

Minerals Yearbook 1966

Volume I

METALS, MINERAL



Prepared by staff

BUREAU OF

N49794

Lead

By Donald E. Mc

The record-breaking expansion of world production and consumption of lead continued in 1969. World mine production, indicated at 3.52 million tons, increased 6.7 percent above 1968 output, and smelter output of 3.67 million tons, including some foreign secondary output, represented a rise of over 10 percent. The free world mine production of 2.64 million tons and smelter production of 2.67 million tons was insufficient to cover demand during the first three-quarters of the year, which resulted in a producer-stock drawdown of 11,000 tons and a continued drawdown of the U.S. stockpile. The expanded supply, however, exceeded demand in the last quarter, and free world producer stocks climbed to an indicated 185,000 tons, a gain of 22,000 tons during the year.

A factor in free world demand was trade in bullion and metal with the Socialist countries, which resulted in a net export of almost 10,000 tons during the first 9 months of the year. Mainland China was an especially large market with almost 35,000 tons imported, mainly from the United Kingdom.

The domestic lead industry experienced a phenomenal year in 1969 with mine production increasing 42 percent to 509,000 tons, the largest amount since 1930. The increase was due in part to uninterrupted mine operation and, mainly to the output of newly developed mines in Missouri, which added almost 143,000 tons of lead to the State's 1968 total. The production of lead, primary and secondary, was almost 1.26 million tons and represented over 90 percent of reported domestic consumption. Primary materials accounted for 655,000 tons or 52 percent and secondary materials for 604,000 tons.

Domestic consumption of lead established a new record of 1.39 million tons, a 4.6-percent increase over 1968 consumption. The major advances in requirements were

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Table 1.—Salient lead statistics

	1965	1966	1967	1968	1969
United States:					
Production:					
Domestic ores, recoverable lead-content..... short tons..	301,147	327,368	316,931	359,156	509,013
Value..... thousands.....	\$93,959	\$98,964	\$88,741	\$94,903	\$161,635
Primary lead (refined):					
From domestic ores and base bullion..... short tons..	305,007	318,646	258,507	349,039	513,931
From foreign ores and base bullion..... short tons..	113,242	122,089	121,387	118,271	124,724
Antimonial lead (Primary lead content)..... short tons..	6,612	11,182	9,083	19,494	16,250
Secondary lead (Lead content)..... short tons..	576,819	572,834	553,772	550,879	603,905
Imports, general:					
Lead in ores and matte..... do.....	122,661	143,991	124,067	87,836	109,252
Lead in base bullion..... do.....	566	2,012	569	8	1,993
Lead in pigs, bars, and old scrap..... short tons..	226,883	293,085	373,887	344,601	285,342
Exports of lead materials excluding scrap..... short tons..	7,811	5,435	6,536	8,281	4,968
Stocks Dec. 31 (lead content):					
At primary smelters and refineries..... short tons..	83,443	115,473	125,479	90,427	101,860
At consumer plants..... do.....	109,195	90,306	105,786	88,900	156,404
Consumption of metal, primary and secondary..... short tons..	1,241,482	1,323,877	1,260,516	1,328,790	1,389,358
Price: New York, common lead, average, cents per pound.....	16.00	15.12	14.00	13.21	14.93
World:					
Production:					
Mine..... short tons..	2,966,508	3,138,779	3,169,343	3,298,741	3,623,401
Smelter..... do.....	2,910,884	3,026,266	3,182,316	3,330,912	3,670,848
Price: London, common lead, average, cents per pound.....	14.37	11.87	10.28	10.88	13.09

21. Utah, 15, and Idaho, 8. The program terminated as of January 1, 1970.

Government participation in exploration, primarily for lead, was withdrawn in June 1962. The program, under the Office of Minerals Exploration, Geological Survey, U.S. Department of the Interior, continued active in exploration for other base-metal deposits, often in association with lead.

Sales of Government surplus lead from the strategic stockpile to commercial users were suspended until approval of Public Law 91-46 on July 19, which authorized the sale of 100,000 tons as an off-the-shelf item. Sales in 1969 totaled 22,698 tons leaving 77,312 tons authorized at the end of the year. In addition 3,085 tons was transferred to Government agencies under authorization of Public Law 89-9. The actual drawdown of Government stocks of refined lead during the year amounted to 11,866 tons. In addition to the refined lead, 10,336 tons of antimonial lead in nonstrategic Government stocks was sold and delivered to commercial consumers. The strategic stockpile objective for lead was revised upward on December 3 to 530,000

tons. The stockpile inventory of 1,152,737 tons at the end of 1969 thus provided a surplus of 622,727 tons.

The International Lead and Zinc Study Group convened in Geneva, Switzerland, for its 13th session on October 8. The meeting marked the 10th anniversary of the international work on lead and zinc problems by the 30-country membership. The supply and demand situation was reviewed and found to be in close balance at that time, but a possibility was indicated of a growing surplus of supply and mounting producer stocks. It was noted that since the study group was organized lead consumption in the free world had increased at an average compound rate of 3.8 percent per year.

The International Lead-Zinc Research Organization, incorporated in 1965 by producers and consumers of lead and zinc and representing a major portion of that free world industry, continued to sponsor research and development programs to promote new and expanded use of lead and zinc.

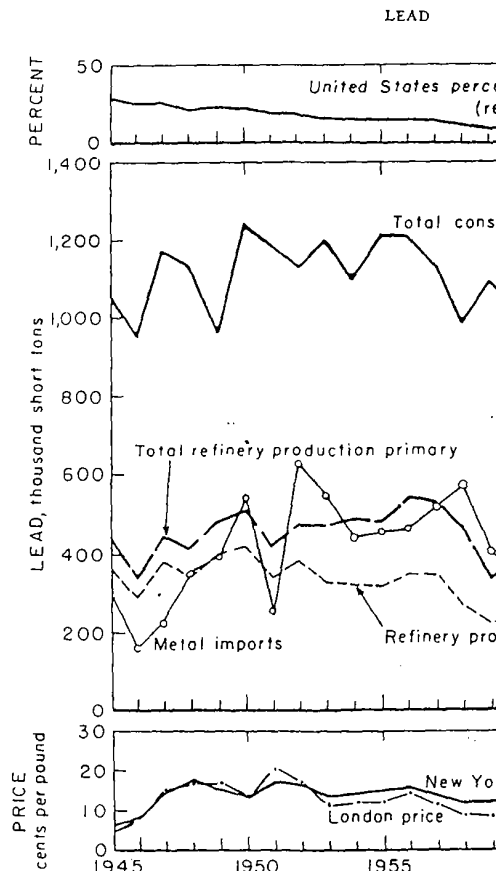


Figure 1.—Trends in the lead industry.

DOMESTIC PRODUCTION

MINE PRODUCTION

Mine production of recoverable lead gradually increased during the first 6 months of the year to reach 45,124 tons during June; during the last 6 months it ranged from 42,300 to 46,200 tons monthly. The total of 509,013 tons for the year compares with 359,156 tons in 1968 and represents a 42-percent increase. This output level was exceeded only in 1930 when production was 558,300 tons. The increase resulted from uninterrupted operations following the labor settlements in 1968 and, primarily, from full-scale production of the

four new lead-bearing mines in Missouri in 1968, in addition to domestic second-hand lead with 8 percent, Tennessee 95 percent supply. South Carolina continued More than in Missouri

opened since 1960, and seven mines are represented in the leading 10 domestic producers. Improvements in technology, mine design, and mining methods permit increased labor efficiencies and metal recoveries substantially above those of older mines and concentrators.

St. Joseph Lead Co., the leading domestic producer, operated the Fletcher, Viburnum, Federal, Indian Creek, and Goose Creek mines and produced 354,131 tons of lead concentrate.² A new mine development, Brushy Creek, was started and will become operational in 1972 with a capacity approaching 50,000 tons of lead. The Magmont mine, a joint venture of Cominco American Inc. and Dresser Industries, Inc., operated at full capacity throughout the year. Ozark Lead Co., a subsidiary of Kennecott Copper Corp., gradually increased output at the Ellington mine to achieve the designed rate by midyear. The Buick mine of Missouri Lead Operating Co., a joint venture of American Metal Climax Inc. and Homestake Mining Co., also gradually increased output during the year although ground-water and labor problems delayed full-scale output. Construction of the concentrator was completed during the year.³

Kennecott Copper Corp. became a major lead producer in 1969 with an output of 48,700 tons from operations in Missouri and Utah.⁴ The production at the Burgin mine, Eureka, Utah, was limited by a critical shortage of miners, which, together with caving ground and ground-water conditions, hindered mine development and stope preparation. Completion of the 1,300-foot-level loading facilities and initiation of stope development assisted in production improvements late in the year. The new development shaft for the Trixie area was completed to the planned depth of 860 feet. The Burgin operation is the first attempt to handle large quantities of the hot, corrosive water of the Tintic District and to use this water in the concentrator, which began operation in June. The Mayflower mine of Hecla Mining Co. and mines of United Park City Mines Co. and of United States Smelting, Refining, and Mining Co. were other large Utah lead producers.

Homestake Mining Co. completed facilities at the Bulldog Mountain mine near Leadville, Colo., in March 1969 and achieved car capacity output by July 1, with 49,200

tons milled during the last 6 months of the year. Reserves of ore as of January 1, 1970, were 409,480 tons with an average grade of 218 ounces of silver per ton and 2.7 percent lead.⁵ American Smelting and Refining Company continued development of the Black Cloud mine near Leadville, Colo. for production in 1971. The shaft was nearing completion at the 1,650-foot depth. Federal Resource Corp. began sinking a shaft to mine a large lead-zinc copper-silver ore body at the old Camp Bird mine near Ouray, Colo. The Keystone mine near Crested Butte, Colo., owned by Park City Consolidated Mines Co. and American Smelting and Refining Company, resumed operation in September under lease by Keystone Mines Co. Idaho Mining Co., a subsidiary of Newmont Mining Corp., was the leading producer in Colorado, and New Jersey Zinc Co. and Rico-Argentine Mining Co. were the other major lead producers.

American Smelting and Refining Co. resumed operations at the Van Stone mine, Northport, Wash., in April and produced 968 tons of lead. The Ground Hog mine near Silver City, N. Mex., was also reopened in May by American Smelting and Refining Company. A new flotation mill near Kingman, Ariz., was completed in February by Standard Metals Corp. to process ore from the Antlers mine and other adjacent properties.

SMELTER AND REFINERY PRODUCTION

The essentially uninterrupted operations, expanded domestic concentrate supply, and full-year operation of the two new Missouri smelters resulted in a primary plant production of 666,280 tons of refined and antimonial lead, a 34-percent increase over 1968 production and the largest total since 1930. Monthly output ranged from a low of 46,700 tons in February to a high of 59,800 tons in November and averaged over 55,500 tons.

