand, owing principally to the automobile strike, caused a decrease in shipments, and stocks rose in October, November, and December to 97,576 tons. Inventories at secondary smelters fell from 885 tons on Jan-

uary 1 to 555 tons at the end of March. Accumulations in the next 3 months increased stocks to the year's high of 1,157 tons at the end of June. Reduced production and larger shipments in the third quarter lowered inventories to 413 tons at the end of September. Production, shipments, and inventories increased in the last quarter as yearend stocks rose to 738 tons.

Consumers Stocks.—The total of slab zinc inventories at consumer plants declined 12 percent in 1970, to 89,551 tons. Declines in all grades except intermediate contributed to the 12,500-ton drop.

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