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Although mullite-based ceramics offer a number of advantages (notably superior mechanical stability and resistance to thermal shock), development of such products has been hampered by inadequacies, both qualitative and quantitative, in the available supply of requisite constituents. Preparation of appropriate ceramic powders of suitable purity by organo-metallic and freeze-dry techniques is costly, tedious, and often hazardous due to the use of volatile solvents that may be both flammable and toxic. Direct mixtures of alpha-alumina and silica do not react readily to form mullite, while those of amorphous alumina and silica, although highly reactive, generally produce mullite with an unacceptable proportion of residual corundum. In the course of research directed toward the processing of aluminosilicate ceramics, an improved method was developed for preparing mullite powder. A weakly acidified colloidal suspension of gamma-alumina was mixed with similarly dispersed amorphous silica, and the resulting hydrosol mixture was then caused to gel by gradually increasing the pH by dropwise addition of aqueous ammonia. Subsequent drying of the gelled material, followed by grinding and firing, yielded a fine-grained product that was shown by chemical and spectrographic analysis and X-ray diffraction to be mullite of theoretical composition and outstanding purity. A feature of the powder was the globular form of the particles, notably different from the acicular habit of mullite obtained in other procedures.

In a subsequent phase of the same research, experiments were carried out on the sintering of the newly available mullite powder under high pressure in an evacuated and induction-heated graphite die. Two journal articles were published presenting information on this experimental work and its conclusions.[12]

Orifice rings, vital components in automatic machines for mass production of glass containers, used to be fabricated from clay-bonded sillimanite or mullite, but the parts so obtained were often deficient in resistance to wear and thermal shock. A switch to harder high-alumina materials for this purpose has posed difficult machining problems with additional complications from the increasing demand for single-, double-, and triple-gob orifices in a profusion of shapes and sizes. Diamond-tool techniques in use by Emhart Corp., Hartford, Conn., for the precision coring of orifice blanks formed by slip casting or press extrusion of the newer materials were described in an industrial journal.[13]

[12] Ghate, B. B., D. P. H. Hasselman, and R. M. Spriggs. Synthesis and Characterization of High Purity, Fine Grained Mullite. Am. Ceram. Soc. Bull., v. 52, No. 9, September 1973, pp. 670–672.
Penty, R. A., D. P. H. Hasselman, and R. M. Spriggs. Pressure Sintering Kinetics of Fine Grained Mullite by the Change in Pressure and Temperature Technique. Am. Ceram. Soc. Bull., v. 52, No. 9, September 1973, pp. 682–693.
[13] American Ceramic Society Bulletin. Precision Orifice Rings Formed by Diamond Drills. V. 52, No. 9, September 1973, p. 690.

Lead

By J. Patrick Ryan

World production and consumption of lead, continuing an upward trend, again reached record high levels in 1973. Free world mine production increased about 1%, with most of the net gain coming from Canada, Mexico and Peru. Refined lead production also was up about 1%. Consumption of metal rose nearly 5% and exceeded production, the deficit being balanced essentially by withdrawals from producers and Government stocks. The world production deficit and continued strong demand was reflected in rising prices. The monthly average London Metal Exchange (LME) cash price increased 86% and exceeded the U.S. producers average price during most of the year. The average equivalent LME price in 1973 was 19.47 cents. The average domestic price of lead on a nationwide basis in 1973 was 16.29 cents per pound.

Both domestic mine and smelter production of lead were down slightly in 1973 from the 43-year record high levels achieved in 1972. Output from the new Brushy Creek mine, which began production at midyear, was not enough to offset losses due to closure of the Federal and Mayflower mines late in 1972. Secondary smelter output increased 6% to 654,300 tons, a new record that amounted to nearly 49% of total smelter and refinery production of lead.

Demand for lead in the transportation field continued to grow as requirements for batteries and gasoline antiknock compounds together increased nearly 4%. The quantity of lead used in battery manufacture again reached a new record high, and lead used in antiknock additives was only slightly less than in 1972. Lead used in pigments increased 22%. Of the total lead consumption of 1.54 million tons, batteries ac-

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of 874,330 tons on December 31.

Following reduction of the stockpile objective, an omnibus bill (H.R. 7153) was introduced in the Congress which would authorize the General Services Administrator to dispose of various materials from the national and supplemental stockpiles, including 464,900 tons of lead representing the difference between the old and new objectives. By yearend, no further action had been taken on the bill.

Bills (H.R. 3743, S607) to amend the Lead-Base Paint Poisoning Prevention Act were introduced in the 93d Congress, 1st session. These bills essentially provide for reducing the lead content of paints, conducting research to determine the safe level of lead in residential paint products, and would prohibit the use of lead-base paint in some consumer products and in future housing built with Federal aid. A compromise bill won final Congressional approval in October and became Public Law 93-151 on November 9. The lead and zinc flexible tariff bill (H.R. 6437) reintroduced in Congress in March contained a provision for increasing tariffs on lead in imported concentrates, unwrought and wrought metals, waste and scrap, and on manufactures of lead when exceeding specified limiting quantities. No further action was taken on the bill by the 93d Congress, 1st session.

On December 9, the Environmental Protection Agency (EPA) published revised regulations applicable to gasoline refiners designed to reduce the lead content of gasoline 60%-65% over a 5-year period, 1975-79. The new schedule, based on the total pool average lead content per gallon for each 3-month period, is as follows:

January 1, 1975	1.7	grams per gallon
January 1, 1976	1.4	grams per gallon
January 1, 1977	1.0	gram per gallon
January 1, 1978	.8	gram per gallon
January 1, 1979	.5	gram per gallon

The provision that at least one grade of lead-free gasoline—0.05 gram per gallon—be made available by July 1, 1974, remained unchanged.

Responding to lead dumping charges by the Bunker Hill Company, the U.S. Treasury Department made a determination in October that primary lead metal from Australia and Canada was being sold in the United States at less than fair market value within the meaning of the Antidumping Act. Following the determination by Treasury, the U.S. Tariff Commission instituted an investigation and held hearings in December on the question of injury, and on January 10, 1974, the Commission ruled that the dumping had caused or threatened injury to the domestic primary lead industry. As a result of the Commission's ruling, imports of primary lead from Australia and Canada sold at less than fair value will become subject to special dumping duties. On December 7, the Cost of Living Council removed its price control on lead and several other nonferrous metals to assure adequate domestic supplies of the metals vital for many capital-goods producers. The Council's action was said to be sufficient to encourage expansion of domestic capacity and supply as well as to bring domestic prices closer into line with world market prices.

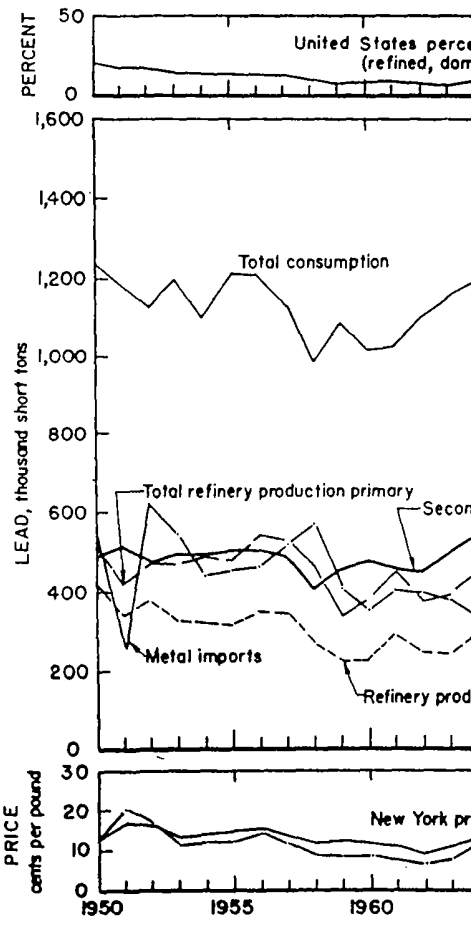

Figure 1.—Trends in the lead industry

Table 1.—Salient lead statistics

(Short tons unless otherwise specified)

	1969	1970	1971	1972	1973
United States:					
Production:					
Domestic ores, recoverable lead content	509,013	571,767	578,550	618,915	603,024
Value ----------thousands--	$151,635	$178,609	$159,679	$186,046	$196,465
Primary lead (refined):					
From domestic ores and base bullion	513,931	528,086	573,022	r 577,398	567,256
From foreign ores and base bullion	124,724	138,644	76,993	103,001	107,260
Antimonial lead (primary lead content)	16,250	11,665	16,116	8,185	13,223
Secondary lead (lead content)	603,905	597,390	596,797	616,597	654,286
Exports of lead materials excluding scrap	4,968	7,747	5,925	8,376	66,676
Imports, general:					
Lead in ore and matte	109,252	112,406	65,998	101,514	102,483
Lead in base bullion	1,993	296	41	895	4
Lead in pigs, bars, and old	285,342	251,480	198,970	245,625	180,788
Stocks December 31 (lead content):					
At primary smelters and refineries	101,860	192,985	121,660	146,573	89,847
At consumer plants	126,404	133,502	125,577	118,544	124,121
Consumption of metal, primary and secondary	1,389,358	1,360,552	1,431,514	1,486,254	1,541,209
Price: Common lead, average, cents per pound [1]	14.93	15.69	13.89	15.03	16.29
World:					
Production:					
Mine	3,566,061	3,741,546	r 3,742,950	3,802,086	3,852,190
Smelter	3,553,458	3,628,422	r 3,690,730	3,744,660	3,800,753
Price: London, common lead, average, cents per pound	13.09	13.76	11.52	13.68	19.47

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[1] Quotation for 1969–71 at New York and for 1972 and 1973 on a nationwide, delivered basis.

DOMESTIC PRODUCTION

MINE PRODUCTION

After rising for 5 consecutive years to a 43-year high in 1972, mine production dropped about 3% in 1973 to 603,000 tons. Monthly production reached a maximum of 55,900 tons in May, slightly less than the maximum achieved in 1972. Production from Missouri mines, which accounted for 81% of the Nation's total, was down slightly. Output in Idaho, which provided 10% of the total, was virtually unchanged. Utah's output dropped sharply following the closure of the Mayflower mine at yearend 1972. Output of lead at Kennecott's Burgin mine also was lower than in 1972 due to a shortage of skilled miners together with delays attributed to adverse underground mining conditions.[2]

The Buick mine jointly owned by Amax Lead Co. of Missouri (AMAX) and Homestake Mining Co. was again the leading lead producer with an output of 1.6 million tons of ore, an increase of 10% over that of 1972. Production of lead concentrate was up 19% to 225,000 tons. The six leading mines, all in Missouri, contributed 75% of the total U.S. mine production of lead. The 10 leading mines produced 86%, and the 25 leading mines contributed 99%. About 1,900 persons were employed in the Nation's lead, lead-silver, and lead-zinc mines and mills in 1973. Output of lead and zinc from these mines per man year was approximately 150 tons. Average grade of lead ore mined was 6.55% lead and 1.08% zinc compared with 5.89% lead and 0.73% of zinc in 1972.

St. Joe Minerals Corp. reported that output from its southeast Missouri mines declined 29,000 tons to 283,602 tons owing to the phasing-in of its new production facilities at Brushy Creek, which replaced the Federal mine in the Old Lead Belt that closed in October 1972. St. Joe, the Nation's largest lead mining company has four mine-mill operations in the New Lead Belt of southeast Missouri: Fletcher, Viburnum, Indian Creek, and Brushy Creek. The company stated that the higher grade ore (4%–8%) and improved mining and milling technology in the New Lead Belt operations has brought a substantial increase in productivity compared with operations in the Old Lead Belt. St. Joe estimates its proven lead reserves at 50 million tons—enough for 15 years production at the current rate of mining—and its probable ore reserves at an additional 100 million tons, or 30 years of production.[3]

Ozark Lead Co. produced 59,199 tons of lead in concentrate from its Ozark mine operations compared with 69,100 tons in 1972. The falloff in production resulted from a 2-month labor strike and a shortage of skilled underground maintenance personnel.[4]

The Bunker Hill Company reported that production of lead from company owned and controlled mines in Idaho aggregrated 31,000 tons, about the same as in 1972. The company reported that proven and probable ore reserves at yearend in the Bunker Hill mine totaled 2.01 million tons averaging about 3.6% lead, 5.1% zinc, and 2.1 ounces of silver per ton.[5] Hecla Mining Co. reported that ore production at the Star-Morning mine, jointly owned by Hecla (30%) and Bunker Hill (70%), increased 2,200 tons to 265,780 tons. Hecla's share of the 1973 production of lead-zinc-silver ore was 79,734 tons assaying 5.18% lead, 6.68% zinc, and 2.79 ounces of silver per ton. Hecla's share of the computed ore reserves increased 21,000 tons to 286,000 tons at yearend. Hecla's Lucky Friday mine produced 176,859 tons of silver-lead-zinc ore assaying 11.2% lead, compared with 192,020 tons assaying 10.4% lead in 1972. The decline in 1973 mine output was attributed largely to a continued shortage of skilled underground miners. Ore reserves at Lucky Friday at yearend totaled 510,000 tons, about 74,000 tons less than a year earlier.[6]

Lead output in Colorado, reversing the rising trend of the preceding 5 years, declined about 3,200 tons to 28,100 tons in 1973. Both the Leadville unit (Resurrection mine) and the Idarado Mines reported lower production during the year. The Leadville unit, a joint venture of ASARCO and Newmont Mining Corp., produced 199,000 tons of lead-zinc-silver ore and recovered 7,200 tons of lead.[7] Owing largely to a manpower shortage, the mine did not produce at more than about 75% of its rated capacity of 700 tons of ore per day during the year. Ore reserves at yearend were estimated at 2.62 million tons averaging 4.98% lead, 9.71% zinc, 2.53 ounces of silver and 0.067 ounce of gold per ton. Idarado Mining Co. mined and milled 378,200 tons of lead-zinc-copper ore

[2] Kennecott Copper Corp. 1973 Annual Report. P. 11.

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of a planned 3-week shutdown to install new environmental control equipment.[8]

ASARCO reported that its lead smelters maintained production at 1972 rates but continued to operate below capacity owing to environmental restrictions. The Glover, Mo., custom smelting and refining plant produced 82,300 tons of lead compared with 86,400 tons in 1972. Most of the concentrate treated at the Glover plant continued to come from the Ozark mine at Sweetwater, Mo. Concentrates from nine other domestic mines in four States and from one mine in Honduras also were treated at Glover. The East Helena, Mont., smelter operated continuously during the year processing crude ore and concentrates from about 94 domestic mines in 9 States and from mines in Canada, Peru, Colombia, and Australia. The El Paso, Tex., lead smelter processed ores and concentrates from approximately 24 domestic mines in 6 States and from mines in Peru, Canada, Honduras, Nicaragua, Australia, and Mexico. Refined metal output at the company's Omaha, Nebr., refinery, which processed lead bullion from the East Helena and El Paso smelters, totaled 165,100 tons, 22,400 more than in 1972.

AMAX reported that its smelter at Buick, Mo., produced 135,000 tons of refined lead in 1973, about 2,000 tons more than in 1972. About 57% of the total production was for the owners' account, and the remainder was refined on toll for other producers.[9]

The Bunker Hill smelter-refinery of Gulf Resources & Chemical Corp. at Kellogg, Idaho, operated continuously, except for a 4-day strike shutdown, and produced 130,200 tons of lead in all forms, about 1,600 tons less than in 1972. The reduction in output was due in part to the work stoppage and partly to efforts to comply with air pollution standards.[10] The company treated concentrates from nine domestic mines in five States and from mines in Canada.

Secondary smelter production of lead from recycled materials increased about 37,700 tons to a new record output of 654,300 tons, about 49% of the total smelter and refinery production. Approximately 140 secondary plants were engaged in recovery of lead and lead alloys from scrap materials during the year. Secondary output represented about 42% of total lead consumption in 1973.

[8] Page 9 of work cited in footnote 3.
[9] AMAX. 1973 Annual Report. Pp. 16–17.
[10] Page 7 of work cited in footnote 5.

Major secondary smelting companies reporting to the Bureau of Mines

Company	Plant
American Smelting & Refining Co. (including Federated Metals Div.)	San Francisco, Calif., Whiting, Ind., Omaha, Nebr., Newark, N.J., Houston, Tex.
East Penn Mfg. Co	Lyons Station, Pa.
General Battery Corp	Reading, Pa.
Gopher Smelting & Refining Co	St. Paul, Minn.
Gould, Inc	Omaha, Nebr., Philadelphia, Pa.
Nassau Smelting & Refining Co	Tottenville, N.Y.
NL Industries, Inc. (including Magnus Metal Division and Master Metals, Inc.)	French Camp and Los Angeles, Calif., Atlanta, Ga., Chicago and Granite City, Ill., Detroit, Mich., St. Louis Park, Minn., St. Louis, Mo., Fremont, Nebr., Pedricktown and Perth Amboy, N.J., Cincinnati and Cleveland, Ohio, Dallas and Houston, Tex.
RSR Corp. (including Murph-Murdock Division and Quemeteo Division).	City of Industry, Calif., Indianapolis, Ind., Middletown, N.Y., Dallas, Tex., Seattle, Wash.
Richardson Graphics	Chicago, Ill., Philadelphia, Pa.
Schuylkill Metal Corp	Baton Rouge, La.
Seitzinger's Inc	Atlanta, Ga.
Selco, Div. of Contract Manufacturers, Inc	Tampa, Fla., Columbus, Ga., Florence, Miss.
U. S. S. Lead Refinery, Inc	East Chicago, Ind.
Hyman Viener, and Sons	Richmond, Va.
Willard Smelting Co	Charlotte, N.C.

RAW MATERIAL SOURCES

Domestic mines delivered 603,000 tons of recoverable lead in concentrates to six domestic primary smelters. This represented 88% of the total production of 687,700 tons of primary refined lead and antimonial lead, about the same proportion as in 1972. Lead recovered from imported concentrates smelted during the year amounted to nearly 111,500 tons, about 6,500 tons more than in 1972. Lead recovered from lead scrap processed at primary plants dropped to about 1,100 tons contained in antimonial lead compared with a total of 7,000 tons in 1972. Raw material stocks at the beginning of the year at primary plants totaled 197,300, of which 101,900 tons was in process and 2,500 tons was in secondary materials. At yearend, stocks of primary materials awaiting process contained 88,500 tons of lead, material in process 78,200 tons, and

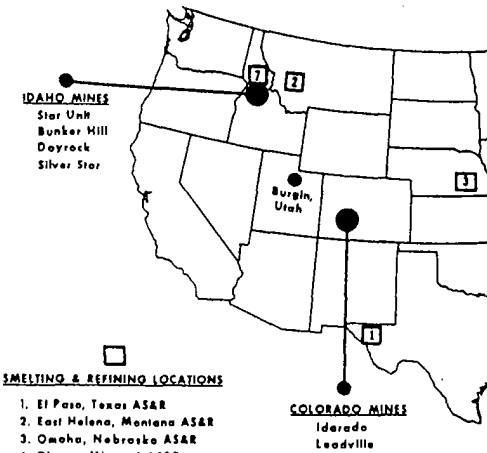

Figure 2.—Lead mines and smelters

CONSUMPTION AND USES

Lead consumption in the United States increased nearly 4% in 1973 to a new record of 1.54 million tons. Monthly requirements ranged from a new record high of 143,200 tons in March to a low of 101,900 tons in July. In the metal products category, which accounted for 72% of the total lead consumption, the 6% increase in battery requirements more than offset combined decreases in ammunition, cables, calking, and tubes. Significant gains also were recorded in the quantity of lead used in brass, pipes, terne and type metals. The growth in requirements for battery lead largely reflected the continued increase in the number of both on-the-road and off-the-road motor vehicles that use battery power for starting, lighting, ignition (SLI), and traction. A total of 57.1 million SLI-type batteries were produced in 1973, about 43.4 million of which were for replacement, 12.6 million were original equipment, and the remainder were exported. The quantity of lead used in gasoline antiknock compounds decreased 1.4%, reflecting a reduction in the average lead content per gallon of gasoline from about 2.6 grams per gallon in 1972 to about 2.2 grams per gallon in 1973.

Soft refined lead represented 66% of the total consumption, antimonial lead accounted for 29%, and lead in other alloys mainly solders and bearing metals, accounted for 4% of the total. Lead in copper-base scrap accounted for 1% of consumption.

The domestic supply of lead metal from all sources—primary and secondary production, imports for consumption, stock changes, and stockpile releases—totaled about 157,000 tons more than reported consumption and exports. The apparent excess supply in 1973 amounting to about 10% of reported consumption was attributed partly to unreported consumption and stock buildup, especially by small producers and dealers that do not report to the Bureau of Mines.

The compound annual growth rate in lead consumption during the 10-year period 1964–73 averaged about 2.5% owing largely to increased demand for batteries, which showed an annual growth of 6% during the period and accounted for approximately 50% of the total domestic consumption in 1973 but only 37% in 1964. Per capita lead consumption was 14.6 pounds compared with 14.2 pounds in 1972.

Lead used in pigments, particularly red lead and litharge, increased 28% and accounted for 7% of the total consumption in 1973. Lead antiknock compounds, and miscellaneous and other unclassified uses decreased slightly and accounted for 18% and 3% of the total, respectively. Lead used in other metal products, virtually the same as in 1972, accounted for 22% of the total.

The Lead Industries Association (LIA) reported the expanding use of terne-coated stainless steel in exposed architectural applications for protection against corrosion. The terne metal alloy coating is 80% lead and 20% tin. LIA also reported the increasing use of sheet lead in sound barrier applications such as accoustical polyurethane foam material used in machinery noise control panels designed to meet Occupational Safety and Health Administration (OSHA) standards.

LEAD PIGMENTS

Lead requirements for the production of lead oxides and pigments totaled 510,000 tons, about 13% more than in 1972. The quantity of lead used in making both white and red lead decreased and constituted only 4% of the total lead consumed in pigments and oxides. Litharge production used about 32% of the total lead requirements, and black oxide production used 64% of the total. Most of the litharge shipments went to battery manufacturers and is included in "Other" in table 20. Litharge shipments increased nearly 31,500 tons and comprised 75% of the total shipments in 1973. Litharge shipped for use in the ceramics industry increased 55% in 1973 and amounted to 20% of the total shipments for the year.

Prices.—The price of basic carbonate white lead in carload lots, freight allowed, remained unchanged at 23.9 cents per pound. The quoted price of red lead oxide (Pb_3O_4) 95%, in carload lots at works, was advanced from 18.75–18.90 cents per pound in January to 19.25 cents in February, 20.25–20.45 cents in April, 20.75–21.20 cents in May, to 21–21.20 cents in June, and remained unchanged thereafter to yearend. The price quotation on lead silicate ($PbSiO_3$) ranged upward from 20.75–21.75 cents per pound in January, 21.75 cents in April, to 23.0 cents in June and was unchanged thereafter. The price quotation of commercial-grade litharge, powdered, in carload lots at works ranged upward from 18 cents per pound in January to 19.5 cents in April, 20–20.25 cents in May, to 20.25 cents in June, and remained unchanged to December when the price quotation was advanced to 21.25–22.75 cents.

The value of shipments of white lead, red lead, and litharge amounted to $72.9 million in 1973, an average of $356 per ton compared with $61.1 million and $344 per ton in 1972.

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STOCKS

Inventories of refined and antimonial lead at primary refineries declined steadily through the first 7 months then trended upward in the last 5 months from the July low. Metal stocks totaling 64,500 tons at the beginning of the year decreased to about 26,100 tons at yearend. Stocks of lead in base bullion declined about 2,700 tons during the year, but the lead content of ore and matte stocks declined nearly 14,700 tons.