Continuous operation of the Hercules smelter of St. Joseph Lead Co. and full utilization of the expanded capacity produced a record tonnage of 223,500 tons, up 31 percent from the 1968 level and 86

percent above the 1967 level. In October a sulfuric acid plant was placed in operation in conjunction with the smelter.⁶

The new smelter of American Smelting and Refining Co. at Glover, Mo., became operative in the first quarter of the year after being delayed by a strike initiated in September 1968. Production of all of the American Smelting and Refining Co. smelters and refineries in 1969 was 207,275 tons of lead, a 35-percent increase over the 1968 strike-curtailed output.⁷

The Bunker Hill Co., a division of Gulf Resources and Chemical Corp., produced 124,000 tons of refined lead, approximately the same output as in 1968. Installation of an updraft sintering machine was in progress, and construction of a new sulfuric acid plant was authorized.⁸

The United States Smelting Lead Refinery, Inc., East Chicago, Ind., a subsidiary of United States Smelting, Refining and Mining Co. produced almost 31,000 tons of lead. This refinery processes bullion from the Tooele, Utah, smelter of International Smelting and Refining Co., a subsidiary of The Anaconda Company.⁹

Secondary lead production in 1969 was a record 603,900 tons, a 9.6-percent increase over 1968 output. Secondary plants and foundries contributed 592,500 tons, or 98 percent, of the total. The ratio of class of material produced remained essentially unchanged from the 1968 pattern, with soft lead comprising 25.5 percent, antimonial lead 56.7 percent, and other lead alloys 17.8 percent. Secondary lead contributed 48.6 percent of the domestic lead production and 39.7 percent of new supply, including metal imports, compared with 53 percent and 40 percent in 1968 and 59 percent and 42 percent in 1967, respectively.

CONSUMPTION AND USE

Consumption of lead again moved upward to a new record of 1.39 million tons, an increase of 60,600 tons, or 4.6 percent, over 1968 consumption. The increase of 68,800 tons in battery requirements and 9,200 tons in gasoline additives represented the major areas of increase. Metal products excluding batteries, reflected a decrease of 11,200 tons, with most of the historical metal uses below the 1968 levels; only collapsible tubes increased significantly. Pigments also decreased in total because of a substantial drop in lead consumed in red

spectively. Reduction in lead consumption, including 5 factors and

Domestic production of lead in 1969 was 525,400 tons, compared with 480,000 tons in 1968, an increase of 8 percent. This compares with 525,400 tons in 1967, a slight increase of 0.1 percent. The increase in production resulted in a surplus of 115,000 tons, compared with a deficit of 115,000 tons in 1967. The surplus was used for a variety of purposes, including 58,800 tons for export.

Consumption of lead in 1969 was 1,390,000 tons, compared with 1,329,400 tons in 1968, an increase of 4.6 percent. The increase was due to a 4.6 percent increase in consumption of lead in batteries, which accounted for 68.8 percent of the total, and a 4.6 percent increase in consumption of lead in gasoline additives, which accounted for 0.7 percent of the total. Consumption of lead in metal products, excluding batteries, decreased 11.2 percent, and consumption of lead in pigments decreased 11.2 percent.

Lead and lead compounds are used in a wide variety of applications, including batteries, gasoline additives, metal products, pigments, and collapsible tubes. The increase in consumption of lead in batteries and gasoline additives represented the major areas of increase.

² St. Joseph Lead Co. Annual Report, 1969, p. 6.
³ Homestake Mining Co. Annual Report, 1969, p. 7.
⁴ Kennecott Copper Corp. Annual Report, 1969, p. 12.
⁵ Homestake Mining Co. Annual Report, 1969, p. 12.
⁶ St. Joseph Lead Co. Annual Report, 1969, p. 12.
⁷ American Smelting and Refining Co. Annual Report, 1969, p. 12.
⁸ Gulf Resources and Chemical Corp. Annual Report, 1969, p. 12.
⁹ United States Smelting, Refining and Mining Co. Annual Report, 1969, p. 12.

92,000 tons in 1968 and an annual average of 48,900 tons for the 1963-67 period. The disappearance is presumed to be unreported consumption or stocks especially at small users and dealers. Consumption averaged 115,800 tons monthly, with July and October continuing to be the historical low- and high-demand periods during the year. The daily average consumption of 3,806 tons compares with 3,641 tons in 1968.

Metal products other than batteries consumed 390,600 tons, a decrease from the 401,800 tons used in 1968. The total use of lead in these products has slowly declined in tonnage and percentage from 440,100 tons, 48.2 percent, in 1966 to 390,600 tons, 40.1 percent in 1969. Examination of the 1966 and 1969 requirements indicates a decline in most of the metal products, except ammunition, casting metal, collapsible tubes, foil, andterne metal, that ranges from 30 percent for calking, 18 percent for cable covering, and 14 percent for type metal, downward to 5 percent for pipes, traps and bends.

The manufacture of lead-acid storage batteries again posted a record requirement of 582,500 tons of lead, approximately 41 percent of the total reported lead consumption. The increased lead requirements reflect the record manufacture and shipment of automotive-type batteries which reached 46.4 million units according to statistics of the Association of American Battery Manufacturers, Inc. Batteries installed as original factory equipment totaled 10.1 units and 35.5 million batteries were classified as replacements. Export of batteries increased to 760,000 units compared with 450,000 units in 1968. The expanding use of automotive type batteries in non-highway use for recreational and farm equipment as well as use of large, industrial-type batteries for emergency power in hospitals and communications, has resulted in an average annual growth of 6.5 percent in battery lead consumption since 1968.

Lead requirements for gasoline antiknock additives was a record 271,700 tons, an increase of 3.5 percent, but well below the 6-percent increase achieved in 1968. A reported factor in the reduced growth was a substantial decrease, due to new foreign manufacturing capacity, in exports of antiknock fluid.

Lead consumed in pigments was the lowest since 1963 with the decrease mainly

in the manufacture of red lead and litharge. A small tonnage increase occurred in white lead and also in pigment colors, an area of gradual growth in recent years.

LEAD PIGMENTS

Production of lead pigments and oxides required 378,400 tons of lead, an increase of almost 10 percent over 1968 requirements. All the lead, except 600 tons, used in leaded zinc oxide was derived from pig lead. Use increased in white lead and decreased slightly in red lead. Lead in oxides, litharge, and black oxide increased 33,100 tons over 1968 requirements to a new record of 348,100 tons.

White lead requirements by the paint and ceramic industries continued the downtrend of recent years, as did red lead in paints rubber, and various other uses. The miscellaneous uses of red lead were especially reduced to less than 4,000 tons in comparison with the large tonnages used in prior years. Litharge requirements declined in the ceramic industry and also in oil refining and rubber manufacture. The largest use of litharge, however, is in the battery industry. The amount cannot be published and is included in other uses in table 20.

Prices.—The quoted price of lead pigments, with the exception of basic carbonate white lead, moved upward throughout the year in accord with the rising price of refined lead. The price of white lead, stable at 20.5 cents per pound, carload lots, freight allowed, since 1966, decreased to 20 cents in early February, increased to 21.5 units per pound in early August, and continued at that price for the remainder of the year. The price of red lead, 95 percent Pb_3O_4 , in carload lots, at works, quoted at 15.75 cents per pound at the beginning of the year, moved upward in 0.5-cent steps beginning in early January to reach 19.75 cents in late December. The price of litharge, commercial grade, powdered, in carload lots, at works, likewise moved upward in unison with the price of lead to reach 19 cents per pound in late December.

The value of shipments of white lead, red lead, and litharge amounted to \$57.6 million, an average of \$342 per ton, compared with \$52.8 million and \$317 per ton in 1968, respectively.

Foreign Trade.—Export of lead oxides, pigment grade, including lead arsenate and

other compounds, continued to decline in gross weight and value from 1,877 tons valued at \$770,000 in 1968 to 1,688 tons valued at \$685,700 in 1969. A total of 46 countries received shipments ranging in value from a high of \$171,800 for Canada to \$500 for Bermuda. South Vietnam was the second largest importer with a total import value of \$40,600.

Imports for consumption of lead pigments and compounds in 1969 increased about 500 tons in weight and \$1,000 in value compared with the 1968 totals. Lead compounds, including lead arsenate, acetate, and nitrate, totaled 355 tons valued

LEAD

STOCKS

Producer stocks of refined and antimonial lead at the start of the year totaled 15,300 tons. These stocks were reduced in January and February to a low of 10,000 tons of metal. A rise initiated in March increased the total to 18,700 tons at the end of May. A decrease in June and July was followed by a buildup culminating in the year-end total of 25,700 tons. Stocks of base bullion increased slightly during the year. Raw material stocks at primary plants declined in the first quarter from 87,000 tons to 75,000 tons, then built up to a high of 112,000 tons at the end of October, and closed the year at 102,000 tons.

PRICES

The strong demand for lead, competition in the world market for concentrates, and critically by low stocks of free world producers at the end of 1968 resulted in continuation of the upward trend in price initiated in October of 1968. Beginning on January 8 a 0.5-cent-per-pound increase to 13.5 cents per pound was followed by like increases on January 30, April 7, June 9, July 3, November 24, and December 15,

FOREIGN TRADE

Exports of lead metal decreased in 1969 to about 5,000 tons and consisted of relatively small shipments to over 18 countries. Export of lead scrap, however, was the largest in recent years at 2,340 tons. The increase was primarily due to a substantial shipment to the United Kingdom and to

duty paid entry of 6,000 tons. Canada supplied 39 percent of the imports for consumption, followed by Australia, 21 percent; Mexico, 19 percent; and Honduras, 12 percent. Australia supplied about 2,000 tons of bullion in addition to ore. Imports of lead metal for consumption decreased for the second successive year to 278,900 tons compared with 363,600 tons in 1967 and 337,600 tons in 1968. Australia supplanted Peru as the leading source with 22 percent; followed by Mexico, 21 percent;

Peru, 21 percent; Canada, 16 percent; and Yugoslavia, 10 percent.

Imports of lead scrap mainly from Canada and Mexico, increased to 6,700 tons and thus exceeded exports of scrap by some 4,300 tons. Semiprocessed sheet, pipe, and shot imported from Canada and West Europe totaled 518 tons with an indicated value of 16.8 cents per pound, and imports of babbitt metal, solder, and other alloys totaled 667 tons, lead content, with a per-pound value of \$2.87 and a gross-weight value of 90 cents per pound.

WORLD REVIEW

Statistical reporting on the world lead industry varies in reporting base, reporting source, and scope of estimating. The Bureau of Mines reports indicate the basis, insofar as possible, used for each country, whereas the International Lead and Zinc Study Group reports on an ore-content basis. The American Bureau of Metal Statistics (ABMS) relies to a large extent on industrial trade associations, as well as Governmental agencies, in obtaining statistical information. Therefore, free world mine production of lead ranged from the Lead and Zinc Study Group total of 2.68 million tons¹⁰ through the Bureau of Mines total of 2.64 million to the 2.56-million-ton total of ABMS. In addition the Bureau of Mines estimated production in Communist countries, excluding Yugoslavia, to be 887,000 tons and the world total is thus 3.52 million tons. Smelter reporting of metal output also varies, with the Bureau of Mines reporting, insofar as possible, only primary metal, whereas the Lead and Zinc Study Group reports metal output from both primary and secondary sources. Free world smelter output in 1969 thus ranged from the Study Group total of 3.23 million tons through the ABMS total of 2.94 million to the Bureau of Mines total of 2.67 million. An additional output of a million tons of metal was estimated for the Communist countries, excluding Yugoslavia, to provide a world output of primary metal of 3.67 million tons.

The United States became the leading producer during the year with 14 percent of the world total production. Australia and the U.S.S.R. shared second place with about 490,000 tons each. Canada, Mexico, Peru, and Yugoslavia were the other free

world countries with an output over 100,000 tons each, and these seven countries contributed 69 percent of the free world lead and 52 percent of the world total.

Smelter production was also highlighted by the substantial increase in United States output which after a 2 year period in second place to the U.S.S.R., again became the leading metal producer with 24 percent of the free world total and 17 percent of the world total. Australia, Japan, Canada, West Germany, France, Yugoslavia and Belgium each had metal production in excess of 100,000 tons and the eight leading free world countries produced 72 percent of the free world lead metal.

