Minerals Y
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METALS AND MINERA

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andalusite. A total of 2,208 tons of kyanite and andalusite was produced in 1963.

Rhodesia, Southern.—Output of kyanite group minerals in the first 9 months of 1965 consisted of 456 tons of kyanite and 72 tons of topaz.

South Africa, Republic of.—Production of kyanite group minerals in the first 9 months of 1965 was comprised of 17,278 tons of andalusite and 34,615 tons of sillimanite. Exports of the two minerals during the period totaled 41,853 tons, and 6,720 tons was sold to South African firms.[3] Output of andalusite by the major producer, Zeerust Andalusite (Pty.), Ltd., was increased from 500 tons per month to 1,000 tons per month beginning in February, 1965. A new heavy-media separation plant was installed about 12 miles from the open cast workings in western Transvaal.

TECHNOLOGY

A comprehensive report on the kyanite group minerals and synthetic mullite was published. The report contains descriptions of the minerals, refractory quality and specifications, information on deposits throughout the world including reserves where available, mining and processing methods, world trade, prices, and uses. Synthetic mullite production is also covered. The bibliography is extensive and is broken down into major subject headings.[4]

The results of recent laboratory research at the Atomic Energy Establishment, Trombay, Bombay, India, indicated that sillimanite and other industrial minerals could be recovered by selective flotation from Manavalakurichi beach sands in Madras State which are presently processed for recovery of ilmenite and monazite. Other valuable minerals are rutile and zircon.[5]

New data were published to support recent research reports which indicated that previously accepted values for free energy of formation of andalusite, kyanite, and sillimanite were considerably in error.[6]

Patents were issued on use of kyanite in railroad brake shoes,[7] and in improved high temperature lightweight refractories having discrete, uniform cells.[8]

[3] Republic of South Africa Department of Mines. Quarterly Inf. Cir. Minerals, July to September 1965, pp. 36–41.

[4] Varley, E. R. Sillimanite. Overseas Geol. Surveys, Miner. Res. Div., H. M. Sta. Off., 1965, 165 pp.

[5] Madhaven, T. R., V. M. Karve, and J. Y. Somnay. Selective Flotation of Beach Sand Sillimanite, Zircon and Rutile. Min. Mag. (London), v. 113, No. 3, September 1965, pp. 202–208, 205, 207.

[6] Waldbaum, David R. Thermodynamic Properties of Mullite, Andalusite, Kyanite and Sillimanite. Am. Mineralogist, v. 50, Nos. 1 and 2, January-February 1965, pp. 186–195.

[7] Spokes, R. E., and E. C. Keller (assigned to American Brake Shoe Co., New York). Friction Composition of a Rubber, Cashew Nut Shell Resin and Lead Sulfite. U.S. Pat. 3,168,487, Feb. 2, 1965.

[8] Dreyling, L. J., and A. P. Dreyling (assigned to Quigley Co., Inc., New York). Method for Producing Lightweight High Temperature Refractory Products. U.S. Pat. 3,213,166, Oct. 19, 1965.

Lead

By Donald E. M

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Industrial requirements for lead in 1965 established a domestic record and, despite the marketing of Government stockpile lead, increased secondary production, and increased metal imports, the stock of refined soft lead at producers and consumers declined during the year. Mine production of recoverable lead increased primarily as a result of expanded Missouri facilities, but output at primary refineries declined as imports of bullion decreased and ore imports remained essentially the same, even though ore import quotas were terminated in October. The world production of primary metal, excluding the East European and Far Eastern Communist areas, increased about 7 percent in mine production and over 3 percent in refined metal production. The increase in consumption was indicated to be about 1.5 percent, and producer stocks increased during the year by some 13,000 tons. The price of lead in the domestic market was stable during the year at 16 cents per pound while the London Metal Exchange price (U.S. equivalent) ranged from a high of 19.9 cents per pound to a low of 11.9 cents and closed the year at 13.9 cents.

market price of these metals is less than 14.5 cents per pound, to January 1, 1970. The qualifications of a "small domestic producer" were redefined to expand coverage and new maximum limitations were established on amount of payments and quantities of lead and zinc which are allowable for any one producer in a calendar year. Revised regulations were being prepared by General Services Administration, the authorized government agent.

During the year 1965, the quoted price of lead and zinc remained at levels exceeding the 14.5 cents per pound under which payments are authorized and no payments were made on 1965 production. Under the amendments of Public Law 87-374, effective through 1965, a total of 76 applications had been received of which 59 were certified as eligible. The cumulative stabilization payments made on lead and zinc production for the period 1962-65 were $2,135,100.