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PRICES

The U.S. producer price for common-grade lead on a nationwide basis was reported by *Metals Week* at 14.50 cents per pound on January 1, was advanced 0.5 cent to 15.0 cents on January 12, to 15.5 cents on February 6, and 16.0 cents on March 6. On April 30, the price quotation became split at 16.0–16.5 cents continuing unchanged at 16.5 cents per pound to June 1. Thereafter, the price was frozen at this level under price control regulations until December 6 when the controls on lead were lifted by the Cost of Living Council. On December 10, the producers quoted price was increased to a range of 18–19 cents per pound. The average monthly producer price increased from 14.50 cents in December 1972 to 17.72 cents in December 1973,

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FOREIGN TRADE

Exports of lead metal and scrap materials increased sharply due principally to world prices being substantially higher than domestic prices, which were frozen for most of the year. The outflow of lead materials

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and Italy; the remaining 47% was contained in scrap materials, most of which was shipped to Canada, Japan, and Brazil.

General imports of lead materials into the United States dropped nearly 19% to a total of 283,300 tons valued at $76.1 million. Receipts of lead in concentrates and other crude materials were near the same level as in 1972, but metal receipts dropped nearly 27% to about 178,096 tons, the smallest quantity of metal imports since 1951. The decline in lead imports was attributed partly to price regulations in the United States and partly to the effect of dumping charges filed against Canadian and Australian exporters by a major domestic producer and the subsequent determination by the U.S. Treasury Department sustaining such charges. Peru was the leading supplier of crude lead materials with nearly 23% of the total, followed by Australia, Honduras, and Canada. Canada continued to be the leading metal supplier with 35% of the total, followed by Australia 26%, Peru 24%, and Mexico 11%.

WORLD REVIEW

In 1973 mine production of lead in non-Communist countries (which includes Yugoslavia) based on data compiled by the Bureau of Mines totaled 2.95 million tons, about 7% more than in 1972. The Bureau estimated mine production in Communist countries at 0.87 million tons. Smelter output of lead in 1973 in non-Communist countries, reported as primary metal insofar as possible to determine by the Bureau, totaled 2.92 million tons. In addition, the Bureau of Mines estimated 0.88 million tons of metal produced in Communist countries to provide a world total of 3.80 million tons of primary lead, about 1% more than in 1972.

The United States maintained its rank as the leading mine producer of lead in 1973, accounting for approximately 16% of the world total, followed by the U.S.S.R., Australia, Canada, Peru, Mexico, and Yugoslavia, each with production exceeding 100,000 tons of lead in ore mined; these seven countries produced 67% of the world total. The 1% gain in the non-Communist country lead output was largely due to production gains in Mexico, Peru, Canada, Yugoslavia, Morocco and Australia, which more than offset losses in Japan, Spain, and the United States. The North America area increase was about 1% and the 1.21 million tons produced represented 41% of the non-Communist country total and 31% 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. again ranked second, followed by Australia, Japan, Canada, Mexico, France, the People's Republic of China and Bulgaria. The nine countries each produced more than 100,000 tons and together accounted for 69% of the world total. The North America area accounted for 37% of the non-Communist country metal output and 28% of the estimated world output (excluding U.S. secondary production). The 1% gain in primary metal output by non-Communist countries came chiefly from increases in Australia, Mexico, and Japan. The smelter output data for some countries, particularly France, Japan, and West Germany, includes secondary metal.

According to preliminary data compiled by the International Lead and Zinc Study Group (ILZSG), consumption of refined lead in 1973 by non-Communist countries amounted to 3.8 million tons, about 5% more than in 1972. Most of the increase came from West European countries and Japan. The U.S. accounted for about 40% of the non-communist total consumption. ILZSG comparative statistics on metal production and consumption in non-Communist countries indicate a new supply deficit of about 90,400 tons in 1973, compared with an indicated surplus of 33,000 tons in 1972. The indicated deficit was reflected in producers stocks, which declined about 106,000 tons during the year to nearly 160,000 tons at yearend. Consumers' stocks in the United States, the United Kingdom, and Japan combined decreased about 23,700 tons to 172,000 tons at yearend.

Trade data for the first 9 months of 1973 compiled by ILZSG disclosed that imports of lead bullion and refined lead into Communist countries from the rest of the world totaled about 58,200 tons, 19,700 tons more than exports compared with 40,800 and 11,000 tons, respectively, in the corresponding period of 1972.

Australia.—Mine output of lead increased nearly 1% to 447,000 tons, and Australia maintained its rank as the world's third ranking lead-producing country.

M.I.M. Holdings Limited treated 2.26 million tons of silver-lead-zinc ore at its Mount Isa operations averaging 6.6% lead and recovered 124,000 tons of lead bullion, 3,800 tons less than in 1972. In June 1973, the company reported primary silver-lead-zinc ore reserves at the Mount Isa mine at 60.6 million tons averaging 6.9% lead, 6.4% zinc, and 4.8 ounces of silver per ton. At the Hilton mine primary silver-lead-zinc ore reserves were estimated at 40.8 million tons averaging 5.8 ounces of silver per ton, 7.7% lead, and 9.6% zinc.[11]

Lead production at the Port Pirie smelter operated by Broken Hill Associated Smelter, Pty. Ltd. was 201,660 tons, nearly 19,000 tons less than in 1972.

E.Z. Industries Ltd. continued to expand productive capacity at its West Coast mines in Tasmania. During the year, the company milled 546,600 tons of zinc-lead-copper ore chiefly from the Rosebery and Hercules mines containing 5.3% lead and recovered nearly 25,200 tons of lead concentrate, a 15% gain in ore milled and a 5% gain in output of lead concentrate compared with production in 1972. The higher mine output achieved under the double production capacity plan was partially offset by the effects of a 5-week labor strike. The adoption of long-hole open stope drilling and improved loading equipment contributed to the increased tonnage mined at the Rosebery mine compared with that of the preceding year. Ore reserves totaled 10.3 million tons at fiscal yearend. About 96% of the total reserve was in the Rosebery mine; the remainder was in the Hercules and Farrell mines.[12]

North Broken Hill Ltd. reported that it mined 556,700 tons of lead-zinc-silver ore, about 6,000 tons less than in 1972. The grade of ore was 12.4% lead, 9.20% zinc, and 6.2 ounces of silver per ton, and production was 91,700 tons of lead concentrate containing 67,250 tons of lead and 29.2 million ounces of silver. Ore reserves on June 30 totaled 5.0 million tons, about the same as last year.[13]

Canada.—Canadian mine output of lead contained in ores and concentrates increased 2% in 1973 to 427,400 tons. The gain in output came chiefly from increases at mines in the Yukon and Northwest Territories

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

(Short tons)

Month	1972	1973	Month	1972	1973
January	122,272	135,308	August	127,368	126,707
February	123,671	131,695	September	125,984	124,793
March	132,311	143,197	October	132,241	140,655
April	122,367	128,432	November	131,438	131,420
May	129,012	128,776	December	120,500	120,208
June	126,661	129,124	Total [1]	1,485,264	1,541,209
July	91,439	101,894			

[1] Includes lead which went directly from scrap to fabricated products and lead contained in leaded zinc oxide and other pigments.

Table 14.—Lead consumption in the United States in 1973, by class of product and type of material

(Short tons)

Product	Soft lead	Lead in antimonial lead	Lead in alloys	Lead in copper-base scrap	Total
Metal products	184,141	70,425	68,228	16,239	339,033
Storage batteries	415,471	353,976	--	--	769,447
Pigments	108,766	--	--	--	108,766
Chemicals	275,026	328	--	--	275,354
Miscellaneous	12,208	14,604	48	--	26,860
Unclassified	19,750	1,188	811	--	21,749
Total	1,015,362	440,521	69,087	16,239	[1] 1,541,209

[1] Includes lead that went directly from scrap to fabricated products, and lead contained in leaded zinc oxide and other pigments.

Table 15.—Lead consumption in the United States in 1973, by State [1]

(Short tons)

State	Refined soft lead	Lead in antimonial lead	Lead in alloys	Lead in copper-base scrap	Total
California	87,559	41,223	5,453	799	135,034
Colorado	1,259	1,145	79	--	2,483
Connecticut	10,959	9,500	--	1,496	21,955
District of Columbia	118	--	--	--	118
Florida	4,805	8,929	--	--	13,735
Georgia	61,197	25,671	338	--	87,206
Illinois	96,295	44,303	11,001	1,610	153,209
Indiana	116,641	51,035	3,638	466	171,780
Kansas	12,092	10,279	43	133	22,547
Kentucky	7,673	13,595	2	--	21,270
Maryland	1,060	8,526	2,883	7	12,476
Massachusetts	2,884	684	20	294	3,882
Michigan	13,571	21,321	2,785	67	37,744
Missouri	30,047	9,855	2,014	1,093	43,009
Nebraska	3,428	988	1,524	1,636	7,576
New Jersey	129,780	15,467	7,427	718	153,392
New York	48,984	3,414	11,532	458	64,388
Ohio	12,715	4,543	8,067	2,395	27,720
Pennsylvania	65,413	51,211	4,950	2,573	124,147
Rhode Island	3,866	335	--	--	4,201
Tennessee	1,413	17,530	207	133	19,283
Virginia	663	2,653	1,031	681	5,028
Washington	17,816	910	1	--	18,727
West Virginia	20,119	432	--	--	20,551
Wisconsin	6,361	9,832	23	432	16,648
Alabama and Mississippi	6,123	7,169	--	463	13,755
Arkansas and Oklahoma	5,806	3,600	85	--	9,491
Hawaii and Oregon	4,081	6,959	--	--	11,040
Iowa and Minnesota	6,636	12,722	3,750	141	23,249
Louisiana and Texas	216,419	38,391	1,556	471	256,837
Montana and Idaho	842	--	--	--	842
New Hampshire, Maine, Vermont, Delaware	8,635	11,223	678	173	20,709
North and South Carolina	10,068	7,076	--	--	17,144
Utah, Nevada, Arizona	33	--	--	--	33
Total	1,015,362	440,521	69,087	16,239	1,541,209

[1] Includes lead that went directly from scrap to fabricated products and lead contained in leaded zinc oxide and other pigments.

Table 16.--Production and shipments of lead pigm

Product	1972			
	Production (short tons)	Shipments		
		Short tons	Value [2]	
			Total	Avera per ton
White lead:				
Dry	7,811	9,728	$4,466,278	$45
In oil [3]	304	338	230,201	68
Total	8,115	10,066	4,696,479	46
Red lead	24,168	19,773	7,266,019	36
Litharge	139,800	147,622	49,160,732	33
Black oxide	306,689	--	--	--

[1] Excludes basic lead sulfate, figures withheld to fidential 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 pigments manufacturers, by

(Short tons)

Product	1972		
	Lead in pigments produced from—		
	Ore		Pig lead
	Domestic	Foreign	
White lead	--	--	6,492
Red lead	--	--	21,908
Litharge	--	--	130,014
Black oxide	--	--	292,492
Leaded zinc oxide	W	W	--
Total	W	W	450,906

W Withheld to avoid disclosing individual company co
[1] Excluding lead in basic lead sulfate.

Table 18.—Distribution of white lead (dry a

(Short tons)

Industry	
Paints	
Ceramics	
Other	
Total	1

[1] Excludes basic lead sulfate, figures withheld to fidential data.

Table 19.—Distribution of red lead

(Short tons)

Industry	
Paints	
Storage batteries	
Other	
Total	2

W Withheld to avoid disclosing individual company c

Table 20.—Distribution of litharge shipments, by industry

(Short tons)

Industry	1969	1970	1971	1972	1973
Ceramics	21,570	24,578	24,337	23,188	35,910
Insecticides	W	W	W	W	W
Oil refining	1,603	2,016	1,413	1,262	620
Paints	1,511	1,316	3,086	7,316	3,112
Rubber	1,794	1,663	2,081	2,162	5,078
Other	109,241	116,771	116,928	113,694	134,424
Total	135,719	146,343	147,844	147,622	179,144

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	1972		1973	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
White lead	600	$216	401	$268
Red lead	1,289	377	593	188
Litharge	15,368	4,147	14,318	4,840
Chrome yellow	7,530	3,809	4,492	2,972
Other lead pigments	1,348	490	357	139
Other lead compounds	425	205	354	195
Total	26,550	9,244	20,515	8,602

Table 22.—Stocks of lead at primary smelters and refineries in the United States, Dec. 31

(Short tons)

Stocks	1969	1970	1971	1972	1973
Refined pig lead	21,283	90,866	46,762	60,840	22,018
Lead in antimonial lead	4,448	6,988	5,318	3,626	4,062
Lead in base bullion	12,726	11,710	13,803	11,514	8,845
Lead in ore and matte	63,403	83,421	55,777	69,693	54,922
Total	101,860	192,985	121,660	145,573	89,847

Table 23.—Consumer stocks of lead in the United States, Dec. 31, by type of material

(Short tons, lead content)

Year	Refined soft lead	Lead in antimonial lead	Lead in alloys	Lead in copper-base scrap	Total
1969	67,304	49,649	8,506	945	126,404
1970	82,823	42,420	7,344	915	133,502
1971	81,934	35,700	6,979	964	125,577
1972	74,161	36,157	6,977	1,249	118,544
1973	84,274	32,226	6,964	667	124,121

Table 24.—Average monthly and yearly quo

(Cents per pound)

Month	1972	
	U.S. producer	London Metal Exchang
January	14.00	11.40
February	14.60	13.33
March	15.50	14.51
April	15.57	14.32
May	15.60	14.40
June	15.50	14.10
July	15.50	13.77
August	15.41	13.50
September	15.00	13.71
October	14.67	13.46
November	14.50	13.48
December	14.50	13.98
Average	15.03	13.68

[1] Metals Week. Quotations for United States on a nationwi

Table 25.—U.S. exports of lead, b

Destination	19 Quantity (short tons)
Unwrought lead and lead alloys:	
Belgium-Luxembourg	755
Brazil	28
Canada	553
Dominican Republic	14
Germany, West	4
Greece	--
Honduras	56
Hong Kong	21
Italy	3,203
Jamaica	5
Japan	30
Korea, Republic of	1
Mexico	338
Netherlands	958
Philippines	35
Portugal	--
Singapore	--
Spain	106
Switzerland	--
Taiwan	20
Turkey	--
United Kingdom	34
Venezuela	306
Other	138
Total	6,605
Wrought lead and lead alloys:	
Australia	28
Belgium-Luxembourg	25
Brazil	11
Canada	282
Colombia	13
Denmark	19
Dominican Republic	39
Ecuador	6
France	37
Germany, West	14
Hong Kong	19
Italy	42
Jamaica	27
Japan	114
Korea, Republic of	--
Mexico	102
Netherlands	301
Panama	28
South Vietnam	1
Sweden	67
Taiwan	51

See footnotes at end of table.

oxide from automobile exhaust using catalysts obtained by thermal activation of granular hydrous stannic oxide gel in the temperature range of 200° to 500°C.[20]

In February the Tin Research Institute opened a new office at 2600 El Camino Real, Palo Alto, California 94306. It will serve more efficiently the interests of tin users in the western United States.

[20] Fuller, M. J., and M. Warwick. The Catalytic Oxidation of Carbon Monoxide on Tin(IV) Oxide. J. Catalysis, v. 29, 1973, pp. 441-450.

Titanium

By F. W. Wessel [1]

Production of all titanium commodities increased during 1973. Ore production benefited from a full year's operation by Titanium Enterprises in Clay County, Fla., and the opening of the American Smelting and Refining Company (Asarco) plant at Manchester, N.J. Pigment production increased because of plant expansions, principally that of E. I. du Pont de Nemours & Co. at New Johnsonville, Tenn. Industrial demand for titanium metal rose sharply during the last quarter.

Midyear indications of decreased housing starts had no apparent effect on the demand for pigment. Plastics industry demand was particularly strong, increasing about 35% over the previous year. The paper industry also is trending toward use of more pigment per unit weight of paper.

Worldwide criticism of waste-disposal practices at sulfate-process pigment plants prompted producers to adopt some type of pollution control. One European producer estimated a 15% increase in cost of product as a result. New sulfate-process capacity, accordingly, is being contemplated mainly in the less industrialized nations. Chloride-p
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Table 1.—Salient titanium s

	1969	1970
United States:		
Ilmenite concentrate:		
Mine shipments, short tons	893,034	920,9
Value, thousands	$18,636	$18,6
Imports, short tons	28,624	96,2
Consumption, do	1,003,601	972,5
Titanium slag:		
Imports, do	82,329	184,5
Consumption, do	138,663	129,2
Rutile concentrate, natural and synthetic:		
Imports, do	204,898	248,2
Consumption, do	186,432	189,3
Sponge metal:		
Imports for consumption, do	5,745	5,9
Consumption, do	20,124	16,4
Price: December 31, per pound	$1.32	$1
World production:		
Ilmenite concentrate, short tons	2,777,253	3,109,2
Titanium slag, do	764,898	863,3
Rutile concentrate, natural, do	436,821	469,6

international capital is apparently finding the situation there somewhat less congenial than formerly.

At yearend a commission formed by the European Community was studying titanium pigment operations and seeking a solution to its waste disposal problems.

Legislation and Government Programs.—About midyear the stockpile objectives for both rutile and titanium sponge were revised to zero. Disposal of 17,385 tons of rutile was authorized by Congress; of this quantity, 13,756 tons was sold by yearend for a total of $2.75 million. While deliveries of sponge under the 1972 contracts continued, small quantities of older sponge in inventory were released for sale.

Government exploration assistance for rutile, available through the Office of Minerals Exploration, U.S. Geological Survey, remained at 75% of the approved cost of exploration. The depletion allowance for ilmenite and rutile remained at 22% for domestic deposits and 14% for foreign deposits.

DOMESTIC PRODUCTION

Concentrates.—Production and shipments of titanium-mineral concentrate in 1973 increased 12.9% and 9.4%, respectively; the quantity of TiO_2 contained in the shipments increased 11.0%. The average grade of concentrate shipped was 57.4% TiO_2, a small increase over 1972 levels. The tonnage increases resulted from a full year's production at the new mine of Titanium Enterprises at Green Cove Springs, Clay County, Fla., and one-half year's production at the Asarco mine, Manchester township, Ocean County, N.J. Production continued at the mines of E. I. du Pont de Nemours & Co., Starke and Highland, Fla.; Humphreys Mining Co., Folkston, Ga.; SCM Corp., Glidden-Durkee Div., Lakehurst, N.J., and NL Industries, Inc., Tahawus, N.Y.

At Asarco's New Jersey property, construction was completed early in spring, and operations began in late June. The sand contains 4% heavy minerals; the concentrates contain 63% TiO_2. Some zircon and sillimanite are rejected. The sand reportedly contains no rutile. The dredge capacity is 1,200 tons per hour, but normal downtime, moving, etc., will limit daily production to an average of 20,000 tons. Operating capacity is estimated at 165,000 tons of product annually. The mine will probably operate for at least 20 years.

The Humphreys Mining Co. operation at Folkston, Ga., has probably had its last full year of operation at that locality. It is expected that the company will turn its attention to another sand deposit just within the Florida border and close enough to Folkston to permit trucking of the rough heavy-mineral concentrate to the dry plant there.

Ferroalloys.—Production of ferrotitanium increased to 1,156 tons in 1973, about 75% of the total representing the higher titanium-content alloys. Producers continued to be Shieldalloy Corp., Newfield, N.J., Union Carbide Co., Niagara Falls, N.Y., and Foote Mineral Company, Cambridge, Ohio. Scrap and ores were used as raw material.

Metal.—Production of titanium sponge was 50% higher than in 1972. Part of this increase was to fulfill General Services Administration contracts to procure the material for the Federal stockpile; shipments were made throughout the year by both producers. There was also a sharp increase in demand from industrial sources during the last 4 months of 1973. Producing companies were Titanium Metals Corp. of America (TMCA), Henderson, Nev., owned by NL Industries, Inc. and Allegheny Ludlum Steel Corp.; and RMI Co., Ashtabula, Ohio, owned by National Distillers & Chemical Corp. and United States Steel Corp.

Production of titanium ingot was 28,932 tons, a 43% increase over 1972 levels. As in 1972, the following nine companies produced ingot.

Company	*Plant location*
Crucible Steel Company of America.	Midland, Pa.
Howmet Corp	Whitehall, Mich.
Martin Marietta Aluminum, Inc.	Torrance, Calif.
Oregon Metallurgical Corp	Albany, Oreg.
RMI Co.	Niles, Ohio
Teledyne Titanium, Inc.	Monroe, N.C.
Titanium Metals Corp. of America.	Henderson, Nev.
Titanium West, Inc.	Reno, Nev.
TiTech International, Inc.	Pomona, Calif.

Pigment.—Demand for all grades of titania pigment continued to be strong during 1973. Production increased 7.5% during the year, and shipments about 10.5%. Rutile-type pigment accounted for 72% of total production and was produced by all seven manufacturers. Anatase-type pigment was produced by five companies.

Strikes and mechanical difficulties are estimated to have cost the pigment industry more than 12,000 tons of production. At yearend, companies producing titania pigment, and their plant locations, were as follows: American Cyanamid Co., Savannah, Ga.; Kerr-McGee Chemical Corp., Hamilton, Miss.; E. I. du Pont de Nemours & Co., Antioch, Calif., Edge Moor, Del., and New Johnsonville, Tenn.; NL Industries, Inc., Sayreville, N.J., and St. Louis, Mo.; New Jersey Zinc Co. (a Gulf & Western Industries, Inc. unit), Gloucester, N.J., and Ashtabula, Ohio; SCM Corp., Glidden-Durkee Div., Baltimore, Md.; and Sherwin-Williams Chemical Co., Ashtabula, Ohio.

Du Pont's New Johnsonville plant capacity reached 228,000 tons per year by yearend. Work continued during the year at du Pont's Edge Moor plant, where chloride process capacity was replacing sulfate process units. The chloride-process plant

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**Table 2.—Production and mine shipments of titanium c
from domestic ores in the United States**

Year	Production (short tons, gross weight)	Sh	
		Quantity (short tons gross weight)	TiO (sh
1969	931,247	893,034	4
1970	867,955	920,964	4
1971	683,075	713,610	3
1972 r	696,727	743,401	4
1973	785,268	813,400	4

r Revised.
1 Includes a mixed product containing rutile, leucoxene, and altered ilmenite.

Table 3.—Titanium metal data
(Short tons)

	1969	1970	19
Sponge metal:			
Imports for consumption	5,745	5,931	2
Industry stocks	1,909	2,516	2
Government stocks (DPA inventories) 1	20,385	19,994	19
Consumption	20,124	16,414	12
Scrap metal consumption	7,566	7,242	6
Ingot: 2			
Production	28,490	24,331	18
Consumption	27,082	23,687	17
Net shipments of mill products 3	15,940	14,480	11

r Revised.
1 As of June 30 each year.
2 Includes alloy constituents.
3 Bureau of the Census, Current Industrial Reports Series BDCF-263.

ducing usable gypsum. In May, the Georgia Ports Authority announced its intent to issue revenue bonds to finance construction of pollution abatement facilities based on the Ishihara process. Ground was broken on September 19, and the treatment complex will be operating by the end of 1974. Universal Gypsum Co. of Georgia, a subsidiary of Universal Chemical and Mineral, Inc., will operate the new plant, the cost of which is estimated at $20 million.