Consumption of lead metal in the free world, including refined and antimonial lead from primary and secondary sources and excluding other secondary alloys, amounted to 3.43 million tons, according to the Lead and Zinc Study Group's preliminary totals. The United States was by far the largest consumer with 37 percent of the total. The United Kingdom ranked second, followed closely by West Germany, France, and Japan. The North and South American countries combined consumed 44 percent; West Europe, 44 percent; Asia, 9 percent; Australia-New Zealand, 2 percent; and Africa, 1 percent. The Study Group also reports consumption of refined and antimonial lead in the Free World and preliminary totals for 1969 indicate a metal supply surplus of 128,000 tons, of which 22,000 tons was an increase in free world producer stocks during the year.

Argentina.—Compañía Minera Aguilar S. A., a subsidiary of St. Joseph Lead Co.

¹⁰ International Lead and Zinc Study Group. Monthly Bulletin, July 1970, pp. 10-12.

increased production of lead concentrates from 31,100 tons in 1968 to 46,860 tons in 1969, as the completion of the mill expansion permitted high-level production during the year.¹¹

Australia.—Mount Isa Mines Ltd., 52.7-percent owned by American Smelting and Refining Company, increased lead production over 33 percent during the fiscal year ending June 30, 1969, to 131,388 tons. Since the close of the fiscal year, the ore-production rate has exceeded the 16,000-long-ton-per-day goal of the major expansion program started in 1959. Mount Isa announced plans to bring into production a new mine, to be known as the Hilton mine, located about 13 miles north of Mount Isa. Shaft sinking was initiated on the deposit outlined by drilling. The deposit reported contains 35 million tons of ore averaging 7.6 percent lead and 9.6 percent zinc.¹²

Broken Hill areas mines continued to expand production with a relatively quiet labor situation during the year except for a 3-week strike in August. Zinc Corp. of Australia increased lead output 17 percent over that of 1968. North Broken Hill, Ltd., and New Broken Hill, Consolidated, continued expansion programs designed to increase the area's annual production from 275,000 to 300,000 tons. The fourth major Broken Hill mine, Broken Hill South, is reaching the limits of its ore. The mine was able to increase production only from a residue treatment project.

Exploration continued at a high rate. Possible new deposits were reported by Texas Gulf Sulphur Co., Acme Holdings N.L., and Electrolytic Zinc Co. of Australia, Ltd.

Canada.—The major highlight in Canada was the completion of the \$60 million development and construction of Anvil Mining Corp., Ltd.'s, facilities in the Yukon, which were begun in 1967. The first concentrates from the open pit mine and 5,500-ton-per-day flotation mill and related facilities, owned 60 percent by Cyprus Mines Corp. and 40 percent by Dynasty Exploration, Ltd., were shipped to Japan on December 7. The concentrates were transported by truck 237 miles to Whitehorse and thence 110 miles by railroad to Skagway, Alaska, for transfer to oceangoing cargo ships. Toho Zinc and Mitsui Mining and Smelting will take the

output from Anvil, 15,400

Production from Colum down contin compa Colum tons c 1909. Colum year.

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¹¹ S 16. ¹² A Annua 1969, 1970. Annua

the loss of over a month's production in the smelters and refineries at La Oroya.

Cia Minera Santa Luisa S.A., a subsidiary of Mitsui Mining & Smelting Co. Ltd. of Japan, continued underground developments of the Huanzala mine in the Peruvian Andes.

Poland.—An imperial smelter was placed in operation early in the year at the zinc-lead smelter of Zjednoczenie Gorniczo-

Hutnicze Metali Niezależnych at Miasteczko.

Yugoslavia.—After 5 years of construction, the first open pit lead-zinc mine was placed in operation in Kosovska Mitrovica. This is the first stage of the new Kisnica and Nova Brdo mine-and-pit complex. A modern flotation mill was also placed in regular operation not far from the new mine.

TECHNOLOGY

Research, development, and incorporation of new methods, equipment, and product uses continued to be a major activity in the lead industry. The International Lead Zinc Research Organization, Inc. (ILZRO), conducts cooperative research and development on behalf of major lead and zinc producers throughout the world. Currently there are 35 supporting companies in 12 countries, and some 60 lead research programs cover essentially all existing uses of lead as well as new product development. The Zinc and Lead International Service (ZALIS) was set up in 1969 to stimulate the consumption of lead and zinc in developing countries by providing up-to-date technical service to manufacturers and consumers.

In building, a major effort was development of a composite lead roofing competitive with asphalt-type roofing. Battery applications continue to receive major attention especially in the area of vehicle propulsion as air pollution problems increase in national concern. Cable sheathing of lead-plastic composition is under study and development to combine the corrosion resistance and impermeability of lead with the elasticity of plastics. The organolead compounds are showing technical and commercial potential in many applications warranting extensive research and development into tonnage levels of lead consumption.

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

(Short tons)

State	1965	1966	1967	1968	1969
Alaska.....	W	14	.....	W	2
Arizona.....	5,913	5,211	4,771	1,704	217
California.....	1,810	1,976	1,735	4,001	2,518
Colorado.....	22,495	23,082	21,923	19,778	21,767
Idaho.....	66,606	72,334	61,387	54,790	65,597
Illinois.....	3,005	2,285	2,384	1,467	791
Kansas.....	1,644	1,109	1,031	1,227	395
Kentucky.....	756	484	845	W	.....
Missouri.....	133,521	132,255	152,649	212,611	355,452
Montana.....	6,981	4,409	898	1,870	1,753
Nevada.....	2,277	3,581	1,500	863	1,420
New Mexico.....	3,387	1,596	1,827	1,363	2,368
New York.....	601	1,097	1,653	1,396	1,686
Oklahoma.....	2,813	2,999	2,727	2,387	605
Oregon.....	W	.....	.....	W	(¹)
South Dakota.....	.....	.....	.....	.....	1
Tennessee.....	.....	181	.....	.....	.....
Utah.....	37,700	64,124	53,813	45,205	41,332
Virginia.....	3,651	3,078	3,430	3,573	3,358
Washington.....	6,328	5,859	2,762	5,655	8,649
Wisconsin.....	1,645	1,694	1,596	1,126	1,102
Other States.....	14	.....	.....	140	.....
Total.....	301,147	327,368	316,931	359,156	609,013

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

¹ Less than $\frac{1}{2}$ unit.

Table 3.—Production of lead and zinc in the United States in 1969, by State and class of ore, from old tailings, etc., in terms of recoverable metals
(Short tons)

State	Lead ore			Zinc ore			Lead-zinc ore		
	Gross weight (dry basis)	Lead content	Zinc content	Gross weight (dry basis)	Lead content	Zinc content	Gross weight (dry basis)	Lead content	Zinc content
Alaska.....	50	2	4	.....	.....	.....	2,699	105	94
Arizona.....	571	.....	.....	.....	.....	.....	(¹)	(¹)	(¹)
California.....	104,452	12,283	12,319	.....	.....	.....	330,309	8,804	12,326
Colorado.....	990	49	4	277,350	2,270	28,479	735,370	35,181	45,667
Idaho.....	246,472	24,729	2,842	(¹)	(¹)	(¹)	.....	.....	.....
Kansas.....	.....	.....	.....	59,399	395	1,900	.....	.....	.....
Missouri.....	7,873,845	355,452	41,099	(¹)	(¹)	(¹)	12,446	137	1,085
Montana.....	2,691	1,222	1,903	.....	.....	.....	(¹)	(¹)	(¹)
Nevada.....	117,735	.....	.....	149,920	.....	25,076	.....	.....	.....
New Jersey.....	.....	.....	.....	221,563	243	17,216	54,563	2,124	6,428
New Mexico.....	.....	.....	.....	740,825	1,685	58,728	.....	.....	.....
New York.....	.....	.....	.....	240,998	1,605	2,744	.....	.....	.....
Oklahoma.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Oregon.....	.....	.....	.....	630,587	.....	33,035	.....	.....	.....
Pennsylvania.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
South Dakota.....	.....	.....	.....	4,288,502	.....	114,556	.....	.....	.....
Tennessee.....	.....	.....	.....	(¹)	(¹)	(¹)	450,071	34,167	29,886
Utah.....	2,116	622	91	.....	.....	.....	215,703	7,594	4,265
Virginia.....	.....	.....	.....	660,142	3,358	18,704	.....	.....	.....
Washington.....	.....	.....	.....	261,613	1,055	5,473	.....	.....	.....
Wisconsin.....	.....	.....	.....	846,233	1,102	22,991	.....	.....	.....

Table 3.—Production of lead and zinc in the United States in 1969, by State and class of ore, from old tailings, etc., in terms of recoverable metals—Continued
(Short tons)

State	Copper-lead, copper-zinc, and copper-lead-zinc ores				All other sources ^a				Total	
	Gross weight (dry basis)	Lead content	Zinc content	Gross weight (dry basis)	Lead content	Zinc content	Gross weight (dry basis)	Lead content	Zinc content	
Alaska.....	104,084	33	8,663	20,179,324	16	278	20,287,178	2	9,059	
Arizona.....	411,175	9,316	12,274	6,599	235	8	1,039,973	2,518	3,327	
California.....	---	---	---	70,155	1,323	632	1,039,973	21,767	53,715	
Colorado.....	---	---	---	818,234	5,687	7,391	1,800,123	65,597	55,900	
Idaho.....	---	---	---	---	---	---	7,873,545	355,452	1,909	
Kansas.....	---	---	---	78,169	1,224	4,988	93,306	1,753	6,143	
Missouri.....	---	---	---	1,735,640	153	32	1,753,549	1,420	941	
Montana.....	---	---	---	---	---	---	1,222,762	2,368	25,707	
New Jersey.....	---	---	---	946,516	1	664	1,400,865	1,686	58,728	
New Mexico.....	---	---	---	---	---	---	240,212	605	2,744	
New York.....	---	---	---	(b)	(c)	(c)	630,587	(f)	33,085	
Oklahoma.....	---	---	---	---	---	---	---	---	---	
Oregon.....	---	---	---	---	---	---	---	---	---	
Pennsylvania.....	---	---	---	---	---	---	---	---	---	
South Dakota.....	---	---	---	---	---	---	---	---	---	
Tennessee.....	---	---	---	---	---	---	---	---	---	
Utah.....	1,574,140	5,963	9,976	54,927	680	1,557	5,862,642	41,332	124,532	
Virginia.....	---	---	---	---	---	---	---	---	---	
Washington.....	---	---	---	---	---	---	---	---	---	
Wisconsin.....	---	---	---	---	---	---	---	---	---	
Other States.....	---	---	---	---	---	---	---	---	---	
Total.....	2,207,025	15,357	34,287	24,111,348	9,674	21,456	45,247,845	509,013	553,124	
Percent of total lead-zinc.....	---	---	---	---	---	---	---	---	---	

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

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

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

^d Includes lead recovered from barium sulfate ore.

^e One from "Other Sources" combined with zinc ore to avoid disclosing individual company confidential data.

^f Lead and zinc recovered from: copper, gold, silver, fluorapatite, and uranium ores, and from smelter slags, mill tailings, and miscellaneous cleanups.

^g Less than 1/2 unit.

LEAD

Table 4.—Mine production of recoverable lead in the United States in 1969
(Short tons)

Month	1968	1969	Month
January.....	24,493	36,805	August.....
February.....	24,282	34,944	September....
March.....	24,083	38,816	October.....
April.....	27,440	42,263	November....
May.....	81,052	43,816	December....
June.....	28,965	45,124	
July.....	30,861	44,830	Total.....