Table 4.—Titanium pigment data
(TiO_2 content)

Year	Production (short tons)	Shipments [1]	
		Quantity (short tons)	Value, f.o.b. (thousands)
1969	664,253	654,490	384,521
1970	655,293	643,746	320,014
1971	677,751	684,698	311,140
1972	r 718,177	752,025	358,564
1973	p 772,392	NA	NA

p Preliminary. r Revised. NA Not available.
[1] Includes interplant transfers.

Source: Bureau of the Census.

CONSUMPTION AND USES

Concentrates.—Consumption of ilmenite was 3% greater than in 1972. Consumption of Sorel slag was 7% greater. Consumption of rutile, including the synthetic, increased 14%.

Metal.—Consumption of sponge and ingot increased 54% and 30%, respectively. Shipments of mill products gained 15% over those of 1972. Beginning about September 1, an increase in demand for titanium became evident, originating primarily in the industrial sector. As a material of chemical engineering construction, the metal found increased use in petrochemical plants, chlor-alkali cells, and copper-leaching hardware. Scrap consumed for making ingot increased 29% above 1972 levels. There is some evidence that about 4 million pounds of ingot went into inventories, principally those of consumers, during the year.

Pigments.—Preliminary figures showed a 10.5% increase in shipments. The quantity in excess of the 7.5% increase in production was accounted for, as in 1972, by delivery of imports and of pigment withdrawn from stocks. The plastics industry, consuming pigment at an accelerated rate during 1972 and most of 1973, showed indications of stabilized demand late in the year; the industry was operating near capacity, and some feedstocks were becoming harder to obtain.

Table 5.—Consumption of titanium concentrates in the United States, by product
(Short tons)

Year and product	Ilmenite [1]		Titanium slag		Rutile	
	Gross weight	TiO_2 content [e]	Gross weight	TiO_2 content [e]	Gross weight	TiO_2 content [e]
1969	1,003,501	541,840	138,553	98,075	186,432	178,090
1970	972,314	519,766	129,247	91,639	189,172	181,402
1971	898,783	486,271	143,554	101,751	225,498	216,916
1972:						
Alloys and carbide	(3)	(3)	(3)	(3)	(3)	(3)
Pigments	775,618	453,248	264,095	187,608	208,704	199,894
Welding-rod coatings and fluxes	(3)	(3)	(3)	(3)	11,022	10,392
Miscellaneous [4]	10,766	8,174	--	--	23,032	21,946
Total	786,384	461,422	264,095	187,608	242,758	232,231
1973:						
Alloys and carbide	(3)	(3)	(3)	(3)	--	--
Pigments	795,728	470,087	281,791	199,287	232,969	221,658
Welding-rod coatings and fluxes	(3)	(3)	--	--	10,635	10,059
Miscellaneous [4]	12,005	9,144	--	--	33,303	31,648
Total	807,733	479,231	281,791	199,287	276,907	263,365

e Estimate.
[1] Includes a mixed product containing rutile, leucoxene, and altered ilmenite.
[3] Included with "Miscellaneous" to avoid disclosing individual company confidential data.
[3] Included with "Pigments" to avoid disclosing individual company confidential data.
[4] Includes ceramics, chemicals, glass fibers, and titanium metal.

Table 6.—Distribution of titanium-pigment shipments
(Percent)

Industry	1969	197
Distribution by gross weight:		
Paints, varnishes, and lacquers	58.5	59
Paper	17.0	17
Floor coverings	2.3	1
Rubber	2.6	2
Coated fabrics and textiles (oil cloth, shade cloth, artificial leather, etc.)	1.3	1
Printing ink	2.3	2
Roofing granules	.9	
Ceramics	2.0	1
Plastics (except floor covering and vinyl-coated fabrics and textiles)	6.2	6
Other (including export)	6.9	6
Total	100.0	100
Distribution by titanium dioxide content:		
Paints, varnishes, and lacquers	54.3	55
Paper	19.5	19
Floor coverings	2.6	2
Rubber	3.0	3
Coated fabrics and textiles (oil cloth, shade cloth, artificial leather, etc.)	1.4	1
Printing ink	2.6	2
Roofing granules	1.1	1
Ceramics	2.4	2
Plastics (except floor covering and vinyl-coated fabrics and textiles)	7.1	7
Other (including export)	6.0	5
Total	100.0	100

STOCKS

In 1973, stocks of rutile in the United States continued to decline; yearend inventories were 9% below those at yearend 1972. Slag inventories decreased by 22% but ilmenite in inventories increased by 10% during the year. Yearend stocks of titanium sponge were 1,941 tons, and of titanium scrap 4,447 tons, representing increases of 7% and 2%, respectively. Figures for titanium scrap refer to metal in the hands of ingot and mill shapes producers only. An appreciable but undetermined quantity of scrap was in the inventory of steel and ferroalloy plants. Industry stocks of titanium dioxide declined for the third successive year, from 54,982 tons on January 1 to 34,122 to

Table 7.—Stocks in the United
(

Ilmenite:	
1971	
1972 r	
1973	
Titanium slag:	
1971	
1972 r	
1973	
Rutile:	
1971	
1972 r	
1973	

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PRICES

Concentrates.—Published price quotations for ilmenite, $22 to $24 per long ton at the beginning of 1973, increased to $32 on August 17 and to $38 on December 21. These figures are nominal; almost all domestic production of ilmenite is captive. Australian ilmenite prices increased to A$11–A$12 f.o.b. Australian ports. Indian ilmenite remained unchanged at £3.95 f.o.b. Indian west
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were A$115 to A$125 per long ton until May, when quotations went to A$125 to A$130. In July another small increase became effective; quotations were A$127 to A$132 f.i.d. (free in container depot, a new basing point). Additional increases were noted in October and December; the yearend price was A$147 to A$152. Rutile released from the Federal stockpile during the last half of 1973 brought prices of $170 per short ton in August and $226 in November.

Titanium slag (70% to 71% TiO_2), quoted at $50 per long ton f.o.b. plant at Sorel, Quebec, went to $53 in mid-August and $60 at the yearend.

Manufactured Titanium Dioxide.—Continued heavy demand for all grades of pigment and increasing raw material costs permitted no relaxation of upward price pressures. In lots of 20 tons minimum, prices at yearend were within the following ranges:

	Prices (cents per pound)
Anatase:	
Paper grade	24-24½
Other grades	27½-29½
Rutile:	
Standard grade	27½-28½
Premium grades	28½-30

Material shipped as slurry was generally ½ cent per pound cheaper.

Late in December, one pigment maker announced prices, effective January 1, 1974, to be 30½ cents per pound for premium-grade rutile and 29½ cents per pound for standard-grade rutile and the higher anatase grades.

During the first half of 1973, several major European producers increased prices for pigment. The Kronos group of West Germany raised its prices 8% in European markets and 12% in markets outside Europe in March. In May, British Titan, Ltd., increased its prices by £18 per ton (approximately 2 cents per pound).

Metal.—Domestic sponge began the year at $1.32 per pound. The price increased to $1.42 to $1.45 in May, and ended the year at that level, although at the end of the year a further increase seemed imminent. Sponge imported from Japan, priced at $1.20 to $1.25 at yearend 1972, went to $1.34 to $1.37 in May, to $1.28 to $1.33 in August, and finally ended the year in the $1.36 to $1.38 range.

FOREIGN TRADE

Titanium dioxide exports in 1973 amounted to 20,769 tons, double the 1972 figure. Of this total, Japan received 20%, other Far East countries 31%, Western Europe 17%, Latin America and the West Indies 16%, and Canada 11%. Exports of unwrought, waste, and scrap titanium were 18% higher than in 1972; 47% went to the United Kingdom, 20% to Italy, and 14% to Belgium. The average valuation was 43½ cents per pound compared with 31 cents in 1972. Exports of wrought titanium (ingots and mill shapes) were up 33% from 1972 levels. Canada imported 38% of the total, the United Kingdom 23%, and France, West Germany, and Italy a total of 25%.

As a result of changes in the titanium industry product mix over the past few years import statistics for titaniferous raw materials no longer give a clear, complete picture of foreign trade. Six different materials are being imported in significant quantities: Ilmenite, rutile, Sorel slag, synthetic rutile (beneficiated ilmenite), Sorelflux, and titaniferous iron ore. There are only three T.S.U.S.A. categories for titaniferous raw materials: 601.5120 Ilmenite and ilmenite sand, 601.5140 Titanium minerals n.e.s., and 603.6200 Titanium slag. In addition, some synthetic rutile is imported under category 603.7 (Other metal-bearing materials).

In 1973, imports as reported by the Bureau of the Census, Department of Commerce, were 216,350 tons of ilmenite and ilmenite sand, 311,153 tons of titanium minerals n.e.s., and 100,327 tons of titanium slag. However, the results of a Bureau of Mines canvass showed consumption of 281,791 tons of slag in 1973, of which only 22,373 tons came from inventory.

Since all slag and the great bulk of titaniferous iron ore was imported from Canada, and since Canada was the sole source of slag and of Sorelflux, the raw monthly data for imports from Canada were analyzed. The governing parameter was the declared valuation in U.S. dollars per short ton. Entries in the $5 to $25 range were reclassified as titaniferous iron ore, which included Sorelflux and material for aggregate. Entries in the $30 to $40 range were classified as ilmenite, and those in the $40 to $65 range were classified as Sorel slag. These classifications were for Canadian imports only; data for other imports were accepted on the basis of f.o.b. prices in the country of origin.

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Commodity	601.51
Ilmenite	98,2
Titaniferous iron ore	83,5
Slag	XX
Rutile (natural)	11,1
Rutile (synthetic)	23,8
Total	216,8

XX Not applicable.

Of the 98,262 tons of ilmenite tabulated, 28,571 tons was reported from the Bahamas, a country which has no ilmenite production. Deducting this figure pending verification leaves a total ilmenite import of 69,691 tons.

Certain shipments from Japan, India, and Australia, totaling 37,515 tons, were entered under category 603.7000. These shipments met the declared-valuation criterion for synthetic rutile; however, addition of this quantity to the synthetic rutile tabulated above would result in an import volume far in excess of known world productive capacity. Therefore, pending verification, the data will not be used.

The data of table 9 are presented in accordance with the foregoing computations.

Imports of ilmenite from Australia doubled in 1973, the increase presumably coming from the new operations in Western Australia. Imports of Sorel slag from Canada amounted to 237,000 tons, a 20% decrease from the (revised) 1972 figure. Ru-

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Table 8.—U.S. exports of titanium produ
(Short tons and thousand dollars)

Year	Ores and concentrates		Metal and alloy sponge and scrap		Inter sha proc
	Quantity	Value	Quantity	Value	Quant
1971	1,760	299	1,711	1,189	4
1972	1,802	394	3,610	2,165	5
1973	1,494	368	4,142	3,601	7

Table 9.—U.S. imports for consumption of titanium concentrates, by country [1]
(Short tons and thousand dollars)

Country	1971		1972		1973	
	Quantity	Value	Quantity	Value	Quantity	Value
Ilmenite:						
Australia	21,953	218	14,334	142	29,590	378
Canada	5,888	122	317	11	172	6
Finland	302	18	--	--	--	--
India	--	--	--	--	[2] 3,360	30
Malaysia	--	--	[2] 185	2	16,327	224
Sweden	--	--	--	--	20,242	236
Total	28,093	358	14,836	155	69,691	[2] 875
Titanium slag [3]	152,661	6,561	298,259	13,124	237,248	10,981
Rutile: [4]						
Australia	196,555	21,664	220,025	24,041	174,764	24,378
Austria [5]	--	--	22	8	--	--
Canada [5]	--	--	20	3	134	18
Denmark [5]	--	--	18	2	20	8
India	13,175	1,118	--	--	28,472	2,272
Japan	--	--	448	26	5,405	488
Malaysia [5]	--	--	--	--	23	5
Sierra Leone	18,054	1,472	--	--	--	--
Total	227,784	24,254	220,633	24,074	208,808	27,158
Titaniferous iron ore [7]	134,120	2,423	82,133	954	88,513	1,395

[1] Data adjusted by Bureau of Mines, U.S. Department of the Interior.
[2] May have been used in heavy aggregate.
[3] Data does not add to total shown because of independent rounding.
[4] All from Canada.
[5] Includes synthetic rutile.
[6] Country of transshipment rather than country of production.
[7] Includes materials consumed for purposes other than production of titanium commodities, principally heavy aggregate and steel furnace flux. All from Canada.

Table 10.—U.S. imports for consumption of unwrought titanium and waste and scrap
(Short tons and thousand dollars)

Country	1971		1972		1973	
	Quantity	Value	Quantity	Value	Quantity	Value
Austria	4	3	--	--	758	404
Canada	118	128	12	9	120	116
France	--	--	10	10	17	20
Germany, West	41	28	141	147	311	492
Italy	[1]	1	[1]	1	11	9
Japan	2,523	4,375	2,345	4,255	2,960	5,508
Netherlands	3	3	2	2	12	17
South Africa, Republic of	--	--	2	1	--	--
U.S.S.R.	214	331	1,408	2,109	1,628	2,504
United Kingdom	120	131	253	420	824	1,401
Total	3,023	5,000	4,173	6,954	6,641	10,471

[1] Less than ½ unit.

Principal suppliers were West Germany and Canada, 23% each, and the United Kingdom and France, 14% each.

Imports of synthetic rutile from all three producing nations—Australia, India, and Japan—continued during the year. Shipments were reported from both current production and inventory.

WORLD REVIEW

Australia.—It was announced in August that Australia's Federal budget for 1973–74 for the first time contained no provision for tax concessions to private companies, including mining companies. In addition the Federal Government is restricting exports of minerals by setting minimum prices.

Restrictions inspired by environmental considerations were reported to have prevented mining of about one-fourth of the known mineral sand reserves on Australia's east coast, at an estimated cost of A$300 million in exports. NL Industries' $7.5 million beach sand project in Queensland was rejected by State authorities "for environmental reasons" although rehabilitation of the land following beach sand mining is usually successful.

Elsewhere on the east coast, production slowly advanced from the low fourth quarter of 1972. Totals for the year for New South Wales and Queensland were 351,000 tons of rutile and 38,900 tons of ilmenite.

A process by which ilmenite is upgraded to rutile grade, jointly owned by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and Murphyores Incorporated Pty. Ltd., was being tested jointly by Murphyores and Mitsubishi Chemical Industries, Ltd., in a pilot plant at Kurosaki, Japan. Planning began about midyear for a commercial-scale plant, using the process, to be built in Australia. Successful exploitation will permit expanded use of east coast ilmenites, which were in minimal demand for pigment production because of their chromium and vanadium content.

Mining activity along a 100-mile stretch of the Australian west coast continued at a high level during the year. Expansion of mineral sands production is proceeding from Jurien Bay to Geraldton, where proved and probable reserves exceed 130 million tons of heavy-sand products. Companies involved are Allied Eneabba Pty. Ltd., Ilmenite Pty. Ltd., A. V. Jennings Industries (Australia) Ltd., and Westcoast Rutile Pty. Ltd.

Allied Eneabba formally commissioned its 45,000-ton-per-year pilot plant on April 6. Operations at this scale apparently were successful, since in November it was announced that the company will begin construction of a 350,000-ton-per-year plant at a cost of about $12.4 million, to be fully operational by late 1975. Anticipated annual production at that time will be 200,000 tons of ilmenite and 50,000 tons of rutile. Leucoxene, zircon, monazite, and kyanite will also be produced in commercial quantities. During the pilot operation it became clear that dredging the deposit from a moving dredge pond was unsatisfactory; future mining will be conducted by dry methods. For the time being, exports will be made from the port of Geraldton, but it is possible that the company will build
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tons of upgraded ilmenite between February 1, 1969, and June 30, 1973.

Brazil.—Cia. Vale do Rio Doce and two Japanese companies, Ishihara Sangyo Kaisha, Ltd., and C. Itoh, Ltd., signed an agreement to evaluate anatase resources in a carbonatite formation near Araxá, Minas Gerais. The Departamento Nacional de Produção Mineral (DNPM) evaluated reserves at 1,600 million tons of ore containing 10% TiO_2. The same two Japanese companies also signed an agreement with Cia. Brasileira de Tecnologia Nuclear to appraise the possibility of exploiting ilmenite beach sand resources in Espírito Santo to blend with the anatase as feed for a titania pigment plant. Earliest possible target date will be 1976.

Canada.—In December, Quebec Iron & Titanium Corp. announced plans to expand throughput of ilmenite ore at its Sorel, Quebec, plant to 2.2 million tons. The expansion will cost $8.8 million. An additional $2.6 million will be invested in pollution abatement at Sorel. Project completion is scheduled for mid-1975. Canadian pigment production was reported at 46,318 tons for the year.

India.—Recent estimates of ilmenite reserves and resources in India were placed at 356 million tons by the Geological Survey of India; by extension, reserves of rutile, monazite, and other associated minerals also are substantial. Indian Rare Earths, Ltd., a government corporation, is the sole beach sand mining entity. Annual capacity of the two company beneficiation plants, one at Manavalakurichi, Tamil Nadu, the other at Chavara, Kerala, totals 175,000 tons of ilmenite, 7,700 tons of rutile, and some zircon, monazite, garnet, and sillimanite. A 30% expansion at Chavara, underway during the year, will bring total ilmenite capacity to more than 200,000 tons.

The synthetic rutile facility of Dhrangadhra Chemical Works, Ltd., based on the Benilite process and obtaining its hydrochloric acid from a source adjacent to its location at Sahupuram, Tamil Nadu, was reported to have exported 38,000 tons of product to the United States up to March 31, 1973. The synthetic rutile contains 90%–92% TiO_2, 0.25% V_2O_5, and 0.2% Cr_2O_3.

Political difficulties have delayed the authorization to construct a titanium products complex at Chavara, issued originally to Ballarpur Paper and Strawboard Mills in 1968.

Italy.—The sulfate-process pigment plant of Montecatini Edison S.p.A. (Montedison) at Scarlino was the target of much criticism because of its practice of disposing of waste by dumping at sea. Quantities dumped ranged from 2,500 to 3,000 tons per day. Montedison sought temporary solutions by converting a portion of its effluent to ferrous oxide and reclaiming sulfuric acid, and also by disposing of its waste at depths below the normal habitat of most marine life. However, in September a local magistrate ordered seizure of the two ships used to move waste to the dumping grounds. As a long-range solution, Montedison was committed to adopt a process developed by New Jersey Zinc Co. to separate out ferrous sulfate and concentrate the remaining acid sufficiently for reuse. However, the recovery plant will probably be operative no earlier than mid-1976; meanwhile resumption of operations depends on further court action.

Montedison also contracted to build a 100,000-ton-per-year pigment plant in the U.S.S.R., payment to be received in the form of pigment produced at the plant.

Japan.—Ishihara Sangyo Kaisha, Ltd., reported that experience with its synthetic rutile product in making chloride-process titania pigment has been favorable. Kerr-McGee Chemical Corp. uses some of Ishihara's material in the feedstock to its pigment plant at Hamilton, Miss.

Following environmentally-induced shutdowns of pigment plants during 1972, supplies declined to less than domestic demand. As a result, Japan had no pigment available for export, and was offering to import from producing nations at prices somewhat in excess of those current in the United States. The shortfall of Japanese production was estimated at 11,000 tons for the year.

Japanese companies produced 7,173 tons

Table 11.—Titanium: World production of concentrates (ilmenite, rutile, and titaniferous slag), by country

(Short tons)

Country [1]	1971	1972	1973 [p]
Ilmenite: [2]			
Australia [3]	314,116	781,324	781,493
Brazil [4]	10,906	3,849	4,599
Finland	153,772	164,795	175,267
India	72,752	78,774	e 79,000
Japan	2,619	2,331	e 2,400
Malaysia [5]	171,941	167,743	e 167,800
Norway	707,198	670,723	803,610
Portugal	981	829	e 880
Spain	26,033	25,295	26,088
Sri Lanka	102,396	90,944	e 93,700
United States [6]	683,075	681,644	804,355
Total [7]	r 2,846,789	2,668,251	2,939,192
Rutile:			
Australia	404,283	349,899	361,422
Brazil [3]	129	454	46
India	3,210	3,379	e 3,400
Sierra Leone	13,153	–	–
Sri Lanka [8]	3,100	r 2,800	2,900
Total	r 423,825	356,532	367,768
Titaniferous slag:			
Canada [9]	853,000	920,400	942,700
Japan	6,097	3,668	4,690
Total	859,097	924,068	947,390

e Estimate. p Preliminary. r Revised.

[1] In addition to the countries listed, the U.S.S.R. also produces titanium concentrates, but available information is inadequate to make reliable estimates of output levels.

[2] Titaniferous slag production in Canada and Japan, reported under this heading in previous years, is reported separately in this edition. Ilmenite produced in Canada goes almost entirely into slag production; separate figures are not available.

[3] Includes leucoxene.

[4] Production of Comissão Nacional de Energia Nuclear only.

[5] Exports.

[6] Includes a mixed product containing ilmenite, leucoxene, and rutile.

[7] Contains 70% to 71% TiO_2.

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Sierra Leone.—Ownership of the 60% share of Sierra Rutile, Ltd., was transferred from Armco Steel Corp. to Bethlehem Steel Corp. during the year. Engineering studies, begun in 1972, continued during 1973, and in October Sierra Rutile began to staff key positions. A 100-ton-per-day pilot plant was under construction. Full-scale production at 20,000 tons of feed per day is expected by mid-1975; at this scale, 200 tons of rutile per day may be produced.

In September, the Bayer-Preussag Mining Co. resumed operations at the adjacent Bonthe and Moyamba mines, on a limited scale.

Spain.—Pigment from the 30,000-ton-per-year sulfate-process plant under construction at Huelva by a joint venture of Union Explosivos Rio Tinto (55%) and British Titan, Ltd. (45%), was expected to come on the market in 1975. The cost of the facility was estimated at $20 million. Some imports of ilmenite will be necessary at first. New plans called for expansion to 60,000 tons annually by 1976 and 100,000 tons by 1978. Meanwhile du Pont, which early in the year had been considering Spain as the site of a 100,000-ton-per-year plant, abandoned its interest about mid-year.

Taiwan.—Woodall-Duckham, Ltd., undertook construction of a 30,000-ton-per-year synthetic rutile plant for Taiwan Alkali Co. at Kaohsiung. It will use the Benilite process, which is reputed to be pollution free. The sources of the feedstock and the grade of the product were not specified. Laporte Industries, Ltd., reportedly has signed a forward contract for delivery of 2,000–2,500 tons of the synthetic rutile.

U.S.S.R.—Reports indicated that a titaniferous slag containing 83% titanium dioxide is being made at Zaporozhe. The slag is chlorinated; the tetrachloride is purified and fed to Kroll-type reaction furnaces. New sponge-production facilities were said to be under construction during the year.

Yugoslavia.—A sulfate-process pigment plant of 27,000 tons annual capacity was opened June 30 at Celje. The plant, jointly owned by a Yugoslav and an East German corporation in a 51:49 ratio, was to export part of its production to East Germany. On July 7 production at the $31 million plant was halted by fire. Resumption of full production is expected early in 1974.

TECHNOLOGY

Mineral Deposits, Ltd., an Australian company mining rutile and zircon at Seven Mile Beach, New South Wales, installed Reichert cone concentrators as roughing units in its wet separation plant. A quite low operating cost is claimed. Total power consumption is quoted at 1.36 kilowatt-hours per ton of sand mined.[2]

Since silicates in certain proportions interfere with the effective chlorination of ilmenite in fluidized bed equipment, a mineral-dressing procedure has been devised by which the silicates may be separated on the basis of their selective wetting by an immiscible liquid and consequent spherical agglomeration.[3]

A method for using sulfate-process pigment plant effluent constructively, thereby solving a waste disposal problem, is being tried in Western Australia. Laporte Industries, Ltd., has contracted with Hancock & Wright for the latter to locate part of its manganese dioxide pilot plant at Laporte's Bunbury pigment facility. Treatment of lean manganese ore with the ferrous sulfate wastes permits subsequent extraction of high-grade manganese dioxide; ferric hydroxide becomes the waste product and is relatively less toxic and easier to dispose of than the sulfates.[4]

In spite of the inability of technical observers to find adverse effects in the oceanic dumping areas, pressure against discharging of sulfate-process waste at sea is increasing; the practice soon may no longer be permitted.[5] Three courses are open to the sulfate-process pigment producers: (1) Something useful may be made from the effluent; (2) the effluent can be treated to separate something—most probably sulfuric acid—which can be recycled to the process; or (3) the effluent can be filtered and otherwise treated to make a solid having no pollution potential. Gypsum, copperas, iron powders and ferric oxide, and recycle sulfuric acid are most commonly mentioned as end products of effluent treatment.

Ishihara Sangyo Kaisha, Ltd., makes synthetic rutile by treating partially reduced ilmenite with sulfuric acid. The original plant reached its 27,000-ton capacity by the end of 1971, expanding to 40,000 tons by the end of 1973.[6] The product has been used experimentally as feed to chlorinators making titanium tetrachloride for conversion to titanium sponge. Toho Titanium Ltd., reported satisfactory results and intends using the material commercially.[7]

Basing its work on earlier studies by The Dow Chemical Co. and the U.S. Bureau of Mines, Dow and Howmet Corp. are jointly operating a pilot plant to produce, by fused-salt electrolysis, a titanium metal which will be competitive with Kroll-process sponge. The work is being done at Howmet's research center in Whitehall, Mich. Advantages claimed for the process include smaller capital investment, substantially lower energy needs, fewer pollution control problems, and a higher quality product. Some of the metal produced was converted to ingot, which has obtained some consumer acceptance.[8]

The Wyatt division of U.S. Industries Inc., developed and successfully used a technique by which large sections of titanium metal can be welded in the field. A shield over the welding area permits maintenance of a protective gas atmosphere.[9]

Airco, Inc., developed a method for con-

[2] World Mining. Mining and Concentrating Beach Sands. V. 26, No. 11, October 1973, pp. 49–50.

[3] Sparks, B. D., and R. H. T. Wong. Selective Spherical Agglomeration of Ilmenite Concentrates. Can. Min. & Met. Bull., v. 66, No. 729, January 1973, pp. 73–77.

[4] Industrial Minerals. MnO_2: TiO_2's New Friend? No. 74, November 1973, p. 29.

[5] Chemical Week. Heavy Going Ahead for Waste Discharging at Sea. V. 112, No. 26, June 27, 1973, pp. 45–47.

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Table 4.—Vermiculite exfoliating plants in the United States in 1973

Company	State	County	Nearest city or town
Ari-Zonolite Co	Arizona	Maricopa	Phoenix.
J. P. Austin Assoc., Inc	Pennsylvania	Beaver	Beaver Falls.
J. J. Brouk & Co., Inc	Missouri	St. Louis	St. Louis.
Carolina Wholesale Florists, Inc	North Carolina	Lee	Sanford.
Certain-teed Products Corp., Building Materials Div.	Minnesota	Hennepin	Minneapolis.
Cleveland Building Materials Supply Co., Cleveland Gypsum Co. Div.	Ohio	Cuyahoga	Cleveland.
W. R. Grace & Co., Construction Products Div.	Arkansas	Pulaski	North Little Rock.
	California	Alameda	Newark.
		Los Angeles	Los Angeles.
		Orange	Santa Ana.
	Colorado	Denver	Denver.
	Florida	Broward	Pompano Beach.
		Duval	Jacksonville.
		Hillsborough	Tampa.
	Illinois	Cook	Chicago.
	Kentucky	Campbell	Newport.
	Louisiana	Orleans	New Orleans.
	Maryland	Prince Georges	Muirkirk.
	Massachusetts	Hampshire	Easthampton.
	Michigan	Wayne	Dearborn.
	Minnesota	Hennepin	Minneapolis.
	Missouri	St. Louis	St. Louis.
	Nebraska	Douglas	Omaha.
	New Jersey	Mercer	Trenton.
	New York	Cayuga	Weedsport.
	North Carolina	Guilford	High Point.
	Oregon	Multnomah	Portland.
	Pennsylvania	Lawrence	New Castle.
	South Carolina	Greenville	Travelers Rest.
		Laurens	Enoree.
	Tennessee	Davidson	Nashville.
	Washington	Spokane	Spokane.
	Wisconsin	Milwaukee	Milwaukee.
Hyzer & Lewellen	Pennsylvania	Bucks	Southampton.
International Vermiculite Co	Illinois	Macoupin	Girard.
Koos, Inc	Wisconsin	Kenosha	Kenosha.
La Habra Products, Inc	California	Orange	Anaheim.
McArthur Co	Minnesota	Ramsey	St. Paul.
Mica Pellets, Inc	Illinois	De Kalb	De Kalb.
B. F. Nelson Manufacturing Co	Minnesota	Hennepin	Minneapolis.
Patterson Vermiculite Co	South Carolina	Laurens	Lanford.
Robinson Insulation Co	Montana	Cascade	Great Falls.
	North Dakota	Ward	Minot.
Schmelzer Sales Associates, Inc	Florida	Hillsborough	Tampa.
The Schundler Co	New Jersey	Middlesex	Edison.
Southwest Vermiculite Co	New Mexico	Bernalillo	Albuquerque.
Strong-Lite Products	Arkansas	Jefferson	Pine Bluff.
Supreme Perlite Co	Oregon	Multnomah	Portland.
Texas Vermiculite Co	Oklahoma	Oklahoma	Oklahoma City.
	Texas	Bexar	San Antonio.
		Dallas	Dallas.
Vermiculite of Hawaii, Inc	Hawaii	Honolulu	Honolulu.
Vermiculite Industrial Corp	Pennsylvania	Allegheny	Pittsburgh.
Vermiculite-Intermountain, Inc	Utah	Salt Lake	Salt Lake City.
Vermiculite Products, Inc	Texas	Harris	Houston.

Zinc

By Albert D. McMahon,[1] John M. Hague,[2] a

In many ways 1973 was an outstanding year for zinc in the United States. Highs and lows for items of supply and demand were established, and unique situations developed. It was the best year on record for slab zinc consumption and the worst year for slab zinc production; it was the lowest and highest year for imports of concentrates and metal, respectively; the highest for stockpile releases and exports of concentrates and metal; and prices rose to record levels in both U.S. and world markets. The Government ceiling price control of zinc, administered by the Cost of Living Council, was on and off twice, and the shortage of zinc continued throughout the year. Of the 98 mines accounting for zinc mine production in the United States, the leading 25 mines produced 93% of the total. Missouri, with its byproduct zinc from lead mines in the fairly new southeast lead belt, became the leading zinc-producing State, while Tennessee and New York fell back owing to strikes and operating problems.

Smelter production of slab zinc declined 11% because of a decrease in zinc concentrate imports and the use of more domestic concentrates for American-process zinc oxide. This loss of raw material for the smelters was partially compensated by acquisitions of slab zinc from the national stockpile for remelting and direct shipment to consumers. Closure of the horizontal retort smelter at Amarillo, Tex., was delayed as the Texas Air Control Board rescinded a previous order and issued a variance permitting operations to continue until May 30, 1975. The State of Oklahoma in a similar action extended the variance for the horizontal zinc smelter at Bartlesville, Okla., until June 30, 1975, when it will be replaced by an electrolytic plant. Rehabilitation of the Sauget, Ill., electrolytic plant was completed, and erection of two new plants with a combined

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sold 266,315 short tons of zinc from the stockpile during 1973. Government agencies received 117 tons, which was transferred under authorization of Public Law 89-9, leaving a balance of 21,980 short tons. Commercial sales totaled 266,198 tons as authorized by Public Law 92-283 of April 26, 1972. Of the latter amount, 62,477 tons was sold under the set-aside program, and 204,923 tons was sold to the seven participating primary zinc producers under terms of their long-term contracts. At yearend there remained under Public Law 92-283 approximately 30,085 tons of zinc to be released through primary domestic producers and 25,000 tons in the set-aside program. Based on inventory, actual movement of zinc from the stockpile in 1973 was 272,574 tons. This amount includes the drawdown of some of the zinc that was transferred to the Treasury Department in 1970.

By June 30, 1973, all the zinc that was provided for the initial 75,000-ton set-aside program was sold; therefore, on July 1, 1973, the set-aside program was revised upwards to allow releases of 25,000 tons of zinc per quarter as long as zinc remained in the authorization and at the same time allowing the primary producers to draw more zinc. In the revised program, 5,000 tons of Special High Grade zinc was provided, and consumers were limited to purchases of 120 tons of Special High Grade per quarter or 480 tons of High Grade, Intermediate, or Prime Western. On every quarterly allocation the consumers ordered more zinc than what was made available; consequently, the orders were reduced in proportion to what was available.

In April, the stockpile objective for zinc was reduced from 560,000 tons to 202,700 tons, which created a surplus of 357,300 tons. New legislation, Public Law 93-212, authorizing disposal of this quantity was signed by the President on December 28, 1973. This bill provided that 150,000 tons of zinc be sold direct to the consumers, 75,000 tons during the second quarter of 1974 and 25,000 tons each following quarter for the balance. The remaining 207,300 tons was for the participating primary zinc producers.

The President's economic stabilization program entered phase 3 on January 11, 1973, which removed the mandatory price ceiling on zinc and allowed limited price increases, but on June 13, 1973, phase 4 was established by Presidential order which froze the price of zinc once again. This status remained until December 6, 1973, when the Cost of Living Council was abolished and zinc pricing was decontrolled.

The lead and zinc flexible-tariff bill and the bill to suspend the duty on imports of zinc concentrates were reintroduced in Congress in March 1973. Each incorporated a significant change from the previous bills. The new flexible-tariff bill permitted a larger quantity of zinc metal to enter the United States before the high duties became effective, and the duty suspension bill on zinc concentrates was for 2 years. At yearend, both bills were in the House Ways and Means Committee. Another bill, also in the House Ways and Means Committee, proposed suspension of the duty on imports of zinc metal.

The International Lead and Zinc Study Group held its 17th session in Geneva from November 7–12, 1973, to review developments leading to the current situation and the outlook for these metals. Representatives from 28 of the 30 member countries attended. Representatives of several intergovernmental organizations were also present. The strong growth in zinc consumption featured in 1972 continued through most of 1973, but a slowdown in the rate of growth was forecast for 1974. The 1973 forecasts for mine and metal production were adjusted to increases of 3% and 5%, respectively, over 1972 production; zinc metal consumption, rising strongly in most countries, was expected to register an increase of 10%, following one of 11% in 1972. Producers' stocks were drawn down to very low levels, and a large statistical deficit developed. This situation was expected to continue into 1974. The various price rulings throughout the world created a complex basis for zinc sales. In the United States domestic production was subject to Government price control, substantially under world markets at 20.25 to 21 cents per pound, but imported metal was sold in the United States at much higher levels. The European producer price increased in stages to 31.54 cents per pound, while the London Metal Exchange quotation increased dramatically to over 95 cents per pound. The Statistical Committee set up an ad hoc working party to review the importance of secondary materials as a source for lead and zinc.

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Table 1.—Salient zinc statistics

		1969	1970
United States:			
Production:			
Domestic ores, recoverable content	short tons	553,124	534,136
Value	thousands	$161,512	$163,650
Slab zinc:			
From domestic ores	short tons	458,754	403,963
From foreign ores	do.	581,843	473,858
From scrap	do.	70,563	77,166
Total	do.	1,111,150	954,967
Secondary zinc[1]	do.	307,714	264,074
Exports of slab zinc	do.	9,298	288
Imports (general):			
Ores (zinc content)	do.	602,120	525,759
Slab zinc	do.	324,776	270,413
Stocks, December 31:			
At producer plants	do.	65,788	98,314
At consumer plants	do.	102,007	92,674
Government stockpile	do.	1,142,185	1,141,490
Reprocessed GSA zinc[2]		NA	NA
Consumption:			
Slab zinc	short tons	1,385,380	1,186,951
All classes	do.	1,814,167	1,571,596
Price: Prime Western[3]	cents per pound	14.65	16.32
World:			
Production:			
Mine	short tons	5,888,298	6,023,488
Smelter	do.	5,482,489	5,320,771
Price: Prime Western grade, London	cents per pound	12.96	13.36

r Revised. NA Not available.
[1] Excludes redistilled slab zinc.
[2] Included in total amount withdrawn from Government stockpile.
[3] 1969-70, East St. Louis price; 1971-73 delivered price.

Table 2.—Zinc statistics, 1900–73

(Short tons except as noted)

Year	World		United States									
	World smelter production (thousand tons)	World mine production (thousand tons)	U.S. smelter production (primary)	U.S. mine production	Imports slab zinc	Imports ore zinc content	Exports metal	Exports ore, zinc content	Slab zinc production from secondary materials	Consumption, slab, apparent primary	Consumption, ore, direct	Price cents per pound E. St. Louis
1900	528	NA	123,886	165,948	884	NA	22,401	42,062	NA	99,399	NA	4.30
1901	563	NA	140,822	184,798	278	NA	3,390	44,156	NA	141,679	NA	4.00
1902	603	NA	156,927	212,660	448	NA	3,237	55,733	NA	152,682	NA	4.76
1903	633	NA	159,219	198,630	202	NA	1,521	39,411	NA	154,381	NA	5.25
1904	693	NA	186,702	222,613	341	NA	10,147	35,911	NA	180,911	NA	5.00
1905	727	NA	203,849	234,795	428	NA	5,516	30,946	NA	200,438	60,305	5.90
1906	776	NA	224,770	221,726	1,021	25,076	4,670	27,720	NA	220,781	66,247	6.20
1907	814	NA	249,860	259,951	1,709	26,115	563	20,352	7,050	226,969	56,931	5.50
1908	797	NA	210,424	234,526	881	19,675	1,233	26,108	7,159	214,167	48,004	4.20
1909	854	NA	255,760	305,423	9,464	25,535	334	12,455	9,273	270,730	54,139	5.40
1910	893	NA	269,184	327,712	1,960	16,705	9,244	19,711	12,784	245,884	50,592	5.40
1911	986	NA	286,526	345,260	3,349	14,905	14,355	18,281	14,043	280,059	46,122	5.70
1912	1,061	NA	338,806	378,816	11,115	14,899	7,505	23,349	26,064	340,341	64,032	6.90
1913	1,119	NA	346,676	406,416	6,100	9,424	13,486	17,713	25,991	295,370	70,622	5.60
1914	966	NA	353,049	415,662	880	9,631	74,510	11,110	20,545	299,983	70,619	5.10
1915	923	NA	489,519	587,595	904	31,384	131,410	832	29,764	364,355	79,572	14.20
1916	1,072	NA	668,343	703,317	684	104,005	206,365	78	28,776	459,317	90,276	13.60
1917	1,095	1,214	669,573	713,359	257	84,976	220,064	1,320	16,835	413,643	97,573	8.90
1918	907	1,031	517,927	636,091	35	25,522	106,650	62	9,918	423,792	102,778	8.00
1919	726	889	465,743	548,846	70	13,471	146,297	--	19,748	323,964	100,210	7.00
1920	796	943	463,377	587,524	8,177	13,332	114,267	--	21,371	323,043	116,979	7.80
1921	520	563	200,500	256,640	7,470	2,268	4,956	--	17,573	203,600	57,229	4.70
1922	784	886	354,277	472,032	52	1,003	34,801	1,695	32,988	373,090	94,913	5.70
1923	1,043	1,080	510,434	610,690	21	2,099	32,943	2,804	39,434	446,514	117,543	6.70
1924	1,105	1,613	517,339	637,977	25	1,508	76,241	368	35,486	448,257	109,357	6.30
1925	1,243	1,492	572,946	710,847	24	13,536	76,351	68,951	39,181	500,097	111,227	7.66
1926	1,343	1,767	618,422	774,563	22	14,567	42,920	95,252	40,799	557,026	129,791	7.37
1927	1,440	1,768	592,516	718,541	59	9,513	45,695	46,716	42,784	516,373	121,946	6.25
1928	1,544	1,754	602,581	695,170	2	1,667	25,289	4,518	48,666	626,500	124,090	6.03
1929	1,599	1,891	625,447	724,478	226	14,411	14,411	71	47,348	634,300	138,104	6.49
1930	1,537	1,727	498,045	595,425	281	25,839	4,633	--	34,849	450,900	104,561	4.56
1931	1,099	1,152	291,996	410,318	274	780	643	13	21,625	370,000	74,532	3.64
1932	861	996	207,148	285,231	310	1,904	6,471	--	14,718	259,000	54,932	2.88
1933	1,084	1,250	307,182	384,280	1,890	2,133	1,145	809	30,087	350,300	71,622	4.03
1934	1,287	1,491	363,590	438,726	1,725	14,277	5,105	3,621	19,591	359,900	76,331	4.16
1935	1,468	1,600	420,634	517,903	4,444	10,520	1,617	461	28,650	473,000	85,722	4.33
1936	1,614	1,777	492,132	575,574	11,660	172	37	245	42,209	582,000	95,991	4.90
1937	1,789	1,930	556,904	626,362	37,208	8,812	249	314	51,554	610,000	111,622	6.52
1938	1,726	1,935	446,341	516,703	7,230	18,583	--	135	31,613	421,000	69,099	4.61
1939	1,819	1,972	507,236	583,807	30,898	36,100	4,515	303	50,428	626,000	84,896	5.12
1940	1,786	2,124	675,275	665,068	16,468	180,320	79,091	448	48,917	733,057	95,917	6.34
1941	1,923	2,284	822,020	749,125	34,554	289,213	89,309	--	59,503	827,435	134,815	7.48
1942	1,984	2,308	891,872	768,025	36,394	368,408	133,938	--	53,195	728,169	115,002	8.25
1943	2,028	2,224	942,309	744,196	56,155	539,049	97,439	1	48,215	816,777	114,700	8.25
1944	1,788	2,270	869,302	718,642	63,626	422,694	21,576	--	49,037	888,626	142,256	8.25
1945	1,435	1,781	764,561	614,358	97,116	381,719	7,782	--	49,242	852,311	130,992	8.25
1946	1,534	1,745	728,262	574,833	104,743	272,056	47,224	89	44,516	810,242	133,995	8.73
1947	1,763	1,950	802,495	637,608	72,312	297,959	106,669	1,404	59,542	786,360	145,923	10.50
1948	1,881	2,048	787,764	629,977	93,232	264,203	65,537	3,547	62,320	817,735	132,649	13.58
1949	2,012	2,105	814,782	593,203	126,925	241,179	58,709	2,925	55,041	711,841	88,142	12.15
1950	2,170	2,370	843,467	623,375	155,974	278,573	12,917	1,140	66,970	967,134	134,434	13.88
1951	2,360	2,600	881,633	681,189	88,043	302,777	36,510	3,090	48,657	933,971	133,845	17.99
1952	2,460	2,850	904,479	666,001	115,705	449,636	57,714	3,370	55,111	852,783	109,277	16.21
1953	2,600	2,940	916,105	547,430	234,576	513,724	17,969	2,953	52,875	985,927	118,244	10.86
1954	2,700	2,930	802,425	473,471	156,858	455,427	24,994	--	68,013	884,299	99,247	10.69
1955	2,930	3,200	963,504	514,671	195,696	478,044	18,069	--	66,042	1,119,812	118,135	12.30
1956	3,100	3,430	983,610	542,340	244,978	525,350	8,813	854	72,127	1,008,790	113,388	13.49
1957	3,200	3,470	985,796	531,735	269,007	526,014	10,785	7	72,481	935,620	110,311	11.40
1958	3,010	3,370	781,246	412,005	195,199	461,560	2,073	--	46,605	868,327	94,938	10.31
1959	3,150	3,440	798,666	425,303	156,963	500,115	11,629	1	57,818	956,197	108,070	11.46
1960	3,335	3,680	799,516	435,427	120,767	457,155	75,144	13	68,731	877,884	88,275	12.95
1961	3,580	3,845	846,795	464,390	127,562	415,700	50,055	1,670	55,237	931,213	97,251	11.55
1962	3,755	3,930	879,395	505,491	141,957	467,398	36,102	136	58,880	1,031,821	101,582	11.63
1963	3,844	4,036	892,584	529,254	144,757	372,769	33,853	17	60,303	1,105,113	104,705	12.01
1964	4,071	4,440	954,084	574,858	118,340	357,145	26,515	39	71,596	1,207,268	105,948	13.57
1965	4,353	4,742	994,402	611,153	152,990	428,040	5,939	NA	83,619	1,354,092	122,892	14.50
1966	4,498	4,942	1,025,066	572,558	278,175	521,320	1,406	NA	83,263	1,423,666	126,696	14.50
1967	4,548	5,330	938,830	549,413	222,112	534,092	16,809	NA	73,505	1,250,673	114,301	13.85
1968	5,101	5,484	1,020,891	529,446	304,576	543,366	33,011	NA	79,865	1,350,656	124,109	13.50
1969	5,482	5,888	1,040,597	553,124	324,776	602,120	9,298	NA	70,563	1,385,380	126,712	14.66
1970	5,321	6,023	877,811	534,136	270,413	525,759	288	NA	77,156	1,186,951	124,781	15.32
1971	5,229	6,079	766,433	502,543	319,568	342,521	13,346	NA	80,923	1,254,059	119,254	[1] 16.13
1972	5,646	6,221	633,180	478,318	522,612	254,868	4,324	NA	73,718	1,418,349	118,305	[1] 17.75
1973	5,795	6,377	541,319	478,850	588,725	199,053	14,566	NA	87,466	1,503,938	129,651	[1] 20.66

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[1] Delivered.

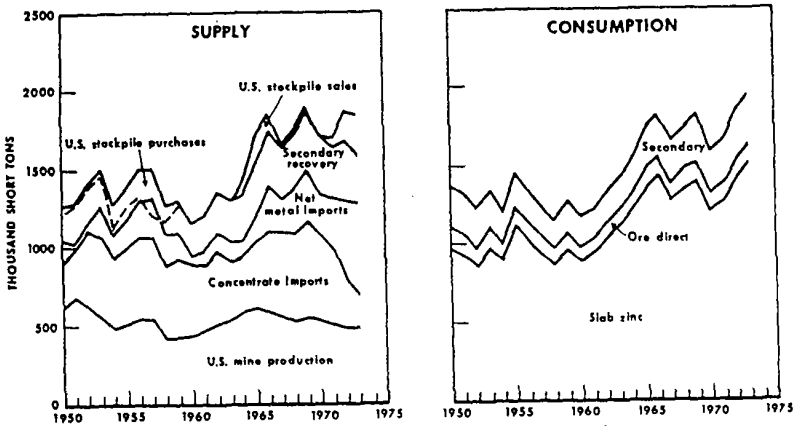

Figure 1.—Trends in supply and consumption in the United States.