Table 5.—Twenty-five leading lead-producing mines in the United States in 1969, in order of output

Rank	Mine	County and State	Output (Short tons)
1	Fletcher.....	Reynolds, Mo.....	St. Joseph
2	Viburnum.....	Crawford, Iron, and Wash- ington, Mo.....	do.....
3	Magmont.....	Iron, Mo.....	Cominco A
4	Federal.....	St. Francois, Mo.....	St. Joseph
5	Ozark.....	Reynolds, Mo.....	Ozark Lea
6	Bunker Hill.....	Shoshone, Idaho.....	The Bunk
7	U.S. and Lark.....	Salt Lake, Utah.....	United Sta
8	Lucky Friday.....	Shoshone, Idaho.....	fining an
9	Buick.....	Iron, Mo.....	Hecla Min
10	Indian Creek.....	Washington, Mo.....	Missouri L
11	Idarado.....	Ouray and San Miguel, Colo.	St. Joseph
12	Pend Oreille.....	Pend Oreille, Wash.....	Idarado M
13	Star-Morning.....	Shoshone, Idaho.....	Pend Oreil
14	Burgin.....	Utah, Utah.....	Co.....
15	Mayflower.....	Wasatch, Utah.....	Hecla Min
16	United Park City.....	Summit and Wasatch, Utah.	United Pa
17	Page.....	Shoshone, Idaho.....	American
18	Sunnyside.....	San Juan, Colo.....	fining C
19	Dayrock.....	Shoshone, Idaho.....	Standard
20	Austinville and Ivanhoe.....	Wythe, Va.....	Day Mine
21	Eagle.....	Eagle, Colo.....	The New
22	Ophir.....	Tooele, Utah.....	do.....
23	Darwin.....	Inyo, Calif.....	United Sta
24	Ground Hog.....	Grant, N. Mex.....	fining an
25	Balmat.....	St. Lawrence, N. Y.....	West Hill

Table 6.—Refined lead produced at primary refineries in the United States in 1969
source material
(Short tons)

	1965	1969
Refined lead:		
From primary sources:		
Domestic ores and base bullion.....	305,007	318
Foreign ores and base bullion.....	113,242	122
Total.....	418,249	440
From secondary sources.....	13,140	9
Grand total.....	431,389	449
Calculated value of primary refined lead (thou- sands) ¹	\$133,840	\$133

¹ Value based on average quoted price, New York, and excludes value of primary refineries.

Table 12.—Lead consumption in the United States, by products
(Short tons)

Product	1968	1969	Product	1968	1969
Metal products:			Pigments Continued:		
Ammunition.....	82,193	79,233	Pigment colors.....	14,163	14,670
Bearing metals.....	18,441	17,406	Other ¹	3,234	1,201
Brass and bronze.....	21,021	21,512	Total.....	109,734	102,386
Cable covering.....	53,456	54,203	Chemicals:		
Calking lead.....	49,718	44,857	Gasoline antiknock addi-		
Casting metals.....	8,693	9,918	tives.....	261,897	271,128
Collapse tubes.....	9,310	12,484	Miscellaneous chemicals.....	629	602
Foil.....	6,114	5,881	Total.....	262,526	271,730
Pipes, traps, and bends.....	21,098	19,407	Miscellaneous uses:		
Sheet lead.....	28,271	26,818	Annealing.....	4,194	4,252
Solder.....	74,074	72,626	Galvanizing.....	1,755	1,797
Storage batteries:			Lead plating.....	389	406
Battery grids, posts,			Weights and ballast.....	16,768	17,366
etc.....	250,129	280,386	Total.....	23,106	23,821
Battery oxides.....	263,574	302,160	Other, unclassified uses.....	17,924	18,287
Terne metal.....	1,427	1,583	Grand total².....	1,328,790	1,389,358
Type metal.....	27,981	26,660			
Total.....	915,500	973,134			
Pigments:					
White lead.....	5,857	6,617			
Red lead and litharge.....	86,480	79,898			

¹ Includes lead content of leaded zinc oxide and other pigments.

² Includes lead which went directly from scrap to fabricated products.

Table 13.—Lead consumption in the United States, by months
(Short tons)

Month	1968	1969	Month	1968	1969
January.....	110,608	118,080	August.....	110,908	112,189
February.....	106,261	106,586	September.....	114,312	123,941
March.....	106,621	117,508	October.....	133,133	131,891
April.....	108,113	115,948	November.....	116,574	112,521
May.....	112,139	117,272	December.....	112,341	117,749
June.....	104,479	116,780	Total¹.....	1,328,790	1,389,358
July.....	93,301	100,894			

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

Table 14.—Lead consumption in the United States in 1969, by class of products and types of material
(Short tons)

Product	Soft lead	Lead in antimonial lead	Lead in alloys	Lead in copper-base scrap	Total
Metal products.....	189,558	98,516	50,970	15,367	354,411
Storage batteries.....	311,987	270,559	.....	.....	582,546
Pigments.....	101,185	.....	.....	.....	101,185
Chemicals.....	271,536	194	.....	.....	271,730
Miscellaneous.....	10,707	13,005	104	.....	23,816
Unclassified.....	15,885	2,050	352	.....	18,287
Total.....	900,858	384,324	51,426	15,367	1,351,975

¹ Excludes 36,182 tons of lead which went directly from scrap to fabricated products and 1,201 tons of lead contained in leaded zinc oxide and other nonspecified pigments.

Table 15.—Lead consumption in the United States
(Short tons)

State	Refined soft lead	Lead in antimonial lead
California.....	92,153	34,898
Colorado.....	1,019	2,832
Connecticut.....	16,465	12,751
District of Columbia.....	.....	.....
Florida.....	5,913	5,771
Georgia.....	41,734	17,615
Illinois.....	80,746	49,306
Indiana.....	83,705	43,546
Kansas.....	12,142	10,489
Kentucky.....	2,912	7,820
Maryland.....	8,815	16,066
Massachusetts.....	5,772	898
Michigan.....	17,593	19,446
Missouri.....	39,679	14,278
Nebraska.....	3,611	988
New Jersey.....	136,616	21,100
New York.....	41,523	1,846
Ohio.....	12,954	3,604
Pennsylvania.....	55,668	36,625
Rhode Island.....	1,557	495
Tennessee.....	197	13,080
Virginia.....	945	1,541
Washington.....	6,958	444
West Virginia.....	18,077	4,948
Wisconsin.....	3,223	3,283
Alabama and Mississippi.....	1,414	2,993
Arkansas and Oklahoma.....	5,210	4,178
Hawaii and Oregon.....	872	3,336
Iowa and Minnesota.....	3,217	8,360
Louisiana and Texas.....	193,923	31,949
Montana and Idaho.....	2,977	.....
New Hampshire, Maine, Vermont, Delaware.....	5,682	18,312
North and South Carolina.....	2,945	2,781
Utah, Nevada, Arizona.....	88	.....
Total.....	900,858	384,324

¹ Excludes 36,182 tons of lead which went directly from scrap to contained in leaded zinc oxide and other non-specified pigments.

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

Pigment	Production (short tons)	1968		
		Short tons	Shipments	
			Value ¹	Average per ton
			Total	
White lead:				
Dry.....	6,614	8,678	\$3,514,502	\$410
In oil.....	2,822	3,056	2,087,601	683
Total.....	9,436	11,634	5,602,103	482
Red lead.....	23,816	23,811	8,458,714	355
Litharge.....	114,900	131,178	38,721,968	295
Black oxide.....	218,119	.....	.....	2

¹ Except for basic lead sulfate; these figures withheld to avoid data.

² At plant, exclusive of container.

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

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

(Short tons)								
Pigment	1968				1969			
	Lead in pigments produced from—			Total lead in pigments	Lead in pigments produced from—			Total lead in pigments
	Ore		Pig lead		Ore		Pig lead	
	Domestic	Foreign			Domestic	Foreign		
White lead.....	---	---	7,549	7,549	---	---	8,396	8,396
Red lead.....	---	---	21,689	21,689	---	---	21,378	21,378
Litharge.....	---	---	108,857	108,857	---	---	114,757	114,757
Black oxide.....	---	---	208,067	208,067	---	---	233,812	233,812
Leaded zinc oxide	768	706	-----	1,474	867	204	-----	571
Total.....	768	706	344,082	345,536	367	204	877,843	878,414

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

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

Industry	(Short tons)				
	1965	1966	1967	1968	1969
Paints.....	9,185	8,260	6,968	6,681	5,969
Ceramics.....	133	130	96	124	67
Other.....	5,355	6,486	5,064	4,829	4,328
Total.....	14,673	14,876	12,128	11,634	10,359

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

Table 19.—Distribution of red lead shipments, by industries

Industry	(Short tons)				
	1965	1966	1967	1968	1969
Paints.....	13,725	14,480	13,318	11,347	9,191
Storage batteries.....	W	W	W	W	9,302
Other.....	15,938	16,790	12,423	12,464	3,684
Total.....	29,663	31,270	25,741	28,811	22,177

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

Table 20.—Distribution of litharge shipments, by industries

Industry	(Short tons)				
	1965	1966	1967	1968	1969
Ceramics.....	21,013	23,476	19,491	24,123	21,670
Insecticides.....	1,161	1,166	W	W	W
Oil refining.....	2,886	1,991	1,835	1,849	1,603
Rubber.....	2,153	2,296	1,928	1,986	1,794
Varnish.....	3,763	1,620	1,228	W	W
Other.....	74,916	79,754	75,500	103,220	110,752
Total.....	105,892	110,303	99,982	181,178	135,719

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	1968		1969	
	Short tons	Value (thousands)	Short tons	Value (thousands)
White lead.....	2,158	\$672	1,791	\$661
Red lead.....	4,412	977	5,617	1,365
Litharge.....	24,829	5,131	23,982	5,542
Other lead pigments.....	207	54	342	107
Other lead compounds.....	398	116	901	809
Total.....	32,004	6,950	32,473	7,984

Table 22.—Stocks of lead at primary smelters and refiners, Dec. 31

Stocks	(Short tons)	
	1965	1966
Refined pig lead.....	17,524	16,175
Lead in antimonial lead.....	7,680	6,396
Lead in base bullion.....	10,735	15,606
Lead in ore and matte.....	47,504	77,296
Total.....	83,443	115,473

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

Year	(Short tons, lead content)	
	Refined soft lead	Lead in antimonial lead
1965.....	61,586	36,190
1966.....	44,490	84,704
1967.....	59,887	35,879
1968.....	43,938	85,009
1969.....	67,304	79,649

Table 24.—Average monthly and yearly quoted prices of lead, New York, and London (Cents per pound)

Month	1968		
	St. Louis	New York	London
January.....	18.80	14.00	9.90
February.....	18.80	14.00	10.80
March.....	18.80	14.00	10.80
April.....	18.80	14.00	10.60
May.....	12.84	13.04	10.70
June.....	12.80	13.00	10.70
July.....	12.60	12.70	11.10
August.....	12.80	12.50	11.20
September.....	12.80	12.50	11.80
October.....	12.61	12.81	11.10
November.....	12.80	13.00	11.10
December.....	12.80	13.00	11.20
Average.....	13.01	13.21	10.80

¹ St. Louis: Metal Statistics, 1970. New York: Metal Statistics, 1970.

² Based on monthly rates of exchange by Federal Reserve Board.

DOMESTIC PRODUCTION

Concentrates.—Production of ilmenite concentrate was 931,000 tons, 5 percent less than that in 1968. Producers were E. I. du Pont de Nemours & Co., Inc., Starke and Highland, Fla.; Humphreys Mining Co., Folkston, Ga.; SCM Corporation, Glidden-Durkee Division, Lakehurst, N.J.; National Lead Co., Tahawus, N.Y.; and American Cyanamid Co., Piney River, Va. No domestic production of rutile concentrate was reported.