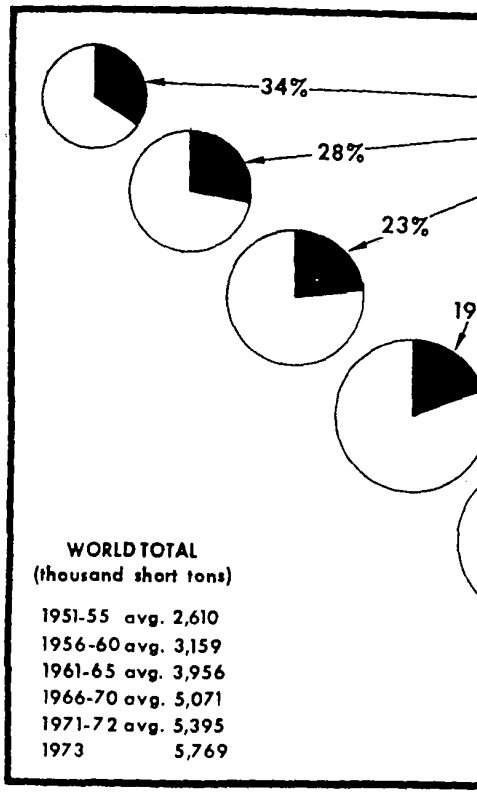

Figure 2.—Trends of United States percentage

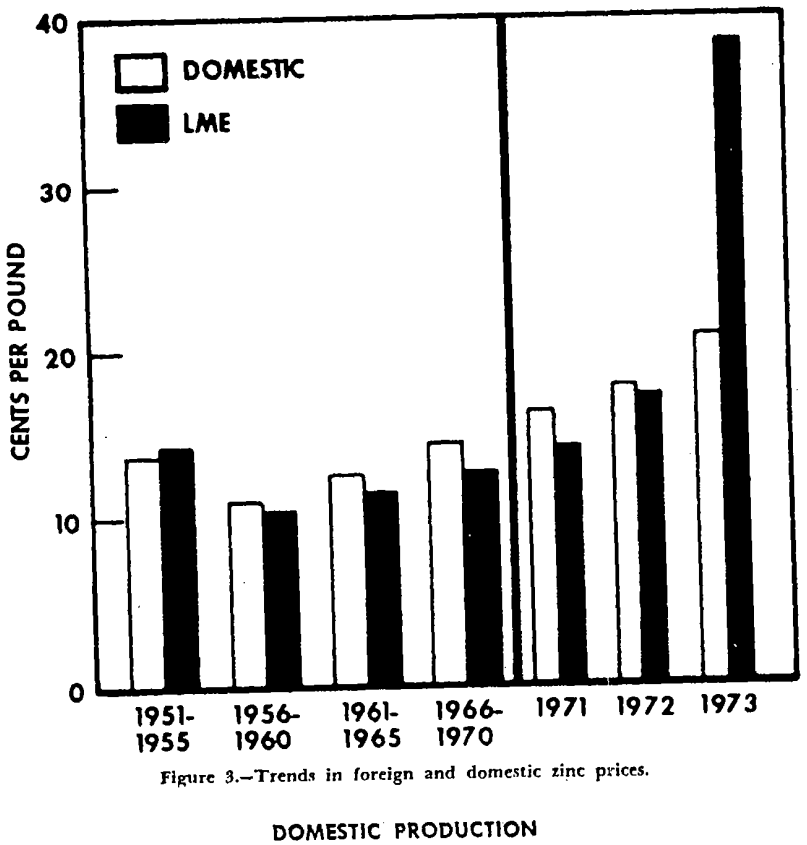

Figure 3.—Trends in foreign and domestic zinc prices.

DOMESTIC PRODUCTION

MINE PRODUCTION

Mines in the United States produced 478,850 tons of recoverable zinc, 532 tons more than in 1972 and the first increase since 1969. Production was reported in 18 States. Seven States recorded increases over that of 1972, and 11 States registered decreases. Missouri with its byproduct zinc recovery from lead ores led the Nation in zinc production with 33% more than in 1972. New York moved up into second place with a 34% increase, and Tennessee dropped to third with a decline of 37%. Colorado, Idaho, and New Jersey followed in order, repeating the 1972 pattern. The States east of the Mississippi River accounted for 52% of the U.S. 1973 mine production.

Sources of zinc production for 1973 are shown in table 5 according to the principal metal or combination of metals extracted. The percentage distribution is as follows: Zinc ore, 57%; zinc-lead ore, 19%; lead ores, 18%; copper-zinc and copper-lead-zinc ores, 5%; all other sources, 1%.

The 25 leading mines listed in table 6 accounted for 93% of the domestic recoverable mine production. The five leading mines produced 43%, and the first 10 mined 63%.

Missouri attained first place among the zinc-producing States with a 33% increase over 1972. Byproduct zinc production from St. Joe Minerals Corp.'s four operating lead mines in the New Lead Belt in southeast Missouri (Fletcher, Viburnum, Indian Creek, and Brushy Creek) increased in 1973, and more is expected in 1974. The mills at Fletcher and Brushy Creek are among the most modern in the industry and incorporate computer-controlled processes allowing the entire plant to be operated by only a few employees.[3] The Missouri mine-mill-smelter complex, owned jointly by American Metal Climax, Inc. (AMAX) and Homestake Mining Co., benefited from higher production, favorable ore grade, and higher prices. About 1.6 million tons of ore were mined and milled in 1973, an increase of 10% over 1972. Production of zinc concentrate was up 42% to 116,500 tons.[4] The Magmont mine at Bixby, Mo., operated by Cominco American Incorporated, a joint venture of Cominco, Ltd. and Dresser Industries, Inc., produced 934,000 tons of ore averaging 8.3% combined lead and zinc compared with 1,034,000 tons of 7.9% ore in 1972. Except for a 1-month strike in June, a high level of production was maintained throughout the year.[5]

Byproduct zinc output by the Ozark Lead Co. was lower in 1973 because of a 2-month strike which ended on April 30 with agreement on a 3-year labor contract. A shortage of skilled underground maintenance personnel also adversely affected production. In 1973, Ozark Lead Co. was awarded the national Sentinels of Safety trophy for outstanding underground mine safety performance. This award is sponsored by the Bureau of Mines and the American Mining Congress. Ozark was honored for the second consecutive year—the first time a U.S. mine has achieved that distinction since 1928.[6]

Mine production in New York, all from the Balmat-Edwards mining complex of St. Joe Minerals Corp., increased 34% in 1973, and higher production is expected in 1974. St. Joe has concentrated on exploration and continued the modernization and underground development programs at the Balmat-Edwards mines. Two mills treat 5,000 tons of ore per day and produce a 55% zinc concentrate. The Balmat mill has over 85% of that capacity and is one of the most automated mills in the world.[7]

Tennessee dropped to third place after ranking first among the mine-producing States for 15 years. The decline of 37%

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day, due largely to a manpower shortage. However, because of an increase in ore grade, higher metal prices, and carefully controlled costs, the mine, operated by ASARCO, had a profitable year. The average grade of ore milled in 1973 was 8.95% zinc, 3.96% lead, 2.8 ounces of silver, and 0.07 ounce of gold per ton, compared with 7.6% zinc, 3.9% lead, 2.4 ounces of silver, and 0.07 ounce of gold per ton in 1972. Ore reserves as of January 1, 1974, were estimated at 2,619,000 tons averaging 9.71% zinc, 4.98% lead, 2.53 ounces of silver, and 0.067 ounce of gold per ton, compared with 2,609,500 tons averaging 9.92% zinc, 5.16% lead, 2.53 ounces of silver, and 0.068 ounce of gold per ton at yearend 1972. The Newmont Mining Corp. Idarado mine was the third largest producer in Colorado, and the Sunnyside mine of Standard Metals Corp. ranked fourth. Idarado's 1973 tonnage milled was only slightly below that of 1972. Additional income from higher metal prices in 1973 was offset by higher operating costs and by increased development expenses required to open more stopes and add to broken ore reserves. In 1973, the mill treated 378,150 tons of ore averaging 3.44% zinc, 2.55% lead, 0.56% copper, 1.39 ounces of silver, and 0.052 ounce of gold per ton. This compares with 386,500 tons milled in 1972 averaging 3.74% zinc, 2.74% lead, 0.72% copper, 1.74 ounces of silver, and 0.063 ounce of gold per ton. Ore reserves at the end of 1973 were 3,241,000 tons averaging 4.61% zinc, 3.36% lead, 0.77% copper, 1.77 ounces of silver, and 0.02 ounce of gold per ton, compared with 2,865,000 tons in 1972 containing averages of 4.80% zinc, 3.31% lead, 0.74% copper, 1.75 ounces of silver, and 0.03 ounce of gold per ton.[13]

Mine production of zinc in Maine increased to 19,640 tons as the Blue Hill mine completed its first full year of operation. The ore body is a difficult one to mine, and at yearend the designed production of 1,000 tons per day had not been attained over a 7-day-per-week basis. Milling throughout the year was restricted to 5 days per week owing to the inability to develop enough ore faces in the mine for a greater production rate. During 1973, 230,200 tons of ore averaging 10.69% zinc and 0.63% copper was milled to produce 885 tons of copper and 23,030 tons of zinc in separate concentrates. Minable ore reserves, including an allowance for dilution and based on past mining experience, on December 31, 1973, were estimated to be 742,000 tons grading 5.68% zinc and 1.7% copper.[14]

Mine production of zinc in Idaho for 1973 increased 19% to 46,107 tons. Ore production at the Bunker Hill mine increased about 17%, reflecting greater production of zinc ores from the upper levels of the mine which have been under development for the last 2 years. Zinc metal content of ore increased 25%, while lead and silver remained unchanged from 1972. Ore reserves were nearly the same as in 1972 with the development of new reserves to replace those mined during the year. The intensified mine exploration program, which began in 1973, is on schedule and will continue for 4 more years. Gross production from the Star mine equaled that of 1972, although zinc production was off by 8%. Higher metal prices more than offset rising operating costs, and the mine experienced its first profitable year since 1967. In 1973 production from company owned and controlled mines amounted to 38,000 tons of zinc, 31,000 tons of lead, and 2.6 million ounces of silver.[15] The Star-Morning mine, 30% owned by Hecla Mining Co. and 70% owned by the Bunker Hill Co., produced 265,781 tons of ore in 1973 assaying 6.68% zinc, 5.18% lead, and 2.79 ounces of silver per ton compared with 263,595 tons in 1972 containing 7.36% zinc, 5.33% lead, and 2.87 ounces of silver per ton.[16] During 1973 an independent contractor operating the Day Mines, Inc., Monitor mine produced 20,674 tons of ore averaging 7.90% zinc, 2.71% lead, and 0.86 ounce of silver per ton from the Gray Rock section. Ore reserves were increased to provide adequate ore for an additional 3 years of production at the current rate.[17]

Mine production of zinc in Utah declined 23%. Zinc, lead, and silver production at the Kennecott Copper Corp. Tintic Division (Utah) decreased in 1973 owing to a critical shortage of skilled miners and mechanics. Also, adverse underground mining conditions inhibited development work and production.[18]

[13] Newmont Mining Corp. 1973 Annual Report. Pp. 9–10.
[14] Kerr Addison Mines Limited. 1973 Annual Report. Pp. 1–6.
[15] Gulf Resources & Chemical Corp. 1973 Annual Report. P. 7.
[16] Hecla Mining Co. 1973 Annual Report. P. 7.
[17] Day Mines, Inc. 1973 Annual Report. P. 3.
[18] Kennecott Copper Corp. 1973 Annual Report. P. 11.

Zinc mine production in Arizona for 1973 was 17% lower than in 1972. The Bruce mine near Bagdad, Ariz., is operated by the Cyprus Bruce Copper and Zinc Co., a wholly owned division of Cyprus Mines Corp. In 1973, mine output of ore was 93,000 tons with an average grade of 12.7% zinc and 3.68% copper. Concentrates produced contained 3,000 tons of copper and 9,500 tons of zinc. Record earnings were achieved owing to good metallurgical results, acceptable production costs, and high average prices received for copper, 60.8 cents per pound, and zinc, 26.4 cents per pound. Exploration did not add much to known reserves, but surface and underground drilling will continue in 1974. Known ore reserves of 467,000 tons with an average grade of 12.4% zinc and 3.72% copper will sustain the operation for about 5 years.[19]

In 1973, mine output of zinc in New Mexico declined 3% from that in 1972. At the ASARCO Ground Hog mine, the zinc content of ore produced was 13,500 tons, compared with 14,000 tons in 1972.[20] UV Industries, Inc., anticipates some zinc production from the reopening of the Hanover mine in New Mexico. Byproduct zinc will be recovered from the copper ore processed at the Continental Mill No. 1 at Bayard, N. Mex. A 2-year program will define the extent of the copper, iron, and zinc reserves.[21]

In Washington, 1973 mine production dropped slightly to 6,378 tons. Pend Oreille Mines & Metals Co. mined and milled 212,289 tons of ore and produced 10,834 tons of zinc concentrate. Development of the Yellowhead Area is underway with several headings being driven from the Yellowhead Exploration Decline. Several areas of low- to high-grade lead-zinc ore have been intercepted, but continuity of mineralization is still a problem that precludes making an accurate estimate of minable ore reserves.[22]

The Callahan Mining Corp. has resumed work at its zinc-lead property near Colville, Wash., under an agreement reached in the last quarter of 1973 granting United States Borax & Chemical Corp. and the British Newfoundland Exploration Ltd. the right to earn jointly up to 51% interest in the property through work expenditures. The program, which will include geologic work and drilling during 1974, is designed to test potential for increasing ore reserves

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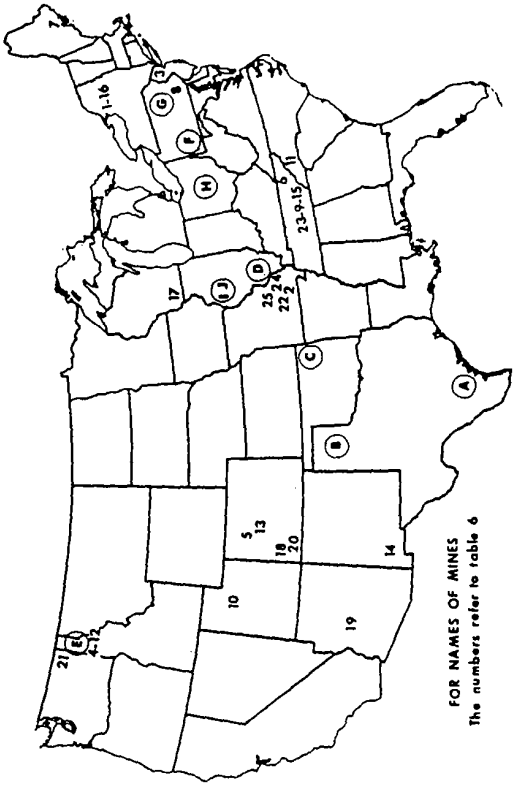

Figure 4.—Locations of the zinc smelters and the 25 leading zinc producing mines in the United States.

more than doubled over that of 1972 and was 4% of the total. Production of all grades of zinc declined except for a 9% increase for Prime Western. Distribution of the total grades was as follows: Special High, 40%; High, 4%; Intermediate, 6%; Brass Special, 10%; and Prime Western, 40%.

ASARCO is considering the construction of an electrolytic zinc refinery on 1,400 acres of land on the Ohio River, near Stephensport, Ky. If undertaken, the plant would be completed by 1976 and would produce about 180,000 tons of zinc per year and significant byproduct sulfuric acid and cadmium. ASARCO's reasons for choosing the Stephensport area were the availability of rail and river barge transportation at the plant site, and its closeness to both ASARCO Tennessee zinc mines and the principal Midwestern markets for refined zinc and sulfuric acid.[24] The cost for construction of the plant was revised upward to $150 million, up $50 million from a previous estimate.[25]

During 1973, ASARCO installed an electric melting furnace at its electrolytic zinc plant in Corpus Christi, Tex., to provide a cleaner and more efficient operation than was possible with the two gas-fired reverberatory furnaces which it replaced. The $3.7 million program to convert from in-plant generation of electric power to purchased power continued and is expected to be completed in 1974. Regarding the Amarillo, Tex., plant, a variance was granted in July by the Texas Air Control Board to allow the plant to operate until May 30, 1975. The operation will be phased out at that time, or shortly thereafter, as the expenditures necessary to meet the applicable air quality standards are not justified at this horizontal retort zinc smelter.[26]

The Sauget, Ill., electrolytic zinc plant, purchased by AMAX in 1972, underwent extensive rehabilitation with initial production commencing in May 1973. A total of 25,000 tons of refined zinc was produced for the year, and an output of 70,000 tons is expected in 1974. Full capacity of 84,000 tons of zinc should be reached by 1975, and an annual production of 1.35 million pounds of cadmium and 150,000 tons of sulfuric acid is also expected. Completion of preleach facilities late in 1974 will permit the processing of high-magnesium-bearing zinc concentrates. At full produc-

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1972, while pigment production was 177,000 tons, an increase of 20%. The strong demand for zinc metal and oxides, combined with reduced U.S. production capacity, contributed to a maximum level of operations.[29]

The New Jersey Zinc Co. announced that it is considering building an electrolytic zinc refinery and a zinc oxide plant near Clarksville, Tenn., and modernizing its Palmerton, Pa., zinc plant. If undertaken, the Clarksville refinery would begin production in 1977, and by 1979 the plant should have an annual capacity of 160,000 tons. The new plant would use zinc concentrates produced at company mines in Tennessee and Virginia. The modernization program at Palmerton includes improved mix houses, modifications of the roasting and acid plant, mechanization of bagroom oxide handling, revisions of materials handling systems, and new dust-control facilities. The modernization program will also increase production capacity for French process and American process zinc oxide.[30]

The Bunker Hill Co., a division of Gulf Resources & Chemical Corp., of Kellogg, Idaho, produced 98,300 tons of zinc in 1973, down from 101,700 tons in 1972. The annual capacity of the zinc plant is approximately 104,000 tons. The drop in production was caused by a work stoppage and by domestic price controls which made it difficult to compete successfully in world ore markets for quality concentrates. Total net sales in 1973 were $102.4 million, compared with $91.9 million in 1972.

The Bunker Hill Co. continued work with the Bureau of Mines on construction of a plant adjacent to the smelter for large-scale testing of the Bureau's citrate process for sulfur dioxide removal from stack gas. The plant was completed, and startup trials have been initiated. The company has budgeted $2.5 million to maintain compliance with regulations under the Environmental Protection Act. Historically Bunker Hill Co. has expended a grand total of $22 million on pollution control and related facilities.[31]

National Zinc Co., Inc., at Bartlesville, Okla., was under attack by the Oklahoma Air Pollution Board, but was granted a 1-year variance to secure financing for an $18 million plant addition to eliminate pollution.[32] The Federal deadline to comply with the pollution law or close down is July 1, 1975. The State of Oklahoma extended its variance until June 30, 1975.[33]

The company announced later that it will build a 50,000-ton-per-year electrolytic plant at Bartlesville to replace the 66-year-old horizontal retort smelter. The scheduled completion date was set for May 31, 1975.[34]

In the latter part of 1973, Engelhard Minerals & Chemicals Corp. contracted to purchase for $4 million the assets of National Zinc Co., Inc. Title to the properties at Bartlesville, Okla., was taken on February 11, 1974. The plan to erect an electrolytic zinc plant at the old site will hold firm. The new installation, estimated to cost approximately $30 million, should be onstream in early 1976, and the company hopes to continue operation of the retort furnaces until they are replaced by the new electrolytic process, but this will be subject to extension of the existing variances issued by pollution control authorities.[35]

Secondary Zinc Smelters.—Zinc recovered from zinc-bearing scrap was 387,539 tons in 1973, nearly the same as in 1972. Semimanufactured forms of zinc- and copper-base alloys accounted for 98% of the new and old scrap. New scrap, chiefly zinc- and copper-base alloys from manufacturers and drosses from galvanizing and die casting pots, accounted for 76% of all the scrap processed. Recovery of new scrap decreased, while old scrap increased to replace that which was not recovered in new scrap. The zinc was recovered in alloys, 53%, principally brass and bronze; in metal, 32%; and in chemical products, 15%.

Slag-Fuming Plants.—Slag-fuming plants process hot and cold lead blast furnace slags and residues which contain from 11% to 23% recoverable zinc to produce zinc oxide fume. The oxide is either sent to zinc smelters or electrolytic refineries for recovery of zinc, or sold to the consumers as zinc oxide. During the year three plants were operating: ASARCO at El Paso, Tex., and East Helena, Mont., and The Bunker Hill Co. at Kellogg, Idaho.

Byproduct Sulfuric Acid.—In 1973, there were nine plants with facilities for roasting zinc sulfide concentrates. Seven plants were equipped with sulfuric-acid-producing facilities, one of which operated solely for producing calcine for subsequent processing to zinc oxide or zinc metal. Two horizontal retort smelters did not have sulfuric-acid-producing facilities, one of

[29] Page 31 of work cited in footnote 9.
[30] American Metal Market. N.J. Zinc Planning 160,000-Ton Smelter. V. 81, No. 133, July 10, 1974, p. 1.
[31] Page 7 of work cited in footnote 15.
[32] Tulsa Tribune. Pollution Agency Grants Extension. V. 79, No. 42, Feb. 21, 1973, p. 9B.
[33] Tulsa Tribune. Antipollution Controversy in Bartlesville is Dying Down. V. 79, No. 31, Feb. 8, 1973, p. 21A.
[34] Metals Week. National Zinc To Build Zinc Plant in Oklahoma. V. 45, No. 2, Jan. 14, 1974, p. 1.
[35] Engelhard Minerals & Chemicals Corp. 1973 Annual Report. P. 3.

CONSUMPTION AN

Consumption of slab zinc in the United States in 1973 was 1,503,938 tons, an increase of 6% over that of 1972. The zinc content of the ore and concentrate used directly in galvanizing or to make pigments and salts was 129,651 tons (118,305 in 1972), and the zinc content of secondary materials to make alloys, zinc dust, and compounds totaled 298,336 tons (307,369 in 1972). Total consumption of zinc for all classes was 1,931,925 tons, an increase of 5% over that of 1972.

Slab zinc consumption was reported by 650 users in 1973. Of the total slab zinc consumed, zinc-base alloys accounted for 610,606 tons (41%); galvanizing, 563,837 tons (37%); brass products, 197,650 tons (13%); rolled zinc, 40,763 tons (3%); zinc oxide, 61,734 tons (4%); and other uses, 29,348 tons (2%). Most of the use categories showed gains over last year. The largest gain was in galvanizing, with an increase of 45,633 tons over that of 1972, followed by die casting alloys with a gain of 31,793 tons over 1972. A net gain of 85,589 tons was realized over last year. While gains were recorded for most of the use categories, losses were noted in slush and sand casting alloys, rolled zinc, and other uses.

Distribution of slab zinc consumed by grade in 1973 was as follows: Special High Grade, 739,447 tons (49%); High Grade, 167,466 (11%); Intermediate, 37,384 tons (3%); Brass Special, 132,148 tons (9%); Prime Western, 426,559 tons (28%); and Remelt, 934 tons (less than 0.1%). Compared with 1972, except for the small decline in Remelt, consumption of all grades of slab zinc increased. The largest increase was in Special High Grade with a gain of 41,866 tons.

Slab zinc consumed by rolling mills was 40,763 tons in 1973, a decrease of 10%

from secondary material and 44% from ore or intermediate products. Lead-free zinc oxide was produced at 12 plants in the United States, and leaded zinc oxide was produced at only 1 plant. At least eight plants produced zinc sulfate, and five produced zinc chloride.

Production of zinc oxide by The New Jersey Zinc Co. and St. Joe Minerals Corp. were described under Smelter and Refinery Production. A third producer using ores or concentrates as a major source material was ASARCO with plants at Columbus, Ohio, and Hillsboro, Ill. Other major zinc oxide producers, such as the Eagle-Picher Industries, Inc., Hillsboro, Ill., plant and the Sherwin-Williams Coffeyville. Kans., plant, used calcines, fume, and secondary materials as raw materials.

Consumption and Uses.—The apparent consumption of zinc oxide increased by 5% from about 259,000 tons in 1972 to 273,000 tons in 1973. Analysis of domestic shipments by industry usage showed the rubber industry as consuming 51% of U.S. shipments, and reported destinations of imported oxide indicated a still higher percentage of imports going to rubber manufacturers. The second-ranking use was photocopying with a 7% annual increase, and third ranking was chemicals with a 15% annual increase. Use of zinc oxide in paints decreased slightly, probably owing to fewer housing starts in 1973. The use of zinc oxide in agriculture may have been partly concealed in "other" or "chemical" destinations. Agriculture is the chief use for zinc sulfate, with lesser amounts going for rayon, flotation reagents, and chemicals. The use of leaded zinc oxide in rubber and paints increased substantially during 1973, regaining the volume of several years ago. Zinc chloride usage declined slightly but continued to be a significant part of zinc compound consumption; incomplete industry returns precluded analysis of shipments by industry.

Prices.—Zinc oxide and compound prices tended to follow increases in the price of zinc metal, but the changes were often announced several days after the metal price change. At the beginning of 1973 prices ranged from 15.75 cents per pound for activation-grade zinc oxide through 18.75 cents for French process to 22 cents for U.S.P. grade. On January 29 price increases were initiated that averaged about 2 cents for each grade. On or about April 1 several companies posted further increases of 1 to 2 cents per pound. By June other suppliers had come up to a scale that ranged from 19 cents for activation grade through 22 cents for French process to 24 cents for U.S.P. grade. Prices remained steady during the period June 13 to December 6, when zinc prices were controlled by the Cost of Living Council. During the second week in December, after release from price control, three companies raised prices about 9 cents per pound so that at yearend most quotations ranged from 30.5 cents for American process lead-free pigment grade through 31.5 cents for French process to 33.5 cents for U.S.P. grade. Leaded zinc oxide was quoted at 17 cents per pound in January 1973 and had risen to 30.25 cents by January 1974. The price of zinc sulfate in June 1973 was reported as $13 per 100 pounds, granular monohydrate industrial, 36% zinc, bags in car-load lots. By yearend this price had become $18.50 per 100 pounds.

Foreign Trade.—Exports of zinc oxide increased by 24% during 1973 to a record 7,600 tons, and lithopone exports decreased by 29% to less than 1,000 tons. Imports of almost all classes of zinc compounds increased in 1973 to a total of 36,500 tons, a 40% gain. As in 1972, zinc oxide was the major component of imports of zinc compounds, with a 42% gain to 27,500 tons. The net imports of zinc oxide, 19,850 tons, thus became about 7% of U.S. supply. Mexico, Canada, and France were major sources, and other European Community countries contributed small tonnages.

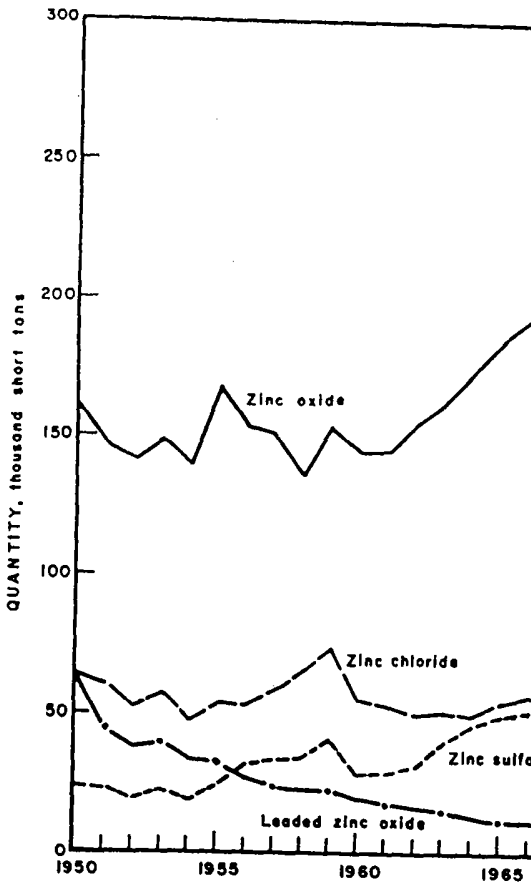

Figure 5.—Trends in shipments of zinc

STOCKS

Producer Stocks.—According to the monthly data reported by producers to the Zinc Institute, Inc., stocks at the beginning of the year were 31,775 tons. By midyear they declined to 22,168 tons, but at yearend they increased to 29,233 tons, just 2,542 tons short of what stocks were at the beginning of the year. The GSA stockpile gave considerable relief; 167,447 tons of zinc passed through the producers either as remelt or direct shipment.

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PRICES

The year began with a three-tier price structure for domestic Prime Western zinc, 18.0, 18.5, and 18.52 cents per pound. Phase 3 of the President's economic stabilization program, effective January 11, 1973, removed the mandatory price ceiling on zinc, and by February 1, the price of Prime Western zinc was increased to 19.0, 19.25, and 19.5 cents per pound. On March 9, another round of price increases began, and by March 28, all the producers but one had increased their price of Prime Western zinc to 20.25 cents per pound. One company, National Zinc Co., Inc., increased its price to 20.5 cents per pound, and on April 19, this same company increased its price to 21 cents per pound while the other producers kept their price at 20.25 cents per pound. During all of this period, the price of Special High Grade zinc was 1 cent per pound higher than that of Prime Western zinc. On June 13, 1973, by Presidential order, the price of zinc was frozen to the last round of increases. Phase 4 of price controls became effective August 12, 1973, when the base price for zinc was set at the price during the last fiscal quarter prior to January 11, 1973, (18 cents per pound). Cost increases were passed through on a dollar-for-dollar basis without the maintenance of profit margins allowed under phases 2 and 3. The Cost of Living Council required a 30-day notice from producers with $100 million sales or more for any price increases. The ceiling prices prevailed until the Cost of Living Council abolished the control on zinc on December 6, 1973. One company immediately raised its price of Prime Western zinc to 32 cents per pound, and others quoted prices between 28 and 30 cents per pound where they remained to yearend.

The foreign producer price (mostly Canada, Peru, and Australia) was always at least 1 cent per pound higher than the U.S. producer price. Coming into the year, imported zinc (Prime Western equivalent) was 19.5 and 20 cents per pound. This price remained in effect until March 8, when the price became 21 cents per pound, but one company representing the Australian producers increased the price of zinc to 22.5 cents per pound on March 29 and to 23.5 cents per pound on May 29. Effective June 12, imported zinc (Prime Western equivalent) ranged from 22.3 to 23.5 cents per pound; however, one Canadian firm passed on the 0.7-cent-per-pound tariff to its U.S. customers. A second Canadian company followed suit on June 30, and a third company raised its price but absorbed the tariff. Effective August 1, 1973, imported zinc (Prime Western equivalent) ranged from 24.3 to 27.5 cents per pound. The high price of 27.5 cents per pound was set on July 26 by an Australian firm. On September 20, the spread increased to 24.3 to 31.0 cents per pound, but on October 1 the range narrowed to 27.3 to 31.0 cents per pound. The high side of the price range increased on November 27 to 36.5 cents per pound, and the final increase for the year on December 21, 1973, occurred on the low end of the range with a price of 31.0 cents per pound.

The European producer price for Good Ordinary Brand (GOB) zinc (Prime Western equivalent) was £173 per metric ton (18.5 cents per pound U.S. equivalent) at the first of the year. During the year the European producer price increased five times, as follows: February 28, £190 per metric ton; June 14, £205 per metric ton; July 16, £220 per metric ton; September 24, £250 per metric ton; and on November 27, £300 per metric ton. The last conversion to U.S. equivalent was 31.5 cents per pound and was the price that prevailed to the end of the year.

The London Metal Exchange (LME) price for zinc started the year at a lower level than the U.S. producer price and the European producer price. The monthly average price for zinc in January was 17.5 cents per pound, but during the year the price fluctuated upward until it reached a record high on December 4, 1973, of 99 cents per pound. The price then declined to 63 cents per pound at yearend.

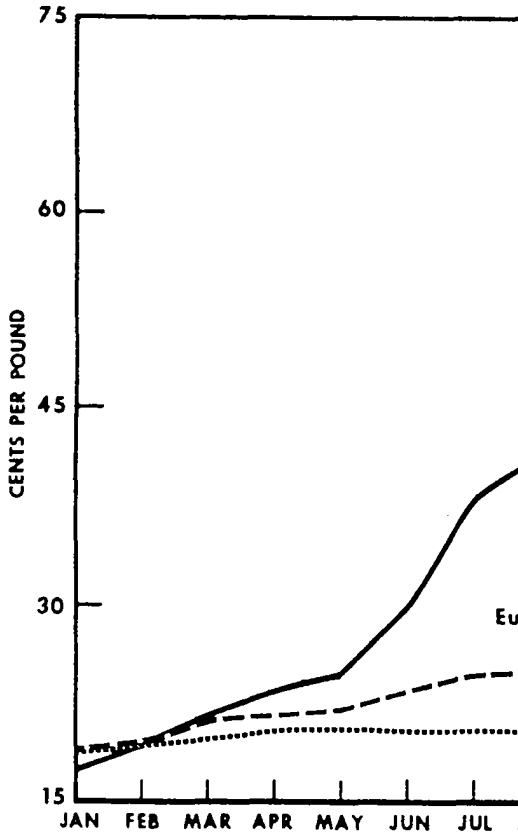

Figure 6.—Average monthly prices in 1973 fo zinc and equivalent foreign

FOREIGN TRADE

Exports of slab zinc increased more than three-fold from 4,324 tons to 14,566 tons in 1973, of which 15% went to Brazil, 15% to Japan, 12% to Venezuela, and 11% to Colombia. Exports of rolled zinc products, sheets, plates, strips, etc., increased 3% over those of 1972; Canada received nearly half, 1,201 tons.

General imports of zinc in ore declined 22% to 199,053 tons in 1973, the lowest since 1940. Canada supplied 62%, or 124,261 tons, and receipts from Mexico accounted for 17%, or 33,878 tons. General imports of metal increased 13% to 588,725 tons.

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No change took place in the tariff rates in 1973. The duties on unmanufactured zinc and zinc-containing materials were as follows: Slab zinc, 0.7 cent per pound; zinc ores, concentrates, and fume, 0.67 cent per pound (on zinc content less specified allowable deductions for processing losses); zinc scrap, including skimmings and drosses, 0.75 cent per pound; and zinc dust, 0.3 cent per pound. The duty rate for unwrought alloys of zinc, which includes diecasting alloys, was 19% ad valorem.

The bill to suspend the U.S. tariff on zinc concentrates (H.R. 6191) passed the House on May 7, 1974, after which it was submitted to the Senate Finance Committee.

WORLD REVIEW

World mine production of zinc in 1973 gained about 3% over that of 1972, continuing the slow but steady growth rate apparent in recent years. Zinc metal production also increased, with gains in Europe and Canada more than making up for the loss of production in the United States. The consumption of zinc in the developing countries continued to grow at a faster rate (12%) than the world average (7%) and helped to maintain a worldwide shortage, driving up prices and spurring the use of substitute materials where available. The generally tight supply situation increased interest in secondary materials and concern for gathering information about their availability and use. Byproducts and scrap were used in greater amounts for production of both zinc metal and zinc compounds.

Argentina.—Compañia Minera Aguilar, a subsidiary of St. Joe Minerals Corp., sustained a 2-week strike in November which was settled after the national government intervened and negotiated a 20% wage increase. Production of zinc concentrates in 1973 was 9% less than in 1972 and was estimated to contain about 43,700 tons of zinc. Two zinc smelters affiliated with Aguilar but not affected by the strike produced about 40,900 tons of zinc in 1973.[36]

Australia.—Mine production of zinc in Australia declined 6% in 1973 to 526,400 short tons of zinc in concentrates. Exports to the United States included 7,281 tons of zinc in concentrates and 42,077 tons of slab zinc, 10% of Australian zinc production.

The decrease in national mine production was due in part to the failure of a stope wall in the New Broken Hill Consolidated Mines at about the No. 17 level during the first week in October. The temporary closure of haulage on the No. 15 level caused a shortfall in production at this most productive Australian zinc mine during the last quarter. Zinc Corp., North Broken Hill, Mount Isa Mines, West Coast Mines, and Cobar mines contributed a normal or slightly reduced zinc production during 1973. Broken Hill South, Ltd., recovered about 8,000 tons of zinc from dumps, partially replacing the loss of production from the closed Broken Hill South mine.

Published ore reserves and announced plans for expansion predicted greater zinc production from Australia in the future. Mount Isa Mines (MIM) was developing the Hilton mine, about 12 miles north of Mount Isa, and was increasing capacity at the Mount Isa concentrator. Both mines have large reserves of zinc-lead-silver ores, 36 million tons at Hilton and 56 million tons at Mount Isa.[37] MIM also holds large reserves or resources of zinc-lead ores in the McArthur River area, Northern Territory, estimated to contain 200 million tons assaying 9% zinc.[38] E–Z Industries, Ltd., planned to expand zinc capacity at its mines in Tasmania and its smelter at Risdon to a yearly production of 242,000 tons of zinc.

Smelter production in 1973 was 328,000 short tons of zinc: Risdon (E–Z Industries) 213,000, Cockle Creek (Conzinc Rio Tinto of Australia) 65,000, and Port Pirie (BHAS Proprietary, Ltd.) 50,000.

Belgium.—Zinc production increased 9% during 1973 to a total of 309,800 tons. Exports to the United States were about 39,400 tons of slab zinc. Metallurgie Hoboken-Overpelt was constructing a new electrolytic zinc refinery at Overpelt scheduled for commissioning in mid-1974; the older zinc retorts were shut down progressively so that zinc production decreased in 1973 from the 1972 output. Société de Prayon, S.A. sustained its first full year of production at its new electrolytic plant at Ehein. Société des Mines et Fonderies de Zinc de la Viellie Montagne, with four plants in Belgium, produced a total of 281,000 tons of ingot zinc, 5% more than in 1972, but plants in France participated in this production.

Brazil.—The two electrolytic zinc plants in Brazil produced 24,600 tons of zinc in 1973, achieving a 43% increase from production in 1972. Both plants are supplied by the silicate and oxide ores from Vazante, Minas Gerais. The Companhia Minera de Metais, one of the two producers, has announced plans to increase production to about 29,000 tons annually by 1977, using a new process developed by Metais and a German firm, Lurgi Chemie und Huettentechnik.

Canada.—Mine production of zinc increased again in 1973 to 1.49 million short tons of zinc content in concentrates. Zinc smelter production increased to 587,000 tons in 1973, a 12% increase from the 525,000 tons in 1972. Canada thus retained by a wide margin its position as the world's largest zinc-mining country and passed the United States to become the third largest zinc-refining country. A substantial part of this production came to the United States. Of a total of 874,900 short tons of zinc in concentrates exported from Canada, 124,300 tons was imported into the United States; of 463,000 tons of metal exported, 345,000 tons came to the United States as general imports. Consumption of zinc in Canada was estimated as 140,000 tons, a 9% increase from 1972 consumption.

In the Northwest Territories, Pine Point Mines Ltd., with Cominco, Ltd., acting as operator, was the major zinc producer mining 3,896,000 tons of ore averaging 6.0% zinc and 2.9% lead. Concentrates from this operation were sold to Canadian refineries, chiefly Cominco, 62%. The remainder was exported with Europe receiving 20%, Japan, 10%, India, 5%, and South America and United States, collectively, 3%.[39] Cominco continued exploration of silver-zinc deposits near Bathurst Inlet and at the Polaris lead-zinc deposit on Little Cornwallis Island. Several thousand tons of high-grade ore

[36] Lead and Zinc Statistics, Monthly Bulletin of the International Lead and Zinc Study Group. V. 14, No. 6, June 1974, pp. 16–17.
[37] M.I.M. Holdings Ltd. Annual Report for the Year Ending June 30, 1973. P. 7.
[38] Mount Isa Mines. Metals Sourcebook. No. 21, Oct. 29, 1973, p. 2.

[39] Pine Point P. 3.
[40] Page 12 of
[41] Texasgulf. 1973, p. 6.

northern British Columbia and to make a link in southwest British Columbia bypassing the Fraser River Canyon; mineral traffic and the development of new mining areas were primary reasons for the proposed construction. The Cominco smelter at Trail produced 248,000 tons of zinc in 1973; operations were hampered in December by an electrical failure and fire in the roaster control room, but by yearend zinc output had returned to normal.

In Manitoba, Hudson Bay Mining & Smelting Co. Ltd. achieved an 8% increase in zinc production in 1973 to 82,882 tons, and began development work on the new Centennial mine. Nine operating mines in the Flin Flon area produced continuously during the year. Ore reserves in the Flin Flon district at yearend were 18,000,600 tons containing 3.1% copper, 2.9% zinc, 0.03 ounce of gold, and 0.5 ounce of silver per ton.[42] Sherritt Gordon Mines, Limited, continued to operate the Fox Lake copper-zinc mine and in May began production from the new copper-zinc Ruttan mine. Production of zinc in concentrates at the two mines was 7,060 tons at Fox Lake and 17,130 tons at Ruttan, making Sherritt Gordon a major zinc producer, in addition to its substantial copper production. Concentrates went to Hudson Bay at Flin Flon, to Mitsubishi Metal Corp. in Japan, and to a zinc plant in the United States.[43] Freeport Canadian Exploration Co., in a joint venture with Beth-Canada Mining Co., discovered a copper-zinc deposit near Reed Lake, Manitoba; a preliminary estimate of the tonnage and grade was given at 1 million tons with about 2% copper and 4% zinc. The two companies are subsidiaries of Freeport Minerals Co. and Bethlehem Steel Corp., respectively.

The largest zinc producer in Ontario was Ecstall Mining Ltd., a subsidiary of Texasgulf, Inc., with a production of about 295,000 tons of zinc in concentrates from the Kidd Creek mine and 107,100 tons of zinc metal from the nearby zinc plant at Hoyle. Annual capacity of the refinery was to be increased from 120,000 to 150,000 tons per year. Production from the open pit mine will be gradually replaced by underground mining within a few years. During 1973, the Canadian Development Corporation, a Crown Corp., acquired a large share of the stock of Texasgulf, Inc., through a public tender offer.

Other zinc mines active in Ontario were Mattagami Lake Mines Ltd., Mattabi mine averaging over 3,000 tons per day grading 11.36% zinc, 1.10% copper, 1.06% lead, and 5.30 ounces of silver per ton and Noranda Mines Limited, Geco mine producing 4,880 tons per day grading 4.53% zinc, 1.70% copper, and 1.63 ounces of silver per ton.[44] The construction of a 1,200 ton-per-day concentrator and mine was started in the Sturgeon Lake area by Sturgeon Lake Mines Ltd. and Falconbridge Nickel Mines Ltd. At Parham in southeastern Ontario the Long Lake mine, a small mine by modern standards, began operation in March, producing about 7,000 tons of crude ore per month with a 10-man crew running the mine and heavy media plant. The upgraded ore, 4,600 tons per month, is trucked to St. Joe Minerals Corp. at Balmat, N.Y. Lynx Canada Exploration Ltd. and Canadian Reynolds Metals Co. Ltd. share ownership of the mine.

Hudson Bay Mining & Smelting Co. Ltd. began construction of a new zinc oxide plant near Brampton, Ontario. The planned initial capacity was 60 tons, increasing ultimately to 100 tons per day; as production reached capacity, an older plant in Montreal operated by a subsidiary of Hudson Bay, Zochem Ltd., would be gradually closed down.

Mattagami Lake Mines, Ltd., continued to be a major zinc producer in Quebec, milling 1,387,000 tons of ore averaging 7.48% zinc, 0.57% copper and 0.84 ounce of silver per ton. The Orchan Mines mill treated 270,100 tons averaging 7.39% zinc and 0.97% copper from the Orchan mine and 180,130 tons averaging 3.33% zinc and 1.45% copper from the Garon Lake mine. Kerr Addison Mines continued to operate the Normetal Mine and the Joutel Mine, producing 12,500 tons and 13,100 tons of zinc in concentrates, respectively. The Lake Dufault division of Falconbridge Copper Ltd. produced 18,795 tons of zinc in concentrates as a coproduct of copper production from ore that averaged 3.65% copper and 4.41% zinc. Manitou Barvue Mines Ltd. reopened the Louvem silver-zinc mine and operated its mill at a rate of 20,000 tons per month through 1973.

The Sullivan Mining Group Ltd. closed the Weldon mine in June 1973 but continued operations at the Cupra and D'Estrie divisions, both producing zinc concentrates from copper-zinc ores. Development of the Clinton Copper Mines property was started with joint control by Dome Mines, Ltd.; reserves contain minor amounts of zinc. Total production of the Sullivan Group for fiscal year 1972–73 was 9,115 tons of zinc.

Canadian Electrolytic Zinc Ltd., owned by Mattagami Lake Mines, Noranda, Orchan Mines, and Kerr-Addison, announced that its electrolytic zinc plant is to be expanded from the present capacity of 400 tons to 620 tons per day by 1975. The expansion will cost $30 million to $45 million and will increase yearly production capacity from 145,000 to 225,000 tons.

In New Brunswick, the Brunswick Mining & Smelting Corp. Ltd. continued to operate the No. 6 and No. 12 mines and the concentrator treated 3,288,000 tons of ore averaging 9.8% combined lead and zinc.[45] The conversion of the zinc-lead Imperial-type smelter at Belledune to a lead smelter was completed early in 1973 and zinc concentrates are now shipped overseas. During 1973, Amax Base Metal Group, operating the Heath Steele Mines, produced 1,078,000 tons of ore yielding 78,000 tons of zinc concentrate. An expansion program started in 1972 proceeded toward an eventual increase in mine-mill production of about one-third when completed in 1975.[46] The Sullivan Mining Group, Ltd., announced plans to resume its Nigadoo River Mines operations in the Bathurst district, subject to negotiating satisfactory smelter contracts.

Nova Scotia was the scene of exploration at a potential zinc-lead property in the Gays River district. The mining division of Imperial Oil Ltd. was drilling on the property of Cuvier Mines with three drill rigs testing zinc-lead mineralization in dolomitized limestone over a wide area. A large tonnage of ore was reported to average 2.75% lead and 3.39% zinc.

A deposit with a similar Appalachian-type environment at Daniel's Harbor in Newfoundland was the subject of a feasibility study by Newfoundland Zinc Mines, Ltd., a subsidiary of Teck Corp., with American Metal Climax, Inc. as a coventurer. A high-grade portion of the ore body was reported to contain 4,400,000 tons averaging 8.8% zinc.

[42] Hudson Bay Mining & Smelting Co. Ltd. 1973 Annual Report. P. 13.
[43] Sherritt Gordon Mines Ltd. 1973 Annual Report. P. 4.
[44] Noranda Mines Limited. 1973 Annual Report. Pp. 10–15.

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and ASARCO was formed to drive an exploratory tunnel beneath the old Rosario mine.

India.—Although lead and zinc prospects are known throughout India and Government statistics claim large ore reserves, Indian zinc smelter production in 1973 was only one-third of its rated capacity and accounted for only 16% of its consumption with the balance made up from imports. Hindustan Zinc, Ltd., produced 2,200 tons and has a capacity for 19,800 tons per year, and Cominco Binani Zinc Ltd. produced 11,800 tons but has a capacity for 22,000 tons per year. Hindustan's Debari smelter was shut down for much of the year because of a breakdown of the melting furnace, and at Cominco Binani labor disputes put the plant out of action for 3 months. Hindustan Zinc announced plans to increase mine capacity in the Zawar area and to expand smelter capacity to 45,000 tons by 1978–79.