Metal.—Production of titanium sponge was 33 percent higher than that in 1968. The producing companies were Titanium Metals Corporation of America (TMCA), Henderson, Nev., owned by National Lead Co. and Allegheny Ludlum Steel Corp.; Reactive Metals, Inc., Ashtabula, Ohio, owned by National Distillers & Chemical Corp. and United States Steel Corp.; and Oregon Metallurgical Corp., Albany, Ore., partly owned by Armco Steel Corp. and Ladish Co. The sponge-production capacity of the three plants was about 20,000 tons per year.

Production of titanium ingot, including alloys, was 28,500 tons, an increase of 48 percent over 1968 production. Nine companies that produced titanium ingot from sponge metal and scrap are as follows:

Company	Plant location
Crucible Steel Company of America	Midland, Pa.
G. O. Carlson, Inc.	Niles, Ohio
Harvey Aluminum, Inc.	Torrance, Calif.
Howmet Corp.	Whitehall, Mich.
Oregon Metallurgical Corp.	Albany, Ore.
Reactive Metals, Inc.	Ashtabula, Ohio
Teledyne Titanium, Inc.	Monroe, N.C.
Titanium Metals Corporation of America	Henderson, Nev.
Titanium West, Inc.	Reno, Nevada

Pigment.—The gross weight of titanium dioxide (TiO₂) pigment produced domestically was 1 percent greater than that of 1968, with the average TiO₂ content of the rutile-, anatase-, and composite-type pigments being slightly higher than in the previous year. Rutile-type pigment, produced by all eight pigment companies, again was about 60 percent of the total on a TiO₂ content basis. Most of the remainder was anatase-type pigment, produced by five companies, and composite-type produced by one company.

Companies producing titanium pigments and plant locations are as follows: American Cyanamid Co., Piney River, Va., and Savannah, Ga.; American Potash & Chemical Corp., a subsidiary of Kerr McGee Corp., Hamilton, Miss.; Cabot Titania, Inc., wholly owned subsidiary of Cabot Corp., Ashtabula, Ohio; E. I. du Pont de Nemours & Co., Inc., Edge Moor, Del., Antioch, Calif., and New Johnsonville, Tenn.; National Lead Co., St. Louis, Mo., and Sayreville, N.J.; New Jersey Zinc Co., controlled by Gulf & Western Industries, Gloucester, N.J.; PPG Industries, Inc., Natrium, W. Va.; and SCM, Glidden-Durkee Division, Baltimore, Md.

Welding Rod Coating.—A total of 256,000 tons of welding rods, containing titaniferous materials in their coatings, was produced. Of the total output 51 percent contained rutile; 16 percent, ilmenite; 18 percent, a mixture of rutile and manufactured titanium dioxide; 9 percent, manufactured titanium dioxide; and 6 percent, miscellaneous mixtures and titanium slag.

Table 2.—Production and mine shipments of titanium concentrates¹ from domestic ores in the United States

Year	Production (short tons, gross weight)	Shipments		
		Short tons (gross weight)	TiO ₂ content (short tons)	Value (thousands)
1965.....	969,459	948,832	494,353	\$18,058
1966.....	965,378	868,436	451,132	17,608
1967.....	935,091	882,414	463,286	18,519
1968.....	978,509	960,118	506,260	19,484
1969.....	931,247	893,034	480,918	18,636

¹ Includes a mixed product containing rutile, leucosene, and altered ilmenite. Production of rutile concentrate in the United States was discontinued in 1968; data for previous years are withheld to avoid disclosing individual company confidential data.

Table 3.—Titanium (Short tons)

	1968
Sponge metal:	
Imports for consumption.....	8,111
Industry stocks.....	9
Government stocks (DPA inventories).....	22,811
Consumption.....	12,111
Scrap-metal consumption.....	8,311
Ingot: ¹	
Production.....	16,211
Consumption.....	14,611
Net shipments of mill products ²	9,811

¹ Includes alloy constituents.

² Bureau of the Census and Business and Defense Services Series BDSAF-263. Net shipments are derived by subtracting from the industry's gross shipments of that shape.

Table 4.—Titanium (TiO₂ content)

Year	Production (short tons)	Quantity (short tons)
1965.....	576,700	576,700
1966.....	594,486	594,486
1967.....	589,449	589,449
1968.....	623,691	623,691
1969.....	651,628	651,628

¹ Preliminary. ² Revised.

³ Includes interplant transfers.

Source: Bureau of the Census.

CONSUMPTION

Metal.—Consumption of titanium sponge was 20,100 tons, up 41 percent from that of 1968. Shipments of titanium mill products were a record 16,000 tons, up 34 percent from 1968 shipments.

Although demand for titanium is increasing for nonaerospace uses, aerospace applications used approximately 90 percent of the metal consumed, and demand for use in the Boeing 747, Lockheed L-1011, and McDonnell-Douglas DC-10 consumed approximately 50 percent of mill products in 1969.

In nonaerospace applications, titanium was used in the chemical industry, where its strength and corrosion resistance are dominant characteristics. A new cathodic

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

Year and product	Ilmenite ¹		Titanium slag		Rutile	
	Gross weight	TiO ₂ content (estimated)	Gross weight	TiO ₂ content (estimated)	Gross weight	TiO ₂ content (estimated)
1965.....	928,804	483,002	148,184	105,483	117,876	118,017
1966.....	962,706	507,879	182,288	98,688	185,888	180,191
1967.....	919,206	488,286	122,926	86,946	158,457	147,168
1968:						
Pigments.....	957,114	509,018	142,168	100,591	112,856	108,544
Titanium metal.....	(²)	(²)	(²)	(²)	(²)	(²)
Welding-rod coatings.....	(²)	(²)	(²)	(²)	21,414	20,409
Alloys and carbide.....	2,097	1,138	(²)	(²)	728	659
Ceramics.....	(²)	(²)	(²)	(²)	(²)	(²)
Glass fibers.....	(²)	(²)	(²)	(²)	(²)	(²)
Miscellaneous.....	347	207	(²)	(²)	26,275	23,988
Total.....	959,558	510,858	142,168	100,591	160,278	158,600
1969:						
Pigments.....	1,000,874	540,403	138,553	98,075	129,668	124,811
Titanium metal.....	(²)	(²)	(²)	(²)	(²)	(²)
Welding-rod coatings.....	343	208	(²)	(²)	22,001	20,987
Alloys and carbide.....	1,963	1,106	(²)	(²)	(²)	(²)
Ceramics.....	(²)	(²)	(²)	(²)	472	461
Glass fibers.....	(²)	(²)	(²)	(²)	(²)	(²)
Miscellaneous.....	60	30	(²)	(²)	33,561	31,934
Total.....	1,003,230	541,747	138,553	98,075	185,702	178,183

¹ Includes a mixed product containing rutile, leucocoxene, and altered ilmenite.
² Included with "miscellaneous" to avoid disclosing individual company confidential data.
³ Included with "pigments" to avoid disclosing individual company confidential data.
⁴ Included with "alloys and carbide" to avoid disclosing individual company confidential data.

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

Industry	1965	1966	1967	1968	1969
Distribution by gross weight:					
Paints, varnishes and lacquers.....	62.9	61.6	61.9	60.7	58.5
Paper.....	12.6	13.9	14.6	14.9	17.0
Floor coverings.....	8.6	8.4	2.7	2.4	2.3
Rubber.....	4.2	4.2	2.8	2.9	2.6
Coated fabrics and textiles (oil cloth, shade cloth, artificial leather, etc.).....	1.4	1.4	1.4	1.4	1.3
Printing ink.....	1.8	1.9	2.0	2.1	2.8
Roofing granules.....	1.3	1.2	1.1	.8	.9
Ceramics.....	1.5	1.7	1.9	2.1	2.0
Plastics (except floor covering and vinyl-coated fabrics and textiles).....	3.6	3.8	5.1	6.0	6.2
Other (including export).....	7.1	6.9	6.5	6.7	6.9
Total.....	100.0	100.0	100.0	100.0	100.0
Distribution by titanium dioxide content:					
Paints, varnishes, and lacquers.....	57.4	56.4	57.5	56.5	54.3
Paper.....	16.2	16.7	17.2	17.4	19.5
Floor coverings.....	4.3	3.9	3.1	2.7	2.6
Rubber.....	5.0	4.9	3.2	3.8	3.0
Coated fabrics and textiles (oil cloth, shade cloth, artificial leather, etc.).....	1.6	1.6	1.6	1.6	1.4
Printing ink.....	2.1	2.2	2.3	2.4	2.6
Roofing granules.....	1.7	1.5	1.4	1.0	1.1
Ceramics.....	1.8	2.1	2.2	2.4	2.4
Plastics (except floor covering and vinyl-coated fabrics and textiles).....	4.3	4.6	6.0	6.9	7.1
Other (including export).....	6.6	6.1	5.5	5.8	6.0
Total.....	100.0	100.0	100.0	100.0	100.0

Industry stocks of rutile decreased 15 percent to 184,000 tons, equivalent to about 1 year's supply at the 1969 consumption rate. Ilmenite inventories decreased 5 percent, and stocks of titanium slag decreased 13 percent. Yearend sponge-metal stocks of producers and melters were 1,908 7

Table 7.—Stocks of titanium concentrates
(Short tons)

Year and stock	Ilmenite	
	Gross weight	TiO ₂ content (estimated)
1968:		
Mine.....	(¹)	(¹)
Distributor.....	209,018	180,787
Consumer.....	682,000	878,860
Total.....	891,018	1,059,647
1969:		
Mine.....	(¹)	(¹)
Distributor.....	247,229	146,228
Consumer.....	600,010	880,515
Total.....	847,239	1,026,743

¹ Revised.

² Included with "distributor" to avoid disclosing individual company confidential data.

³ Included with "consumer" to avoid disclosing individual company confidential data.

Concentrates.—Prices for ilmenite remained the same as those in 1968. Domestic ilmenite with 60 percent titanium dioxide (TiO₂) content was quoted at \$30 to \$35 per short ton. Imported ilmenite containing 54 percent TiO₂, f.o.b. Atlantic ports, was quoted at \$20 to \$21 per long ton of contained TiO₂. The quoted price for imported rutile (96 percent TiO₂) rose in several steps from \$125 to \$160 in August, where it remained at yearend. Titanium slag (70 percent TiO₂) was raised to \$45 per long ton.