Ireland.—Tara Exploration and Development Co. Ltd. started to develop its potentially large mine at Navan, County Meath, in July 1973, with an inclined entry and a 1,000-foot vertical shaft. Commercial production of ores was scheduled to begin in late 1975. The development program proceeded despite a setback by an adverse judicial decision concerning ownership of the northern part of the proposed state mining lease containing about 10 million tons of ore. The balance of the ore body, now under development, was said to contain about 67 million tons grading 10.9% zinc and 2.6% lead. Near the end of 1973, an agreement was negotiated with Noranda Mines Limited under which Noranda would arrange a $6 million line of credit in return for warrants to purchase 100,000 shares of Tara and other considerations subject to Tara obtaining an acceptable state mining lease. As a result of this association, Tara, together with its controlling parent, Northgate Exploration Ltd., and Noranda, began a joint study as to the feasibility of constructing an electrolytic zinc reduction plant in Ireland.[50]

Two other major lead-zinc mines in Ireland continued production in 1973. The Tynagh mine of Irish Base Metals Ltd. in County Galway produced 16,500 short tons of zinc, 1,300 tons of copper, and 45,000 tons of lead in concentrates. The mine at Silvermines, County Tipperary, 75% owned by Mogul of Ireland Ltd., treated 917,400 tons of ore to produce concentrates containing 59,500 tons of zinc and 17,600 tons of lead.[51]

The Irish Government announced in September 1973 that the 20-year tax holiday on profits of base metal mines was to end. A new tax system, beginning April 1, 1974, will allow prospecting and depreciation deductions with special provisions for companies already in production and relief for marginal mines.

Italy.—Production of slab zinc in Italy reportedly increased from 171,800 tons in 1972 to 209,500 tons in 1973. This reflected the operation during 1973 of the new Imperial Smelting furnace by Ammi Sarda, S.p.a., at Porto Vesme, Sardinia. Italy is still a net importer of zinc, importing about 53,000 tons of metal in 1973.

Japan.—Japan once again achieved world record production with a total of 929,000 tons of zinc metal. Mine production supplied about 291,000 tons of zinc in concentrates. Consumption of zinc increased 14% to 834,800 tons in 1973, and demand for remelted zinc metal increased by 20% to 59,300 tons, making total slab zinc consumption about 894,100 tons.[52] Akita Zinc Co. Ltd. reported that the program to double capacity at its Iljima plant to 14,000 tons per month was expected to be completed in the summer of 1974 with full production at the end of the year. At the end of 1973, Mitsui Mining & Smelting Co. Ltd. was increasing the capacity of its Hikoshima refinery from 5,500 to 7,700 tons per month. However, all Japanese zinc producers predicted setbacks in scheduled zinc production in 1974 owing to power restrictions caused by the energy shortage.

Mexico.—Production of zinc from mines in 1973 continued at a rate about the same as in 1972, slightly over 299,000 short tons. Smelter output of primary metal was below that of 1972, 74,000 tons versus 87,500 tons. Exports of zinc concentrates and metal from Mexico to the United States decreased sharply in 1973 from exports in 1972. U.S. general imports of zinc from Mexico were about 33,900 tons of zinc in concentrates and 1,900 tons as slab zinc, compared with 57,300 tons of zinc in concentrates and 8,400 tons of slab zinc in 1972.

Industrias Peñoles, S.A., inaugurated its new electrolytic zinc refinery at Torreón on October 30, 1973. The new plant was expected to produce 115,000 tons of zinc annually as well as 200,000 tons of sulfuric acid and 935 tons of cadmium. The feed to the plant will be mainly Mexican concentrates, thus cutting Mexican exports of zinc concentrates from about 300,000 tons (gross) to 100,000 tons per year and gaining about $58 million per year in foreign exchange.

Two feasibility studies concerning construction of zinc refineries in Mexico were undertaken during 1973, one conducted by Asarco Mexicana, S.A. and Dowa Mining Co. of Japan and the other by Zincamex, S.A. and Mitsui. The Asarco Mexicana-Dowa study indicated that the proposed smelter would require imports of zinc ores or concentrates from outside Mexico, and thereafter negotiations made little progress.

Netherlands.—Construction of the new electrolytic zinc plant at Budel was substantially completed in 1973, and full production was expected for the third quarter of 1974.[53] The older retort smelter was being gradually phased out. Production of primary zinc in the Netherlands in 1973 was about 33,600 short tons.

Nicaragua.—Neptune Mining Co., owned 51.8% by ASARCO and 36% by Rosario Resources, produced over 12,000 tons of zinc and 138 tons of cadmium in zinc concentrates from the Vesubio mine. Rosario acquired the Rosita copper mine and the Siuna gold mine and announced plans to do exploration work in adjacent areas for base metals as well as gold and silver.

Peru.—The Cerro de Pasco Corp. properties in Peru were expropriated by the Peruvian government effective January 1, 1974, after talks, carried on during the second half of 1973, concerning a partial takeover, were unsuccessful. However, operations were still under Cerro control throughout 1973 and resulted in a high level of zinc output. Refined zinc produced by the Cerro smelter was 73,959 short tons, and zinc concentrates and calcines produced for export amounted to 115,728 tons of zinc content.[54] Compañía Minerales Santander, Inc., a subsidiary of St. Joe Minerals Corp., produced 69,725

[50] Tara Exploration and Development Co. Ltd. 1973 Annual Report. P. 5.
[51] International Mogul Mines Ltd. 1973 Annual Report. P. 4.
[52] Metals Week. Japan's Consumption of Zinc Increased. V. 45, No. 24, June 17, 1974, p. 6.

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Yugoslavia.—Zinc metal production in Yugoslavia in 1973 was 60,820 short tons, an increase of 13% over that of 1972. Three plants were the major contributors, the electrolytic plant of Trepča at Zvecán, the electrolytic plant at Sabac-Zorka, and the new imperial furnace smelter at Zletovo (Titov Veles) which started production in the summer of 1973. The annual capacity of the Titov Veles smelter should eventually become 72,000 tons of zinc and 39,000 tons of lead, all destined for export. Two new lead and zinc concentrators at Kriva Feja and Leposavci in Serbia were completed in 1973. Concentrates will go to the Trepča smelter. The Trepča Enterprise was renovating or developing several mines in Serbia and one in Montenegro in a program to increase lead and zinc mine production. Yugoslavian mine production of zinc was estimated as 110,000 tons of zinc in concentrates in 1973.

TECHNOLOGY

Research at the Bureau of Mines Rolla Metallurgy Research Center was conducted to develop a workable means for separating and recovering zinc and lead from flue dusts, slags, and other metallurgical processing wastes. The project included construction and operation of a continuous system for the recovery of zinc and lead from electric furnace steelmaking dusts. An evaluation of other zinc-bearing waste such as lead blast furnace slag will also be made. Another project at Rolla was to develop low-cost hydrometallurgical processes for recovering zinc and elemental sulfur from sphalerite concentrate with minimum evolution of sulfur oxides, hydrogen sulfide, or other pollutants. A project on reduction of zinc sulfide with iron was underway at the Albany Metallurgy Research Center. The objective was to determine the practicability of winning zinc from sulfide concentrates by direct reduction with iron, thereby bypassing sulfurous gas formation. The Reno Metallurgy Research Center was conducting a research project to develop an aqueous chlorine or anodic oxidation leaching process for extracting metal values from lead-zinc sulfide concentrates, and to develop techniques for recovering metal values from leaching solution in a marketable form.

Results of several research investigations or studies were published by the Bureau of Mines and Geological Survey.[55]

Gulf & Western Industries, Inc., and Occidental Petroleum Corp. were engaged in a $10 million joint venture to perfect a practical zinc chloride rechargeable battery system that would power urban and recreational vehicles.[56]

The International Lead-Zinc Research Organization (ILZRO) sponsored numerous projects in 1973 to develop fundamental data on particular applications of zinc or zinc-containing materials. Progress reports of these projects are released annually by means of the ILZRO Research Digest.

Work during the year involved an ILZRO Prototype House which illustrates a variety of zinc applications, improvement of die-casting processes, galvanizing, alloy development, and plating.[57]

A comprehensive coverage of zinc-related investigations and an extensive review of current world literature on the uses of zinc and its products are contained in monthly issues of the 1973 Zinc Abstracts published by the Zinc Institute. Inc., 292 Madison Avenue, New York, N.Y. 10017, and provided free of charge.

[55] Kelly, J.E., and H.M. Harris. Contact Angle of Zinc on Some Ceramic Materials and Metals. J. Testing and Evaluation, JTEVA, v. 2, No. 1, January 1974, pp. 40–43.
McMahon, A.D., C.H. Cotterill, J.T. Dunham, and W.L. Rice. The U.S. Zinc Industry: A Historical Perspective. BuMines IC 8629, 1974, 76 pp.
Petrick, A., Jr., H.J. Bennett; K.E. Starch, and R.C. Weisner. The Economics of Byproduct Metals (in Two Parts). 2. Lead, Zinc, Uranium, Rare-Earth, Iron, Aluminum, Titanium, and Lithium Systems. BuMines IC 8570, 1973, 99 pp.
Powell, H.E., and L.W. Higley. Recovery of Zinc, Copper, Silver, and Iron from Zinc Smelter Residue, BuMines RI 7754, 1973, 15 pp.
Wedow, H., Jr., T.H. Kilsgard, A.V. Heyl, and R.B. Hall. Zinc. Ch. in United States Mineral Resources. U.S. Geol. Surv. Prof. Paper 820, 1973, pp. 697–711.

[56] Page 15 of work cited in footnote 9.

[57] Pages 1–27 of work cited in footnote 47.

Table 3.—Mine production of recoverable zinc in t

(Short tons)

State	1969	19
Arizona	9,039	9
California	3,327	3
Colorado	53,715	56
Idaho	55,900	41
Illinois	13,765	16
Kansas	1,900	1
Kentucky	4,988	4
Maine	7,639	9
Missouri	41,099	60,
Montana	6,143	1
Nevada	941	
New Jersey	25,076	28
New Mexico	24,308	16
New York	58,728	58
Oklahoma	2,744	2
Pennsylvania	33,035	29
South Dakota	--	
Tennessee	124,532	118
Utah	34,902	34
Virginia	18,704	18
Washington	9,738	11
Wisconsin	22,901	20
Other States	--	
Total	563,124	534

Table 4.—Mine production of recoverable zinc in t

(Short tons)

Month	1972	1973		
January	37,747	40,807	August	..
February	40,087	36,881	September	
March	45,579	39,218	October	.
April	41,704	37,204	November	
May	44,007	40,086	December	
June	41,905	37,731		
July	36,329	40,364		Tot

Table 5.—Production of zinc and lead in the United Sta ore, from old tailings, etc., in terms of r

(Short tons)

State	Zinc ore			Lead c	
	Gross weight (dry basis)	Zinc content	Lead content	Gross weight (dry basis)	Zi co te
Arizona	--	--	--	--	
California	--	--	--	222	
Colorado	224,942	21,313	2,600	692	
Idaho	9,270	423	9	244,660	2,0
Illinois	(2)	(2)	(2)	--	
Kentucky	--	--	--	--	
Maine	230,172	19,640	204	--	
Missouri	--	--	--	7,585,647	82,3
Montana	--	--	--	196	
New Jersey	193,402	33,027	--	--	
New Mexico	128,367	12,035	2,484	--	
New York	1,093,838	81,455	2,304	--	
Pennsylvania	382,511	18,867	--	--	
Tennessee	2,134,789	59,570	--	--	
Utah	--	--	--	--	
Virginia	577,348	16,683	2,637	--	
Washington	--	--	--	500	
Wisconsin	379,014	8,672	844	--	
Other States	--	--	--	12	
Total	5,363,653	271,676	11,082	7,831,928	84,4
Percent of total zinc-lead	--	57	2	--	

See footnotes at end of table.

Table 5.—Production of zinc and lead in the United States in 1973, by State and class of ore, from old tailings, etc., in terms of recoverable metals—Continued

(Short tons)

State	Copper-zinc, copper-lead and copper-zinc-lead ores			All other sources [3]			Total		
	Gross weight (dry basis)	Zinc content	Lead content	Gross weight (dry basis)	Zinc content	Lead content	Gross weight (dry basis)	Zinc content	Lead content
Arizona	93,284	8,407	192	61,571,820	20	571	61,665,104	8,427	763
California	--	--	--	[1] 5,257	[1] 12	[1] 10	5,479	20	44
Colorado	390,354	10,310	8,818	107,502	1,196	1,937	1,195,393	58,339	28,112
Idaho	--	--	--	312,459	768	1,012	1,440,645	46,107	61,744
Illinois	--	--	--	[2] 66,848	[2] 5,250	[2] 541	66,848	5,250	541
Kentucky	--	--	--	--	273	--	--	273	--
Maine	--	--	--	--	--	--	230,172	19,640	204
Missouri	--	--	--	--	--	--	7,585,647	82,350	487,143
Montana	--	--	--	25,686	59	152	26,209	73	176
New Jersey	--	--	--	--	--	--	193,402	33,027	--
New Mexico	--	--	--	2,803,668	228	4	2,933,577	12,327	2,556
New York	--	--	--	--	--	--	1,093,838	81,455	2,304
Pennsylvania	--	--	--	--	--	--	382,511	18,857	--
Tennessee	1,322,930	4,602	--	--	--	--	3,457,719	64,172	--
Utah	--	--	--	--	--	--	188,311	16,800	13,733
Virginia	--	--	--	--	--	--	577,348	16,683	2,637
Washington	--	--	--	61,372	2	1	274,161	6,378	2,217
Wisconsin	--	--	--	--	--	--	379,014	8,672	844
Other States	--	--	--	--	--	--	12	--	6
Total	1,806,568	23,319	9,010	64,954,612	7,808	4,228	81,695,390	478,850	603,024
Percent of total zinc-lead	--	--	5	1	--	1	1	--	100	100

[1] Zinc-lead ore, and ore from "other sources" combined to avoid disclosing individual company confidential data.
[2] Zinc ore and ore from "other sources" combined to avoid disclosing individual company confidential data.
[3] Lead and zinc recovered from copper, gold, silver, and fluorspar ores, and from mill tailings and miscellaneous cleanups.

Table 6.—Twenty-five leading zinc-producing mines in the United States in 1973, in order of output

Rank	Mine	County and State	Operator	Source of zinc
1	Balmat	St. Lawrence, N.Y	St. Joe Minerals Corp	Zinc ore.
2	Buick	Iron, Mo	AMAX Lead Co. of Mo	Lead ore.
3	Sterling	Sussex, N.J	New Jersey Zinc Co	Zinc ore.
4	Bunker Hill	Shoshone, Idaho	Bunker Hill Co	Lead-zinc ore.
5	Eagle	Eagle, Colo	New Jersey Zinc Co	Zinc ore.
6	Zinc Mine Works	Jefferson, Tenn	U.S. Steel Corp	Do.
7	Blue Hill	Hancock, Maine	Kerramerican Inc	Do.
8	Friedensville	LeHigh, Pa	New Jersey Zinc Co	Do.
9	New Market	Jefferson, Tenn	American Smelting and Refining Company.	Do.
10	Burgin	Utah, Utah	Kennecott Copper Corp	Lead-zinc ore.
11	Austinville and Ivanhoe	Wythe, Va	New Jersey Zinc Co	Zinc ore.
12	Star Unit	Shoshone, Idaho	Bunker Hill Co. and Hecla Mining Co.	Lead-zinc ore.
13	Leadville	Lake, Colo	American Smelting and Refining Company.	Do.
14	Ground Hog	Grant, N. Mex	---do---	Do.
15	Jefferson City	Jefferson, Tenn	New Jersey Zinc Co	Zinc ore.
16	Edwards	St. Lawrence, N.Y	St. Joe Minerals Corp	Do.
17	Shullsburg	Lafayette, Wisc	Eagle-Picher Industries, Inc.	Do.
18	Idarado	San Miguel, Colo	Idarado Mining Co	Copper-lead-zinc ore.
19	Bruce	Yavapai, Ariz	Cyprus Mines Corp	Copper-zinc ore.
20	Sunnyside	San Juan, Colo	Standard Metals Corp	Lead-zinc ore.
21	Pend Oreille	Pend Oreille, Wash	Pend Oreille Mines & Metals Co.	Do.
22	Ozark	Reynolds, Mo	Ozark Lead Co	Lead ore.
23	Young	Jefferson, Tenn	American Smelting and Refining Company.	Zinc ore.
24	Magmont	Iron, Mo	Cominco American Inc	Lead ore.
25	Viburnum #29	Washington, Mo	St. Joe Minerals Corp	Do.

Table 7.—Primary and redistilled secondary slab zinc

(Short tons)

	1969
Primary:	
From domestic ores	468,7
From foreign ores	581,8
Total	1,040,6
Redistilled secondary	70,5
Total (excludes zinc recovered by remelting)	1,111,1

[1] Excludes processed GSA stockpile zinc.

Table 8.—Distilled and electrolytic zinc, pr produced in the United States, by met

(Short tons)

Method of reduction	1969
Electrolytic primary	453,6
Distilled	587,0
Redistilled secondary:	
At primary smelters	60,6
At secondary smelters	9,9
Total	1,111,1

Table 9.—Distilled and electrolytic zinc, primary the United States, by gra

(Short tons)

Grade	1969	
Special high	468,792	40
High	136,416	10
Intermediate	57,180	5
Brass special	89,306	7
Prime western	359,456	32
Total	1,111,150	90

Table 10.—Primary slab zinc produced in the United

(Short tons)

State	1969	
Idaho	105,700	9
Illinois	131,243	11
Montana	174,034	14
Oklahoma	143,575	12
Pennsylvania [1]	286,164	22
Texas	199,881	17
Total	1,040,597	87

[1] Prior to 1972, included West Virginia.

Table 11.—Primary slab zinc plants by group capacit

Type of plant	Pla
Electrolytic plants:	
Amax Zinc Co., Inc	Sauget,
American Smelting and Refining Company	Corpus C
Bunker Hill Co	Kellogg,
Horizontal-retort plants:	
American Smelting and Refining Company	Amarillo
Blackwell Zinc Co., American Metal Climax, Inc.[1]	Blackwel
National Zinc Co	Bartlesvi
Vertical-retort plants:	
New Jersey Zinc Co	Palmerto
St. Joe Minerals Corp	Josephto

[1] Zinc operations ended November 1973.

Table 12.—Secondary slab zinc plants, by group capacity in the United States in 1973

Company	Plant location	Slab zinc capacity (short tons)
W. J. Bullock, Inc	Fairfield, Ala	40,100
Gulf Reduction Co	Houston, Tex	
Hugo-Neu-Proler Co	Terminal Island, Calif	
Pacific Smelting Co	Torrance, Calif	
Prolerized-Shibo-Neu Co	Jersey City, N.J	

Table 13.—Stocks and consumption of new and old zinc scrap in the United States in 1973

(Short tons, gross weight)

Class of consumer and type of scrap	Stocks Jan. 1 [1]	Receipts	Consumption			Stocks Dec. 31
			New scrap	Old scrap	Total	
Smelters and distillers:						
New clippings	63	696	708	--	708	51
Old zinc	474	6,688	--	5,659	5,659	503
Engravers' plates	248	1,755	--	1,853	1,853	150
Skimmings and ashes	7,482	63,180	64,657	--	64,657	6,005
Sal skimmings	70	261	--	--	--	331
Die-cast skimmings	2,125	7,243	6,830	--	6,830	2,538
Galvanizers' dross	16,620	59,809	63,531	--	63,531	12,898
Diecastings	2,128	40,088	--	38,698	38,698	3,518
Rod and die scrap	107	1,935	--	2,011	2,011	31
Flue dust	1,430	4,033	4,705	--	4,705	758
Chemical residues	--	15,320	15,320	--	15,320	--
Total	30,747	200,008	155,761	48,221	203,972	26,783
Chemical plant, foundries, and other manufacturers:						
New clippings	2	21	21	--	21	2
Old zinc	1	12	--	4	4	9
Engravers' plates	--	--	--	--	--	--
Skimmings and ashes	4,670	10,313	12,397	--	12,397	2,586
Sal skimmings	6,942	4,645	6,256	--	6,256	5,331
Die-cast skimmings	--	--	--	--	--	--
Galvanizers' dross	--	--	--	--	--	--
Diecastings	37	140	--	156	156	21
Rod and die scrap	4	65	--	66	66	3
Flue dust	230	4,445	4,425	--	4,425	250
Chemical residues	496	28,289	27,822	--	27,822	963
Total	12,382	47,930	50,921	226	51,147	9,165
All classes of consumers:						
New clippings	65	717	729	--	729	53
Old zinc	475	5,700	--	5,663	5,663	512
Engravers' plates	248	1,755	--	1,853	1,853	150
Skimmings and ashes	12,152	73,493	77,054	--	77,054	8,591
Sal skimmings	7,012	4,906	6,256	--	6,256	5,662
Die-cast skimmings	2,125	7,243	6,830	--	6,830	2,538
Galvanizers' dross	16,620	59,809	63,531	--	63,531	12,898
Diecastings	2,165	40,228	--	38,854	38,854	3,539
Rod and die scrap	111	2,000	--	2,077	2,077	34
Flue dust	1,660	8,478	9,130	--	9,130	1,008
Chemical residues	496	43,609	43,142	--	43,142	963
Total	43,129	247,938	206,672	48,447	255,119	35,948

[1] Figures partly revised.

Table 14.—Production of zinc products from zinc-base scrap in the United States

(Short tons)

Products	1969	1970	1971	1972	1973
Redistilled slab zinc	70,553	77,156	80,923	r 73,718	87,466
Zinc dust	33,747	29,605	29,095	40,569	36,531
Remelt zinc	3,978	3,494	1,590	5,850	1,096
Remelt die-cast slab	16,979	16,686	18,339	13,555	12,595
Zinc-die diecasting alloys	4,401	4,361	3,316	3,927	4,786
Galvanizing stocks	1,849	762	633	872	670
Secondary zinc in chemical products	45,298	42,238	45,312	50,047	56,591

r Revised.

Table 15.—Zinc recovered from scrap processed in th
and form of recover

(Short tons)

Kind of scrap	1972	1973	F
New scrap:			As met
Zinc-base	145,620	137,671	By
Copper-base	158,834	152,190	
Aluminum-base	3,649	4,035	
Magnesium-base	281	306	By
Total	308,384	294,202	
Old scrap:			In zin
Zinc-base	42,998	50,301	In bra
Copper-base	32,456	38,494	In alu
Aluminum-base	3,854	4,436	In mag
Magnesium-base	69	106	In che
Total	79,377	93,337	Zi
			Zi
Grand total	387,761	387,539	Zi
			Mi

r Revised.
[1] Includes zinc content of redistilled slab made from rem

Table 16.—Zinc dust produc
United States

Year	Quantity (short tons)	Total (thou-sands)
1969	55,066	$21,361
1970	51,136	20,045
1971	50,259	19,691
1972	59,368	24,669
1973	56,154	29,279

Table 17.—Consumption of zinc in

(Short tons)

	1969	1970
Slab zinc	1,386,380	1,186,9
Ores (recoverable zinc content) [1]	126,712	124,7
Secondary (recoverable zinc content) [2]	302,075	259,8
Total	1,814,167	1,571,5

r Revised.
[1] Includes ore used directly in galvanizing.
[2] Excludes redistilled slab and remelt zinc.