Manufactured Titanium Dioxide.—The basic price of anatase grades of titanium dioxide pigment was raised 1 cent per

Table 4.—Vermiculite exfoliating plants in the United States in 1969

Company	State	County
Arlzonolite Co.	Arizona	Maricopa.
California Zonolite Co.	California	Alameda, Los Angeles.
Carolina Wholesale Florist Co.	North Carolina	Lee.
Cleveland Gypsum Co., Division of Cleveland Builders Supply Co.	Ohio	Cuyahoga.
Coralux Perlite Corp. of New Jersey	New Jersey	Middlesex.
Filter Media Co., Inc.	Louisiana	St. John the Baptist.
Hyzer & Lewellen	Pennsylvania	Bucks.
International Vermiculite Co.	Illinois	Macoupin.
La Habra Products, Inc.	California	Orange.
Lanmont, Inc.	Texas	Llano.
MacArthur Co.	Minnesota	Ramsey.
Mica Pellets, Inc.	Illinois	De Kalb.
The B. F. Nelson Manufacturing Co.	Minnesota	Hennepin.
Patterson Vermiculite Co.	South Carolina	Laurens.
Robinson Insulation Co.	Montana	Cascade.
Solomon's Mines, Inc.	North Dakota	Ward.
Southwest Vermiculite Co.	Arizona	Maricopa.
Supreme Perlite Co.	New Mexico	Bernalillo.
Texas Vermiculite Co.	Oregon	Multnomah.
	Oklahoma	Oklahoma.
	Texas	Bexar.
		Dallas.
Verlite Co. (Schmelzer Sales Assoc., Inc.)	Florida	Hillsborough.
Vermiculite of Hawaii, Inc.	Hawaii	Honolulu.
Vermiculite Industrial Corp.	New Jersey	Essex.
Vermiculite-Intermountain.	Utah	Salt Lake.
Vermiculite-Northwest, Inc.	Oregon	Multnomah.
	Washington	Spokane.
	Texas	Harris.
	Arkansas	Pulaski.
	Colorado	Denver.
	Florida	Duval, Hillsborough, Palm Beach.
	Georgia	Fulton.
	Illinois	Cook.
	Kentucky	Campbell.
	Louisiana	Orleans.
	Maryland	Prince Georges.
	Massachusetts	Hampshire.
	Michigan	Wayne.
	Minnesota	Hennepin.
	Missouri	St. Louis.
	Nebraska	Douglas.
	New Jersey	Mercer.
	New York	Cayuga.
	North Carolina	Guilford.
	Pennsylvania	Lawrence.
	South Carolina	Greenville, Laurens.
	Tennessee	Davidson.
	Wisconsin	Milwaukee.

Zinc

By Donald E. Moulds¹

The free world production and consumption of zinc continued at a record level in 1969, although in the second half of the year indicated supply had surpassed requirements. Mine production was again expanded 7 percent to 4.56 million tons, and smelter output increased 12 percent to 4.26 million tons. Consumption maintained a growth slightly above metal output with a resulting reduction in producer stocks, until June; then decreased consumption and expanded supply reversed the trend in producer stocks and resulted in a 102,000-ton increase in these stocks during the June-December period. The price of zinc in the world market trended upward throughout the year as metal demand and competition for smelter feed materials brought pressure. The producer

price, both domestic and foreign, however, in the second half of the year.

The domestic zinc market showed a downward trend throughout the year, although production of slab zinc was up 1.37 million tons, or 4.5 percent, from 1968 output. Although all metal supply was adequate, personnel shortages and rates. Smelter output increased 1 percent in 1968 output. Imports of zinc provided an easing of the market.

¹ Physical Metals.

Table 1.—Salient zinc statistics

	1965	1966
United States:		
Production:		
Domestic ores, recoverable content		
short tons	611,168	572,558
Value	\$178,284	\$166,044
Slab zinc:		
From domestic ores, short tons	551,215	628,580
From foreign ores	448,187	501,488
From scrap	88,619	88,243
Total	1,078,021	1,108,329
Secondary zinc	271,694	277,967
Exports of slab zinc	6,989	1,406
Imports (general):		
Ores (zinc content)	428,040	521,320
Slab zinc	152,990	278,176
Stocks, December 31:		
At producer plants	28,622	64,798
At consumer plants	150,763	129,593
Consumption:		
Slab zinc	1,854,092	1,410,197
All classes	1,742,067	1,806,548
Price, Prime Western, East St. Louis		
cents per pound	14.50	14.50
World:		
Production:		
Mine	4,741,537	4,942,013
Smelter	4,852,671	4,498,262
Price: Prime Western grade, London		
cents per pound	14.12	12.75

¹ Revised.² Excludes redistilled slab zinc.

New York output of zinc, all from the Balmat-Edwards Division of St. Joseph Lead Co., decreased 11 percent from 1968 production. The lower production was attributable to changes in grade and ore tonnage milled, as well as to a labor shortage and construction work in progress for the new mine and mill facilities to be completed.⁵

Idaho production decreased slightly in 1969 mainly due to permanent closure of the Page mine by American Smelting and Refining Co. upon depletion of the ore. The Bunker Hill mine of Gulf Resources & Chemical Corp. increased production, but shaft construction and slow development of the Star mine deep ore body resulted in an overall 7 1/4-percent decrease in mine output of zinc in concentrates during the year.⁶ The 1 1/4-mile-deep development of the Star-Morning unit area, owned by Gulf Resources & Chemical Corp. and Hecla Mining Co., was scheduled to be in operation in the second quarter of 1970. The work, started in 1966, comprises a new No. 4 main shaft, ore and waste-handling facilities, and a hoisting plant capable of a 7,100-foot vertical lift.⁷

Zinc production in Colorado in 1969 essentially regained the level of production prior to the strike-curtailed output of 1967-68. The Eagle mine of The New Jersey Zinc continued to be the dominant producer, followed by the Idarado mine of Newmont Mining Corp. The start of milling operations at the Keystone mine in Crested Butte was announced on September 3. The mine and mill, operated by Keystone Mines Co., can process 300 tons per day of lead-zinc-silver ore. Newmont Mining Corp. and American Smelting and Refining Co., jointly developing a lead-zinc deposit near Leadville, completed the 1,650-foot Black Cloud shaft in February 1970. The deposit was stated to have an estimated 2.4 million tons of ore averaging 9.95 percent zinc, as well as comparatively high values in lead and silver. A 300-ton-per-day mill associated and facilities are expected to be in production early in 1971.⁸ Federal Resources began sinking a shaft in September to reach a newly discovered ore body below the old workings of the Camp Bird mine near Ouray.

Pennsylvania, New Jersey, and Virginia production by New Jersey Zinc Co. increased approximately 1,500 tons to 76,800 tons.

United States Smelting Refining and Mining Co. operated the U.S. and Lark mine throughout the year. The ore was processed at the Midvale, Utah, flotation mill along with other custom ores. Other substantial Utah producers were the Burgin mine of Kennecott Copper Corp., the Mayflower mine of Hecla Mining Co., and United Park City Mines Co. Development work at the Burgin mine, Tintic, Utah, to increase the ore production rate to 800 tons per day continued, and the development shaft at the new Trixie area, also at Tintic, was completed. Production of zinc at the Burgin mine and at Kennecott's Missouri lead operation totaled 15,300 tons in 1969.⁹ The Mayflower mine operated by Hecla Mining Co. and owned by New Park Mining Co. produced 117,500 tons of ore averaging 3.13 percent zinc.¹⁰

Missouri became the fifth-ranking zinc-producing State in 1969, the first full year of operation of the new lead-belt mines and mills of St. Joseph Lead Co., Kennecott Copper Corp., Cominco-Dresser Industries, and American Metals Co.-Homestake Mining Co. Zinc is a byproduct of lead production. The ratio of zinc to lead in 1969 was 1 ton of zinc for each 8.64 tons of lead, and it is expected to increase as the output of the new lead belt supplants production from the old lead belt.

American Smelting and Refining Co. resumed operation of the Ground Hog unit at Vanadium, N. Mex. in May after being shutdown since 1965. Monthly ore production reached almost 9,000 tons in December, and 6,125 tons of zinc in concentrates was produced in 1969.¹¹ United States Smelting Refining Mining Co. operated the Continental No. 1 mine, Fierro, N. Mex., a copper-zinc deposit, and the Princess mine at Bayard, N. Mex. The Princess mine was gradually phased out during the year. The Bullfrog mill at Bayard, N. Mex., processed zinc ore from the Princess mine and also copper ore from the New Continental mine at a 400-ton-per-day rate.

Cypress Mines, Corp., began production

⁵ St. Joseph Lead Co. Annual Report, 1969, p. 8.

⁶ Gulf Resources & Chemical Corp. Annual Report, 1969, p. 6.

⁷ Hecla Mining Co. Annual Report, 1969, p. 8.

⁸ Newmont Mining Corp. Annual Report, 1969, p. 12.

⁹ Kennecott Copper Corp. Annual Report, 1969, p. 12.

¹⁰ Hecla Mining Co. Annual Report, 1969, p. 8.

¹¹ American Smelting and Refining Co. Annual Report, 1969, pp. 5-6.

In midyear from the newly developed Bruce mine near Bagdad, Ariz., and achieved a monthly rate of 9,000 tons of copper-zinc ore. Standard Metals Corp. began construction of a 250-ton-per-day flotation mill near Kingman, Ariz., to concentrate copper-zinc ores from its Antlers mine. American Smelting and Refining Co. resumed operations at the Van Stone mine at Northport, Wash., in April, and concentrates containing 6,137 tons of zinc were produced during the year.¹² Eagle-Picher Industries Inc. completed the development work at the Swalley lease near Baxter Springs, Okla., and began shipping ore to its Central mill at Carden, Okla. Zinc production from the Illinois-Wisconsin area decreased 16 percent from the 1968 total and over 25 percent from the 1967 total.

• SMELTER AND REFINERY PRODUCTION

Production of slab zinc increased 1 percent in 1969 to a record 1.11 million tons as operations continued normal at all of the plants except the electrolytic refinery of The Anaconda, Mont., which was shut down at the end of August. Output during the first half of 1969 was at the high level established in the last 3 quarters of 1968. Over 100,000 tons was produced in January and in March, and the 6-month average was 97,900 tons. Shipments during this period exceeded production by some 29,300 tons with a corresponding decline in stocks. The reduction in output beginning in August, however, resulted in an average monthly production of 92,600 tons for the year. Shipments were reduced severely, and September was the only month in the last half of the year in which shipments exceeded production.

Secondary zinc production increased 11 percent to 307,700 tons as continuous operations in the brass mills provided a larger supply of new and old scrap. The total supply from secondary sources, processed into slab zinc, zinc dust, alloys, and chemicals, amounted to 376,400 tons and represented 21 percent of the total consumption of zinc the same as in 1968.

Slab Zinc.—The slab zinc production of 1.11 million tons was derived from domestic ores, 41 percent; foreign ores, 52 percent, and secondary materials, 7 percent. The domestic ores continued the decline, begun in 1966, in percentage of total feed. In 1965 domestic ores represented 55 percent of the total slab zinc output, as im-

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of contained zinc was continued at five plants—American Smelting and Refining Co. at Selby, Calif., and El Paso, Tex.; The Anaconda Company at East Helena, Mont.; Bunker Hill Co. at Kellogg, Idaho; and International Smelting & Refining Co., at Tooele, Utah. Material processed during the year consisted of 741,100 tons of new hot-slugs, 76,200 tons of old slugs, and 8,600 tons of ores. The total of 825,900 tons was substantially above the 612,700 tons treated in 1968. The yield of oxide fume was 144,900 tons containing 94,700 tons of recoverable zinc compared with 113,600 tons of fume and 72,900 tons of zinc in 1968.

Secondary Zinc Smelters.—Zinc recovered from processing secondary materials amounted to 376,400 tons compared with 354,700 tons in 1968. New scrap from reprocessing various alloys, primarily zinc-base and copper-base, provided 78 percent of the feed material. Zinc-base scrap declined with the curtailed activity in diecasting, while copper-base scrap reflected the

full-year operation at brass mills. Old scrap continued to be a minor component of secondary zinc. The recovered zinc was mainly reused in copper-base alloys. Processing to metal decreased from 34 percent of the total in 1968 to 29 percent in 1969.

Byproduct Sulfuric Acid.—The recovery of sulfur from stack gases evolved in the roasting of zinc sulfide ores and in retorting processes has been intensified to meet increasingly rigid clean-air requirements. The sulfur dioxide is usually processed to sulfuric acid. A measure of the progress in air pollution abatement is the byproduct acid output. In 1965 about 961,600 tons of sulfuric acid was produced, or 0.89 ton per ton of slab zinc, while in 1969, the 1,086,900 tons of sulfuric acid produced represents 0.98 ton per ton of slab zinc.

Zinc Dust.—Production of zinc dust decreased in 1969 after an upward trend for several years. Of the 55,100 tons produced about 33,200 tons came from metal distilled from scrap.

CONSUMPTION AND USES

Consumption of slab zinc increased 2.6 percent to 1.37 million tons. Zinc-base alloys required 42 percent of the slab zinc; galvanizing, 35 percent; brass mills, 13 percent; rolled zinc, 4 percent; and zinc oxide, 3 percent. The remaining 3 percent was used in many small-tonnage applications. The 1-percent drop in galvanizing was essentially in light-gage sheet and in wire rope and reflected the depressed construction and automobile markets. Galvanized pipe, containers, and fencing requirements were bright spots in the galvanizing area. The 11-percent increase in brass requirements reflected a full-year operation at brass plants compared with strike-curtailed production in 1967-68. A shortage of copper in 1969 undoubtedly adversely affected the demand for slab zinc. Zinc-base alloys, the major factor in the recent growth of zinc demand, posted only a 2-percent increase and reflected the curtailed demand from the automobile industry. Rolled zinc use was similar to that in 1968, while the use of slab zinc for high-purity zinc oxide in the French process increased almost 19 percent and thus continued the growth trend initiated in 1964. The average annual compound growth in the last 5 years was about 15 percent per year.

Consumption of slab zinc by grades was as follows: Special High grade, 50 percent; Prime Western grade, 29 percent; High grade, 10 percent; Brass Special, 9 percent; and Intermediate and remelt grades each about 1 percent. The pattern in 1969 indicated a shift in demand with Brass special decreasing 5½ percent compared with 1968 consumption. Special High grade posted a 1-percent increase, and Prime Western increased 5 percent.

Rolling mills used 48,700 tons of slab zinc and produced 46,500 tons of salable products, mainly strip and foil and photoengraving plate. Imports of rolled products—plates, sheets, and strip—amounted to 970 tons; exports were 2,700 tons. While the overall value of domestic output increased slightly, as did the value of imported rolled zinc, the value of exports declined, and the value added by rolling also decreased. The total tonnage through the rolling mills, including 24,400 tons remelted and rerolled from scrap, amounted to 70,900 tons compared with 69,500 tons in 1968.

Illinois continued to lead the United States in consumption of slab zinc with 14 percent of the total and was followed by Michigan, Pennsylvania, Indiana, and New

York. The zinc-consuming industries in these five States represent 56 percent of the domestic requirements for slab zinc. The largest end uses were diecasting in Michigan, galvanizing in Ohio, and brass products in Connecticut.

contrast of shipments of oxide products and the percentage, however, tonnage, the 1968 2,000 ton down of zinc 17 percent

ZINC PIGMENTS AND COMPOUNDS

Production.—Production of zinc pigments and compounds increased in total to 341,700 tons, or slightly above the record 336,100 tons in 1968. Shipments of 340,200 tons were slightly below production, in

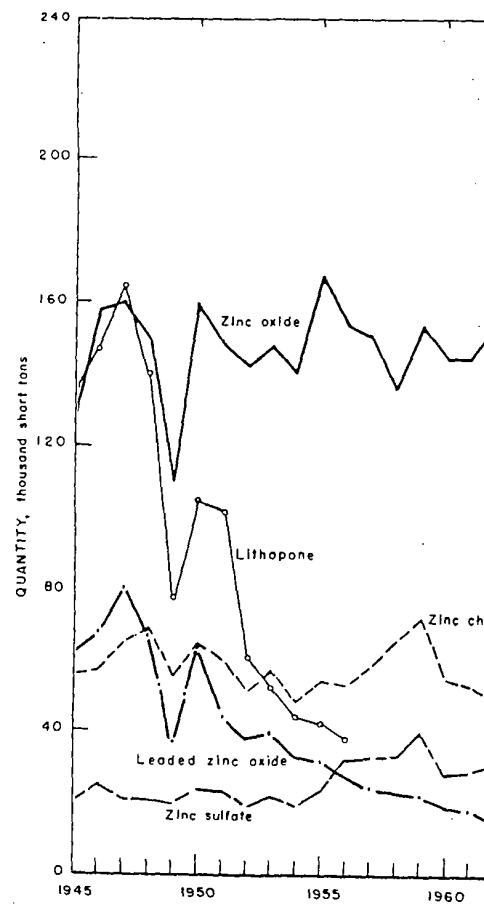


Figure 2.—Trends in shipments of

increased 20 percent to 68,500 tons and exceeded shipments by almost 3,900 tons.

Zinc pigments and compounds were produced from ore, refined metal, and secondary materials, depending on the process used. Lead-free zinc oxide production by the American process from ores amounted to 59 percent of the total. The French process using slab contributed 29 percent, and the remaining 12 percent was derived from secondary materials and residues. Production of zinc oxide and sulfate consumed 120,700 tons of zinc in ores, of which 89,900 tons, or 74 percent, was from domestic mines. The amount of domestic zinc in ores consumed in pigments represented 16 percent of the domestic mine production in 1969 and was significantly above the 12.6 percent posted in 1968.

Consumption and Uses.—The leading requirements for zinc oxide is in manufacture of rubber, a use which continued to trend upward to a record 116,000 tons and represented 53 percent of the lead-free zinc oxide consumption. The use in photo-sensitive copying paper continued to gain in tonnage; at 27,600 tons, it was the second largest requirement in 1969 and surpassing the 25,200 tons used in paint pigments, especially in the widely used alkyd-latex paints. Zinc oxide in various chemical compounds continued at the high level established in 1968, while agricultural and ceramic requirements declined compared with 1968.

Consumption of leaded zinc oxide in paint pigments has developed about 2,000 tons per year since 1966. Zinc sulfate shipments increased in gross weight, but moisture content was indicated at 22 percent compared with 10 percent in 1968. Agriculture requirements decreased, as did the various other uses on a dry basis.

Prices.—The pricing of zinc oxide followed the uptrend in the price of slab zinc, although the January 10 increase of one-half cent in slab zinc was not reflected in the zinc oxide price until April 1, and the one-half-cent rises in slab zinc on May

1 and September 2 were not reflected until October. The price of American-process zinc oxide, lead-free, carload lots, freight allowed, thus increased from 15¼ cents per pound to 15¾ cents on April 1 and to 16½ cents per pound on October 1. French process, green seal grade, advanced from 17½ cents per pound to 18 cents and then to 18¾ cents on April 1 and October 1, respectively. Leaded zinc oxide, 35 percent grade, increased from 15¾ cents per pound to 16¼ cents and then to 17 cents.

Zinc sulfate, monohydrate, 36-percent in carload lots, was quoted at 9½ cents per pound until early August when a range of 9½ to 10 cents per pound developed. The price stabilized in early September at 10 cents. Zinc chloride, 50-percent, in tank cars, continued throughout the year at the 6.20-cents-per-pound price effective October 1, 1968.

Foreign Trade.—Exports of zinc oxide in 1969 amounted to 3,780 tons. Shipments were directed to 38 countries. Canada was the leading destination with 1,454 tons, followed by West Germany and Belgium-Luxembourg. Lithopone exports amounted to 1,090 tons to 31 countries. South Vietnam was the largest importer with 612 tons, followed by Canada with 323 tons.

Imports of zinc compounds for consumption totaled 23,500 tons in 1969 compared with 20,800 tons in 1968. Zinc oxide amounted to 14,600 tons, all except 242 tons of which was lead-free. Mexico was the largest source with 6,180 tons, followed by Canada, 4,780 tons; Japan, 750 tons; and West Germany, 650 tons. Poland supplied 25 tons in 1969. Lithopone imports of 261 tons were mainly from West Germany and the Netherlands. Zinc chloride came mainly from West Germany, 730 tons; Belgium-Luxembourg, 422 tons; and Canada, 190 tons. Zinc sulfate imports increased sharply in 1969 to 6,240 tons, of which 5,000 tons came from Mexico and 1,060 tons from Australia. The total value of zinc compound imports was \$4.48 million compared with \$4.15 million in 1968.

STOCKS

Producer Stocks.—Stocks of slab zinc at producer plants at the beginning of the year amounted to 65,380 tons, of which 64,700 tons was located at primary reduction plants and 680 tons at secondary plants. Shipments exceeded production for

the first 5 months with a resulting decline in stocks of 30,000 tons at smelters and 5,000 tons elsewhere by the end of May. A slight buildup of 10,000 tons occurred in the period June to October, but in November and December production substan-

tially exceeded shipments, and stocks increased to 67,700 tons at yearend of which secondary plants held 890 tons.

Consumer Stocks.—Slab zinc stocks held by consumers opened the year at 101,800 tons and were reduced to 94,600 tons by the end of March. A buildup in the second quarter brought stocks back to the 101,800-ton level at the end of June. The buildup continued in the third quarter to

105,700. Increased the four reduce year at from be demand change ton red the incr grades o

PRICES

The domestic price of prime western grade zinc at East St. Louis, stable at 13½ cents per pound since June 20, 1967 began an upward trend on January 10 when American Zinc Co. announced increases that raised the price to 14 cents per pound. Other producers followed the move, and 14 cents per pound was the domestic quotation by January 14. Effective April 30, American Zinc Co. again increased the price a ½ cent per pound to 14½ cents, and by May 1 all other producers had followed the increase. National Zinc Co. initiated, effective September 2, an increase of 1 cent per pound bringing the price to 15½ cents per pound. Between September 2 and September 12 a range of 14½ to 15½ cents existed in the market as other producers split on the price increase,

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FOREIGN TRADE

Exports of slab zinc decreased to 9,300 tons, of which India received 90 percent. The substantial reduction essentially resulted from curtailed shipments of zinc from Government stocks to India by the U.S. Agency for International Development. Exports of semimanufactured products—sheets, plates, strips, etc.—amounted to 2,700 tons compared with 3,000 tons in 1968. Canada was the major destination with 44 percent, followed by Pakistan, 29 percent, and India, 13 percent. Zinc scrap exports also decreased in 1969 with Canada receiving 62 percent of the 2,000 tons, followed by the United Kingdom and Venezuela, 3 percent each, and 10 other countries, principally in South America, receiving small shipments. Exports of semifabricated forms almost doubled to 28,800 tons. The semimanufactured zinc was shipped, in castings and other forms, to 31 countries

with th Canada, zinc exp million 1968. Import cles, oth 866 ton tons of piping, and flak and 716 value o \$3.47 m for 76 p cent. Ca lowed b slavica. Gener tons of metal.

and zinc metal established new records well above the previous highs in 1968. Imports for consumption indicated that a substantial tonnage of ore and metal was delivered to warehouses rather than to consumers. The major suppliers of zinc in ore were Canada, 58 percent; Mexico, 25

percent; and Peru, 10 percent. Of the imported metal, Canada furnished 46 percent; Japan, 16 percent; Australia, 10 percent; and Peru, 9 percent. The value of imports for consumption of ore and metal was \$164 million compared with \$145 million in 1968.