Table 18.—Slab zinc consumption in the United States, by industry use

(Short tons)

Industry and product	1969	1970	1971	1972	1973
Galvanizing:					
Sheet and strip	268,682	253,165	255,335	294,205	321,927
Wire and wire rope	32,348	30,857	29,895	30,769	34,315
Tubes and pipe	65,898	64,479	65,122	64,549	68,048
Fittings (for tube and pipe)	11,418	9,498	10,240	11,106	11,969
Tanks and containers	5,561	3,924	2,759	3,645	2,941
Structural shapes	19,454	18,761	18,589	20,302	21,714
Fasteners	5,536	5,318	5,159	4,310	4,782
Pole-line hardware	9,409	9,938	8,358	8,437	8,193
Fencing, wire, cloth, and netting	17,984	18,114	20,232	21,995	25,418
Other and unspecified uses	57,091	60,205	59,063	68,886	64,530
Total	493,381	474,249	474,762	518,204	563,837
Brass products:					
Sheet, strip, and plate	90,777	61,672	78,929	105,405	109,582
Rod and wire	56,989	41,459	46,514	63,143	63,164
Tube	10,928	9,086	9,399	8,886	10,868
Castings and billets	5,958	4,606	4,479	6,840	6,000
Copper-base ingots	13,642	9,946	10,440	7,137	6,895
Other copper-base products	1,175	978	725	736	1,151
Total	179,469	127,747	150,486	192,147	197,660
Zinc-base alloy:					
Diecasting alloys	565,839	453,490	504,823	566,932	598,725
Dies and rod alloy	504	87	270	56	111
Slush and sand-casting alloy	10,048	10,059	11,018	12,773	11,770
Total	576,391	463,636	516,111	679,761	610,606
Rolled zinc	48,650	41,065	38,852	45,216	40,763
Zinc oxide	41,447	43,829	40,043	51,992	61,734
Other uses:					
Light-metal alloys	7,562	3,985	4,575	6,300	7,466
Other [1]	38,480	32,440	29,240	24,729	21,882
Total	46,042	36,425	33,815	31,029	29,348
Grand total	1,385,380	1,186,951	1,254,059	1,418,349	1,503,938

[1] Includes zinc used in making zinc dust, wet batteries, desilverizing lead, bronze powder, alloys, chemicals, castings, and miscellaneous uses not elsewhere mentioned.

Table 19.—Slab zinc consumption in the United States in 1973, by grade and industry use

(Short tons)

Industry	Special high grade	High grade	Intermediate	Brass special	Prime [1] western	Remelt	Total
Galvanizing	40,242	31,745	16,235	125,083	350,054	478	563,837
Brass and bronze	43,745	113,421	86	6,795	33,668	35	197,650
Zinc-base alloy	595,867	13,739	14	269	388	329	610,606
Rolled zinc	16,553	479	20,462	--	3,269	--	40,763
Zinc oxide	25,930	2,876	195	--	32,733	--	61,734
Other	17,110	5,206	392	1	6,547	92	29,348
Total	739,447	167,466	37,384	132,148	426,659	934	1,503,938

[1] Includes select grade.

Table 20.—Rolled zinc produced and quantity av
the United States

	1972		
	Short tons	Value	
		Total (thousands)	Av p
Production: [1]			
Photoengraving plate	13,418	$10,118	$
Sheet zinc less than 0.375 inch thick	--	--	
Strip and foil	28,189	17,100	
Total rolled zinc [2]	r 43,473	28,820	
Exports	2,419	2,138	
Imports	486	310	
Available for consumption	r 41,314	--	

r Revised.

[1] Figures represent net production. In addition, 41,764 tons
rerolled from scrap originating in fabricating plants operating

[2] Includes other plate over 0.375 inch thick, and rod and w
to publish these data separately.

Table 21.—Slab zinc consumption in the United States

(Short tons)

State	Galvanizers	Brass mill
Alabama	51,320	W
Arizona	W	--
Arkansas	--	--
California	38,269	3,032
Colorado	W	W
Connecticut	3,647	42,172
Delaware	W	W
Florida	W	--
Georgia	W	--
Hawaii	W	--
Idaho	--	--
Illinois	54,753	27,431
Indiana	62,295	W
Iowa	W	--
Kansas	--	W
Kentucky	W	W
Louisiana	1,758	--
Maine	W	--
Maryland	27,389	--
Massachusetts	2,630	W
Michigan	5,681	W
Minnesota	2,841	--
Mississippi	W	--
Missouri	8,018	W
Nebraska	W	W
New Jersey	2,026	6,672
New York	14,356	W
North Carolina	--	--
Ohio	108,241	W
Oklahoma	8,013	--
Oregon	1,060	W
Pennsylvania	83,334	W
Rhode Island	W	--
South Carolina	W	--
Tennessee	W	--
Texas	13,721	W
Utah	W	W
Virginia	W	W
Washington	919	--
West Virginia	W	W
Wisconsin	1,275	W
Undistributed	71,913	118,308
Total [4]	563,369	197,616

W Withheld to avoid disclosing individual company confid
tributed."

[1] Includes brass mills, brass ingot makers, and brass foundri

[2] Includes producers of zinc-base alloy for diecastings, stampi

[3] Includes slab zinc used in rolled zinc products and in zin

[4] Excludes remelt zinc.

Table 22.—Production and shipments of zinc pigments and compounds[1] in the United States

Pigment or compound	1972				1973			
	Production (short tons)	Shipments			Production (short tons)	Shipments		
		Quantity (short tons)	Value[2]			Quantity (short tons)	Value[2]	
			Total (thousands)	Average per ton			Total (thousands)	Average per ton
Zinc oxide[3]	237,015	245,867	$84,244	$343	252,475	262,833	$88,378	$350
Zinc sulfate	38,897	39,595	5,220	132	43,866	45,197	5,510	122

[1] Excludes leaded zinc oxide, lithopone, and zinc chloride; figures withheld to avoid disclosing individual company confidential data.
[2] Value at plant, exclusive of container.
[3] Zinc oxide containing 5% or more lead is classed as leaded zinc oxide.

Table 23.—Zinc content of zinc pigments[1] and compounds produced by domestic manufacturers, by source

(Short tons)

Pigment or compound	1972				1973			
	Zinc in pigments and compounds produced from—			Total zinc in pigments and compounds	Zinc in pigments and compounds produced from—			Total zinc in pigments and compounds
	Ore	Slab zinc	Secondary material		Ore	Slab zinc	Secondary material	
Zinc oxide	109,133	52,117	31,106	192,356	112,638	67,457	31,821	211,916
Zinc sulfate	5,113	--	8,280	13,393	6,339	--	8,226	14,565

[1] Excludes leaded zinc oxide, zinc sulfide, and lithopone; figures withheld to avoid disclosing individual company confidential data.

Table 24.—Distribution of zinc oxide shipments, by industry[1]

(Short tons)

Industry	1969	1970	1971	1972	1973
Rubber	115,988	111,421	124,472	129,170	129,462
Paints	25,170	21,894	24,990	27,244	26,115
Ceramics	9,469	9,011	8,125	10,702	11,678
Chemicals	22,775	19,435	18,901	22,781	26,187
Agriculture	4,007	2,246	1,615	1,101	2,044
Photocopying	27,666	31,850	34,504	36,190	38,724
Other	14,748	17,426	14,896	18,679	18,623
Total	219,723	213,283	227,503	245,867	252,833

[1] For information on leaded zinc oxide shipments prior to 1971, refer to the 1970 Minerals Yearbook.

Table 25.—Distribution of zinc sulfate shipments, by industry

(Short tons)

Year	Agriculture		Other[1]		Total	
	Gross weight	Dry basis	Gross weight	Dry basis	Gross weight	Dry basis
1969	19,029	16,424	45,563	33,861	64,592	50,285
1970	17,213	14,803	36,855	26,572	54,069	41,375
1971	16,268	13,812	33,035	28,690	49,303	42,502
1972	10,496	8,602	29,099	25,935	39,595	34,537
1973	13,909	8,353	31,288	24,902	45,197	33,255

[1] Includes rayon; Bureau of Mines not at liberty to publish these data separately.

Table 26.—Stocks of slab zinc at zinc-reduction plants

(Short tons)

Stocks	1969	19
At primary reduction plants	64,903	97,
At secondary distilling plants	885	
Total	65,788	98,

Table 27.—Consumers stocks of slab zinc at pla

(Short tons)

Date	Special high grade	High grade	Intermediate	Bra spec
Dec. 31, 1972 r	46,696	9,552	570	17,2
Dec. 31, 1973	47,775	9,703	2,296	14,3

r Revised.

Table 28.—Average monthly U.S., LME, and Eu Prime Western Zinc and eq

(Metallic zinc, cents per po

Month	1972		
	United States	LME[1] cash	Europe produc
January	17.00	17.21	17.49
February	17.00	17.66	17.71
March	17.30	17.99	17.81
April	17.74	17.90	17.76
May	17.88	17.61	17.78
June	18.00	16.77	17.48
July	18.00	16.49	17.75
August	18.00	16.48	17.78
September	18.00	16.69	17.72
October	18.00	16.48	17.38
November	18.00	17.16	17.31
December	18.11	17.00	18.40
Average for year	17.75	17.13	17.73

[1] London Metal Exchange.

Source: Metals Week.

Table 29.—U.S. exports of slab and sheet zinc, by country

Destination	1971 Quantity (short tons)	1971 Value (thousands)	1972 Quantity (short tons)	1972 Value (thousands)	1973 Quantity (short tons)	1973 Value (thousands)
Slabs, pigs, blocks:						
Belgium-Luxembourg	--	--	--	--	221	$89
Brazil	1	$1	1	$1	2,123	1,492
Canada	233	63	349	70	509	101
Chile	8	3	10	5	459	608
Colombia	--	--	--	--	1,651	891
Costa Rica	--	--	--	--	607	188
El Salvador	--	--	--	--	528	277
Guatemala	--	--	--	--	220	87
Italy	--	--	--	--	110	44
Japan	--	--	--	--	2,151	1,326
Laos	--	--	--	--	110	95
Malaysia	--	--	--	--	108	75
Netherlands	--	--	--	--	1,488	610
Panama	--	--	3	2	209	85
Philippines	--	--	--	--	769	458
Switzerland	--	--	--	--	964	328
Turkey	3,024	738	--	--	--	--
United Kingdom	10,005	1,501	3,786	568	110	109
Venezuela	--	--	110	42	1,817	1,138
Other	75	31	65	26	412	259
Total	13,346	2,337	4,324	714	14,566	8,259
Sheets, plates, strips, or other forms, n.e.c.:						
Algeria	--	--	--	--	22	23
Argentina	51	34	32	23	28	21
Australia	85	75	51	42	24	23
Canada	1,065	946	1,329	1,194	1,201	986
Chile	2	2	23	16	26	21
Colombia	4	4	7	5	24	26
Costa Rica	14	13	12	11	11	11
Dominican Republic	51	20	15	12	21	17
Ecuador	8	8	8	8	27	29
Egypt	--	--	--	--	36	25
El Salvador	14	13	10	10	15	14
France	(1)	(1)	33	39	49	61
Hong Kong	1	4	6	5	49	38
Ireland	16	17	20	23	--	--
Israel	28	19	84	60	82	64
Jamaica	13	10	26	23	9	13
Japan	1	1	20	18	38	30
Lebanon	--	--	41	31	34	27
Mexico	43	36	81	65	17	17
New Zealand	2	1	14	9	62	43
Peru	4	5	--	--	20	21
Philippines	1	1	--	--	62	50
South Africa, Republic of	101	90	166	145	132	131
Spain	--	--	--	--	70	59
Sweden	--	--	--	--	39	24
Taiwan	--	--	4	3	40	31
Thailand	--	--	22	13	66	38
United Kingdom	119	124	156	169	2	7
Venezuela	34	32	120	106	97	101
Other	29	31	139	108	177	149
Total	1,686	1,486	2,419	2,138	2,480	2,100

[1] Less than ½ unit.

Table 30.—U.S. exports of zinc, by class

Year	Slabs, pigs, or blocks Quantity (short tons)	Slabs, pigs, or blocks Value (thousands)	Sheets, plates, strips, or other forms, n.e.c. Quantity (short tons)	Sheets, plates, strips, or other forms, n.e.c. Value (thousands)	Zinc scrap and dross (zinc content) Quantity (short tons)	Zinc scrap and dross (zinc content) Value (thousands)	Semifabricated forms, n.e.c. Quantity (short tons)	Semifabricated forms, n.e.c. Value (thousands)
1971	13,346	$2,337	1,686	$1,486	2,000	$504	6,042	$2,709
1972	4,324	714	2,419	2,138	1,446	431	6,052	3,076
1973	14,566	8,259	2,480	2,100	7,032	2,717	15,077	10,565

Table 31.—U.S. exports of zinc

Kind	1972 Quantity (short tons)	1972 Value (thousands)	Quan (sh ton
Zinc oxide	6,172	$2,306	7,6
Lithopone	1,395	458	9
Total	7,567	2,764	8,6

Table 32.—U.S. imports for consumption

Country	1971 Quantity (short tons)	1971 Value (thousands)	Qu (s t
ORES [1]			
Australia	3,188	$720	
Bolivia	4,738	696	
Brazil	--	--	
Canada	257,655	38,688	109
Germany, West	3,517	528	1
Guatemala	--	--	
Honduras	22,486	2,934	3
Ireland	1,965	310	2
Mexico	121,016	14,925	39
Morocco	8,531	868	
Nicaragua	--	--	
Peru	44,256	3,088	8
South Africa, Republic of	100	19	9
Other	16	2	
Total	467,368	62,678	174
BLOCKS, PIGS, OR SLABS			
Australia	37,096	11,634	41
Belgium-Luxembourg	9,365	2,701	39
Bulgaria	--	--	
Canada	149,700	42,698	272
Ecuador	--	--	
Finland	32,417	9,270	8
France	2,211	752	11
Germany, West	6,138	1,772	31
Japan	8,705	2,308	30
Mexico	10,130	2,442	8
Netherlands	18,745	5,849	14
Norway	2,205	329	
Peru	24,412	7,283	30
Poland	2,508	729	4
South Africa, Republic of	4,740	1,422	
Spain	5,071	1,475	1
Taiwan	--	--	
U.S.S.R.	--	--	
United Kingdom	745	196	1
Yugoslavia	138	39	1
Zaire	8,898	2,444	22
Zambia	315	91	
Other	716	194	
Total	324,255	93,628	516

[1] Does not include zinc ores and concentrates for refining a
11,791 short tons ($1,816,250); Mexico 14 short tons ($2,723)
Ireland 10 short tons ($981); Republic of South Africa 82 sho
short tons ($735,225); Mexico 171 short tons ($27,437); Ireland
lands 98 short tons ($17,595); Belgium-Luxembourg 16 short
short tons ($790,625); Mexico 11,816 short tons ($1,832,675);
Nicaragua 6,431 short tons ($363,030); Peru 1,287 short tons
($15,467).

[2] Less than ½ unit.

Table 33.—U.S. general imports of zinc, by country

Country	1971 Quantity (short tons)	1971 Value (thousands)	1972 Quantity (short tons)	1972 Value (thousands)	1973 Quantity (short tons)	1973 Value (thousands)
ORES						
Australia	2,857	$201	5,871	$239	7,282	$288
Canada	209,084	30,027	136,534	19,483	124,261	22,057
Germany, West	--	--	1,162	260	848	147
Guatemala	138	13	723	130	--	--
Honduras	21,512	3,230	17,370	2,415	6,029	539
Ireland	3,975	657	5,978	885	2,001	401
Japan	--	--	--	--	519	93
Mexico	89,846	11,099	57,315	7,106	33,878	5,057
Nicaragua	--	--	10,960	1,163	11,244	1,324
Peru	15,025	2,375	15,256	2,007	12,981	1,812
South Africa, Republic of	61	11	4,690	779	--	--
Other	24	3	9	(1)	10	(1)
Total	342,521	47,616	254,868	34,467	199,053	31,718
BLOCKS, PIGS, OR SLABS						
Australia	38,552	12,056	39,623	14,441	42,076	19,256
Belgium-Luxembourg	9,365	2,701	39,616	13,998	39,908	21,186
Bulgaria	--	--	--	--	221	199
Canada	150,868	43,050	271,130	91,826	344,697	148,236
Ecuador	--	--	909	301	121	46
Finland	31,702	9,348	8,583	2,572	14,183	5,581
France	2,211	752	11,825	4,225	10,727	5,705
Germany, West	3,661	1,085	31,358	11,551	8,203	4,562
Japan	8,705	2,308	30,072	10,968	42,668	19,039
Mexico	10,130	2,442	8,394	2,276	1,913	732
Netherlands	13,283	4,220	14,001	5,096	3,229	2,095
Norway	2,205	329	--	--	220	300
Peru	23,873	7,132	30,625	9,760	19,343	7,171
Poland	2,618	764	4,199	1,514	13,168	8,873
Romania	1,221	354	5,526	1,603	--	--
South Africa, Republic of	4,740	1,422	--	--	329	264
Spain	5,071	1,475	1,102	381	11	10
U.S.S.R.	--	--	--	--	3,599	2,777
United Kingdom	800	210	1,553	563	8,474	5,365
Yugoslavia	138	39	1,543	589	6,792	6,984
Zaire	8,898	2,444	22,493	6,860	28,440	12,488
Zambia	315	91	--	--	273	140
Other	1,212	332	60	21	130	47
Total	319,568	92,554	522,612	178,545	588,725	271,056

[1] Less than ½ unit.

Table 34.—U.S. imports for consumption of zinc, by class

Year	Ore (zinc content) Quantity (short tons)	Ore (zinc content) Value (thousands)	Blocks, pigs, slabs Quantity (short tons)	Blocks, pigs, slabs Value (thousands)	Sheets, plates, strips, other forms Quantity (short tons)	Sheets, plates, strips, other forms Value (thousands)
1971	467,368	$62,678	324,256	$93,628	509	$237
1972	174,063	24,275	516,643	176,707	485	310
1973	153,898	24,667	587,429	270,213	236	159

Year	Old and worn out Quantity (short tons)	Old and worn out Value (thousands)	Dross and skimmings Quantity (short tons)	Dross and skimmings Value (thousands)	Zinc dust Quantity (short tons)	Zinc dust Value (thousands)	Total value[1] (thousands)
1971	1,114	$147	853	$140	8,184	$2,949	$159,779
1972	814	235	2,068	r 357	9,197	3,822	r 205,706
1973	1,537	583	2,515	491	4,671	2,298	298,411

r Revised.
[1] In addition, manufactures of zinc were imported as follows: 1971—$1,346,752; 1972—$2,040,029; 1973—$3,406,781.

Table 35.—U.S. imports for consumption o

Kind	Qu (sho
Zinc arsenate	
Zinc oxide	1
Zinc sulfide	
Lithopone	
Zinc chloride	
Zinc sulfate	
Zinc cyanide	
Zinc hydrosulfite	
Zinc compounds, n.s.p.f	
Total	2

Table 36.—Zinc: World mine production (content of ore), by country

(Short tons)

Country [1]	1971	1972	1973 [p]
North America:			
Canada [2]	1,397,246 [e]	1,409,388	1,489,331
Guatemala (exports)	558	340	309
Honduras	25,236	26,678	21,681
Mexico	292,081	299,656	299,137
Nicaragua	4,471	19,285	12,228
United States	502,543	478,318	478,850
South America:			
Argentina	[r] 48,351	49,318	44,864
Bolivia [3]	49,689	46,372	56,206
Brazil	[r] 18,651	19,600	[e] 32,000
Chile	[r] 2,186	1,281	1,766
Colombia	123	[r e] 95	NA
Ecuador	139	54	60
Peru	[r] 350,615	415,020	456,062
Europe:			
Austria	23,229	22,576	24,417
Bulgaria	[r] 88,000	[r e] 88,000	[e] 88,000
Czechoslovakia	9,440	10,210	[e] 11,000
Finland	56,093	54,998	64,587
France	16,689	14,650	14,700
Germany, East [e]	11,000	[r] 8,800	6,600
Germany, West	145,487	134,188	135,368
Greece	15,664	18,739	23,038
Greenland	--	--	50,800
Hungary [e]	5,300	5,300	5,300
Ireland	96,500	104,500	75,830
Italy	116,700	113,075	85,976
Norway	11,813	17,562	21,323
Poland	213,400	215,000	[e] 230,000
Portugal	2,255	1,971	769
Romania (recoverable) [e]	43,900	44,000	46,000
Spain	96,496	98,612	104,069
Sweden	109,176	125,364	126,400
U.S.S.R. [e]	717,000	717,000	740,000
Yugoslavia	108,791	106,628	110,000
Africa:			
Algeria	17,413	16,400	15,900
Congo, Republic of (Brazzaville)	[r] 698	2,373	[r] 2,400
Morocco	13,600	21,500	20,171
South Africa, Republic of	174	2,215	18,756
South-West Africa, Territory of [4]	[r] 48,167	38,296	41,798
Tunisia	13,000	11,200	8,800
Zaire	[r] 120,400	110,500	97,600
Zambia (smelter)	62,904	66,711	58,814
Asia:			
Burma	[r] 4,413	4,428	4,402
China, People's Republic of [5]	110,000	110,000	110,000
India	9,089	9,776	13,682
Iran [e 6]	64,000	66,000	66,000
Japan	324,541	309,911	290,964
Korea, North [e]	149,000	154,000	160,000
Korea, Republic of	31,042	39,600	53,077
Philippines	4,271	5,074	5,921
Thailand [e]	[7]	[7]	132
Turkey	26,705	27,155	24,486
Oceania:			
Australia	[r] 498,957	558,155	526,395
New Zealand	[r] 2,170	1,821	1,423
Total	[r] 6,079,365	6,220,692	6,377,392

[e] Estimate. [p] Preliminary. [r] Revised. NA Not available.

[1] In addition to the countries listed, North Vietnam also produces zinc, but available information is inadequate to make reliable estimates of output levels.

[2] Zinc content of concentrates.

[3] Sum of production by COMIBOL and exports by medium and small mines.

[4] All data for 1971 are for fiscal year ending June 30, 1971; data for 1972 and 1973 are a summation of company figures for calendar year 1972 and 1973 for Tsumeb Corp. Ltd. and for fiscal year ending June 30, 1972, and June 30, 1973, for Rosh Pinah mine and Berg Aukas mine. Output of Tsumeb Corp, Ltd. for period July 1, 1971, through December 31, 1971 (which is not otherwise covered in this table), was 3,161 short tons.

[5] Year beginning March 21 of year stated.

[6] Contained in zinc concentrates. Additional quantities of zinc may be contained as a byproduct in lead concentrates produced, but information is inadequate to make reliable estimates of such production, if any.

[7] Revised to zero.

Table 37.—Zinc: World smelter prod

(Short tons)

Country [1]	
North America:	
Canada	
Mexico	
United States	
South America:	
Argentina	
Brazil	
Peru	
Europe:	
Austria [2]	
Belgium [2]	
Bulgaria [2]	
Finland	
France	
Germany, East [e 2]	
Germany, West	
Italy	
Netherlands	
Norway	
Poland [2]	
Romania [e]	
Spain	
U.S.S.R. [e]	
United Kingdom	
Yugoslavia [2]	
Africa:	
South Africa, Republic of	
Zaire	
Zambia	
Asia:	
China, People's Republic of [e]	
India	
Japan	
Korea, North [e]	
Korea, Republic of	
Oceania: Australia	
Total	

[e] Estimate. [p] Preliminary. [r] Revised.

[1] In addition to the countries listed, North Vietnam also p
is inadequate to make reliable estimates of output levels.

[2] Includes production from reclaimed scrap.