WORLD REVIEW

The reporting and compiling of statistical data on zinc production and consumption throughout the world vary in reporting guidelines, sources, and scope of estimating. Mine production in the free world in 1969 thus ranges from the 4.43 million tons of the American Bureau of Metal Statistics (ABMS) ¹⁸ through the 4.66 million tons of the Bureau of Mines to the preliminary total of 4.74 million tons by the International Lead and Zinc Study Group. ¹⁹ The addition, the Bureau of Mines estimate of 1.20 million tons for the communist areas, excluding Yugoslavia, results in a world total of 5.86 million tons of mined zinc. This preliminary total represents an increase of about 6 percent over the revised total for 1968. Smelter output likewise varies widely; the Bureau of Mines reports insofar as possible primary metal, while the Lead and Zinc Study Group reports slab zinc output from both primary and secondary sources. Free world smelter output thus ranges from the 4.33 million tons reported by ABMS through the 4.35 million tons reported by the Bureau of Mines to 4.48 million tons reported by the Lead Zinc Study group. The output of Communist countries is estimated by the Bureau of Mines at 1.17 million tons; thus, world production is indicated at 5.52 million tons. This preliminary total indicates a 9 percent increase in 1969 over the revised total for 1968. The Lead and Zinc Study Group compiles data on both free world production and consumption of slab zinc on a contained metal basis, and the preliminary total 4.43 million tons consumed, compared to 4.52 million tons produced, indicates a surplus of some 90,000 tons of metal, of which 54,000 tons was reportedly an increase in 1969 free world producer stocks. The preliminary total for consumption indicates a 7-percent increase over consumption in 1968, well below the 10-percent increase achieved in 1968.

Mine production of zinc expanded about

4 percent in North America, and the 2.17 million tons produced represented 37 percent of the world output. South American production also expanded by some 13 percent, and Australia increased output 19 percent. The combined output of North and South America and Australia represented 53 percent of world production. Canada continued to lead in output with almost 23 percent of the world total, followed by the U.S.S.R., Australia, the United States, Peru, Japan, and Mexico.

Smelter production increased almost 4 percent in North America and 18 percent in Australia, while South America increased 3 percent. The combined output from these three continents represented 36 percent of world production. The United States continued to lead in metal output with 19 percent of the world total. Japan supplanted the U.S.S.R. as the second largest producer as a result of an 18-percent increase over 1968 output. The annual growth of zinc metal output in Japan has been phenomenal with an average annual compound rate of 15 percent since 1961. West Germany posted a 78-percent increase in zinc metal output owing to a new electrolytic smelter and expansion at two other zinc plants.

The world zinc industry continued to emphasize, as in recent years, exploration for new ore deposits and development and construction of new mine, mill, and smelter facilities. Essentially all of the major producing countries have announced new projects, in progress or planned, which will substantially increase zinc production.

Argentina.—*Cia. Minera Aguilar, S.A.*, an affiliate of St. Joseph Lead Co., utilized its expanded capacity to produce 67,900 tons of zinc concentrates. The greatest bulk of the concentrates was shipped to

¹⁸ American Bureau of Metal Statistics Yearbook, 1969, pp. 70-71.

¹⁹ International Lead and Zinc Study Group Bulletin, July 1970, pp. 16-18.

the electrolytic zinc plant of Compañía Sulfadid, S.A., near Rosario and to Compañía Metalúrgica Austral's zinc smelter at Comodoro Rivadavia. ²⁰

Australia.—The highlight for zinc production was the major expansion in output at the Mount Isa Mines Ltd., 52.7-percent owned by American Smelting and Refining Company (Asarco). Production of zinc during fiscal year 1969 increased from 54,900 tons to 87,700 tons as the mining rate achieved 16,000 tons per day, the planned goal of the major expansion program started in 1959. Plans were announced to bring into production a new mine in the northern leases to be known as the Hilton mine. A production rate of 7,000 tons per day of silver-lead-zinc ore is scheduled for 1976. Reserves have been estimated at 39 million short tons averaging 7.7 percent lead and 9.6 percent zinc. ²¹

The Broken Hill mines of North Broken Hill, Ltd., The Zinc Corp., Ltd., New Broken Hill Consolidated, Ltd., and Broken Hill South Ltd. had a relatively quiet labor situation except for a strike in March. Production was expanded during the year and developments were in progress that should increase the annual zinc production from the area to 280,000 tons from the current 260,000 tons.

E.Z. Industries, Ltd., operating mines at Rosebury in Tasmania and a smelter at Risdon was in the process of doubling mine production from the present level of 50,000 tons per year and also of expanding the smelter from 150,000 to 220,000 tons per year. A new zinc ore body at Beltana South, Australia, which may come into production late in 1970, was announced by E.Z. Industries. The 40,000-ton-per-year capacity of the Broken Hill Associated Smelters plant at Port Pirie for distilling lead-zinc slags continued operating at full capacity. Sulphide Corp. Pty. Ltd. operated its 55,000-ton-per-year Imperial smelter and brought into production its new zinc metal upgrading plant at Cockle Creek, New South Wales.

Canada.—Canadian production of zinc in ore expanded from 500,000 tons in 1963 to 1,300,000 tons in 1969 and established Canada as the leading world exporter of zinc. In 1969, 805,000 tons in concentrates and 308,000 tons of metal were exported. Ontario now ranks first in zinc output, followed by Northwest Territories, Quebec, New Brunswick, and British Columbia.

These five P the total min

The highl in 1969 was open pit mi portation fac 18,000 tons o cember. The ect, owned Corp. and 40 tion Ltd. ha 63.5 million cent lead an planned cap of 54-perce which have smelters ove sion of the c crease capaci ditional con West Germa Yukon, refle increased fro tons in 1969.

The deve mines, Quebe in 1963-64, Pine Point i in 1965, and mine in Or River mines in 1969 have the output o Mining and Ltd., Buchan Mines, Ltd.,

The four Electrolytic 2 Coast Smelt Hudson Bay have an ann refined zinc. nounced in trolytic zinc to process a trates from plant will c scheduled fo

Germany, in the Euro creased met The 105,500 full year of trolytic zinc

²⁰ St. Joseph 16.
²¹ American Report, 1969

Stolberger Zinc A.G. and Metallgesellschaft A.G. The refinery began operation in August 1968 with a designed capacity of 80,000 tons of zinc per year. Increased activity by Preussag at the Harlingerade and Oker plants pointed toward an annual zinc capacity of 140,000 tons.

Japan.—While mine production of zinc increased about 6,100 tons in 1969, smelter output increased 117,500 tons as a result of plant expansion at Mitsui Mining and Smelting Co., Toho Zinc Co., Nippon Mining Co. Ltd., and Mitsubishi Metal Mining Co. Ltd. and the startup of a new Imperial Smelting process plant by Hachinohe Smelting Co. early in 1969. The annual capacity for zinc metal production was indicated at about 800,000 tons per year, which was almost achieved in 1969. Imports of zinc ores in 1969 increased from 451,000 tons to 478,000 tons and originated principally in Peru, Canada, Australia, South Korea, Bolivia, and Mexico. The large zinc output of the Anvil mine in Canada and the Matilde mine in Bolivia was contracted for delivery in concentrates to Japanese smelters.

Mexico.—Zinc ore production increased from 264,600 tons in 1968 to 279,300 tons in 1969, while smelter output was essentially unchanged at 88,500 tons. Asarco Mexicana, S.A., 49-percent owned by Asarco, produced 64,700 tons of refined zinc and 56,000 tons of zinc in concentrates and fume. Asarco Mexicana is constructing a new concentrator at the San Martin, Zacatecas mine with double the capacity of the old mill. Construction of a new mill at the San Antonio mine, Santa Eulalia, Chihuahua, was also in progress, and the new mill at the Plomosas mine in Chihuahua achieved capacity by mid-1969.²²

Cia. Metalúrgica Mexicana Peñoles S.A. continued development of La Negra mine at Maconí, Queretaro, with production scheduled at the end of 1970. Peñoles also announced construction of an electrolytic zinc refinery, to be completed in 1972, at Torreón with a capacity of 120,000 tons per year. Asarco Mexicana began a study on building an electrolytic zinc refinery of similar capacity, to supplement its present retort refinery in Nueva Rosita, Coahuila and the Zincamex refinery at Saltillo, Coahuila. The combined zinc refinery capacity will exceed 330,000 tons annually when the projects are completed.

Peru.—Mine output of zinc in 1969 increased from 321,218 tons in 1968 to 346,954 tons, while smelter output declined to 68,600 tons. Operation of the Cerro de Pasco Corp. smelting complex at La Oroya was interrupted by a labor stoppage in April and in August and September. Over a month's worth of production was lost.

Toho Zinc Co. Ltd. of Japan contracted with Banco Minero del Peru to jointly prospect and develop the Gran Bretaña mine located some 230 miles east of Lima. Confirmed deposits are said to total 1 million tons of ore averaging over 20 percent zinc.

Compañía Minerales Santander Inc. a subsidiary of St. Joseph Lead Co., continued development of its underground zinc-lead mine and shipped 81,200 tons of zinc concentrates during the year.²³

San Ignacio de Morococha S.A. completed installation of a concentration plant at the new San Vicente mine in central Peru. The plant will produce about 48,000 tons of zinc in concentrates annually for shipment to Japan.

TECHNOLOGY

The International Lead-Zinc Research Organization (ILZRO) conducts an industry-sponsored research and development program for zinc and lead that covers a wide range of individual projects in zinc chemistry, corrosion protection, diecasting, and wrought zinc. Progress in the various programs is published in semiannual reviews, which are available from Zinc Institute Inc., 292 Madison Ave., New York, N.Y. 10017. The Zinc Development Association and the Zinc Institute Inc. re-

view and publish abstracts of all current world literature on the uses of zinc and on research work on zinc. An index of these abstracts may also be secured from the Zinc Institute.

The Bureau of Mines published the results of a study on various materials for use as retort flasks in horizontal distillation furnaces and the laboratory evaluation

²² American Smelting and Refining Co. Annual Report, 1969, pp. 13-15.
²³ St. Joseph Lead Co. Annual Report, 1969, p. 16.

of the most promising modifications.²⁴ The properties of a zinc-copper-titanium alloy at extrusion temperatures between 400° and 720° F were also published.²⁵ The Bureau of Mines developed a process for producing high-purity zinc and tin by electrorefining from liquid amalgams. Commercial grades of zinc and tin were dissolved in mercury to produce saturated amalgam anodes for electrorefining to cathode metal.²⁶ Also investigated were alternate processes for aluminum removal from

melted zinc skimmings with results.²⁷

²⁴ Tyrell, M. Retoria. BuMin.
²⁵ Neumeier, Varied Extrusion of Zinc-Copper. Inv. 7229, 1969.
²⁶ Chambers, Purity Zinc and BuMin. Rept.
²⁷ Montana, Zinc-Base Die-C BuMin. Rept.

Table 2.—Mine production of recoverable zinc in the U.S. (Short tons)

State	1965	1966
Arizona	21,757	15,985
California	225	885
Colorado	58,870	54,822
Idaho	58,084	60,997
Illinois	18,814	16,192
Kansas	6,508	4,769
Kentucky	5,654	6,686
Missouri	4,812	3,988
Montana	38,786	29,120
Nevada	8,858	5,627
New Jersey	38,297	25,297
New Mexico	36,460	29,296
New York	69,880	78,454
Oklahoma	12,715	11,287
Oregon	W	W
Pennsylvania	27,885	28,080
Tennessee	122,887	108,117
Utah	27,747	37,828
Virginia	20,491	17,688
Washington	22,230	24,772
Wisconsin	26,998	24,775
Other States	—	—
Total ¹	611,158	672,658

W Withheld to avoid disclosing individual company confidential data.

¹ Less than 1/2 unit.

² Totals are of listed figures only.

Table 3.—Mine production of recoverable zinc in the U.S. (Short tons)

Month	1968	1969	Month
January	42,894	42,205	August
February	41,985	43,040	September
March	41,887	45,076	October
April	43,728	48,112	November
May	45,297	48,007	December
June	44,664	47,151	
July	42,986	45,686	Total