The disposal of 200,000 tons of lead in the Government stockpile was authorized under Public Law 89-9, enacted in March 1965, of which 50,000 tons was designated for direct Government use and 150,000 tons for domestic industry use. The first offering of 60,000 tons under this authorization was made by General Services Administration in April, and disposal of 19,565 tons was made to domestic producers of primary and secondary lead, importers of lead, and domestic consumers. In October General Services Administration announced the remaining 40,000 tons would be offered for sale on an on-the-shelf basis with offers to purchase accepted during the third week of each calendar month. Sales during the fourth quarter on this basis amounted to 16,904 tons, essentially all to domestic primary producers of lead. Of the 50,000 tons available for direct government use, 1,184 tons was used by government agencies. Government holdings of lead in the various stockpiles at the end of the year amounted to 1,284,636 tons, of which 10 tons was nonstockpile grade. Average acquisition cost of the lead remaining in the stockpile was 14.4 cents per pound.

The International Lead and Zinc Study Group held its ninth session in Tokyo, Japan, from November 1 through November 5, and delegates representing each of the 25 member countries were in attendance. The session was preceded by meetings of the various committees designated to review statistics and other special projects. The group noted that world production of ore and metal had increased at a slightly higher rate than consumption to offset the 1964 shortfall, and supply and demand in 1965 were approximately in balance. Further rises in production of ore and metal in 1966 were expected to adequately meet the steadily rising demand and 1966 would show a continuing reasonable supply-demand balance. Discussions at the meetings centered on improvement of statistics concerning production, consumption, and international trade in lead and on

Table 1.—Salient lead statistics

	1956-60 (average)	1961	1962	1963	1964	1965
United States:						
Production:						
Domestic ores, recoverable lead content---short tons	292,135	261,921	236,956	253,369	286,010	301,147
Value ---thousands	$77,318	$53,966	$43,602	$54,727	$74,936	$93,959
Primary lead (refined):						
From domestic ores and base bullion short tons	284,023	288,078	245,645	239,660	294,254	305,007
From foreign ores and base bullion short tons	169,850	161,487	130,418	155,072	165,175	113,242
Antimonial lead (primary lead content)---short tons	12,052	24,966	27,383	9,256	8,607	6,612
Secondary lead (lead content) ---short tons	463,812	452,792	444,202	493,471	541,582	575,819
Exports of lead materials, excluding scrap ---short tons	3,909	6,570	5,006	1,092	10,194	7,811
Imports, general:						
Lead in ores and matte---do	176,211	147,186	138,631	147,742	123,257	122,661
Lead in base bullion---do	189	422	4,599	5,437	4,838	566
Lead in pigs, bars, and old short tons	295,456	261,794	269,522	235,902	212,898	224,942
Stocks December 31 (lead content):						
At primary smelters and refineries ---short tons	179,294	262,102	196,661	120,836	84,398	83,443
At consumer plants---do	119,994	99,140	93,496	119,930	113,444	109,196
Consumption of metal, primary and secondary---short tons	1,089,308	1,027,216	1,109,636	1,163,358	1,202,138	1,241,482
Price: New York, common lead, average, cents per pound	13.39	10.87	9.63	11.14	13.62	16.00
World:						
Production:						
Mine ---short tons	2,582,000	2,640,000	2,765,000	2,820,000	2,835,000	2,975,000
Smelter ---do	2,474,000	2,645,000	2,630,000	2,715,000	2,825,000	2,905,000
Price: London, common lead, average, cents per pound	10.72	8.03	7.06	7.93	12.59	14.37

DOMESTIC PRO

MINE PRODUCTION

The domestic output of 301,100 tons of recoverable lead was about 15,000 tons above the 1964 total. The substantial increase in production of the Missouri mines and increases reported for nine of the other lead-producing States more than offset a major decrease in Idaho and Utah and small decreases reported in five other States. Missouri contributed 44 percent of the domestic output; Idaho, 22 percent; Utah, 13 percent; and Colorado, 7 percent. Output of these four States represented 86 percent of the total domestic output.

Table 2.—Mine production of recoverable

(Short to

State	1956-60 (average)	
Arizona	10,965	
Arkansas	8	
California	2,712	
Colorado	17,192	1
Idaho	58,973	7
Illinois	2,796	
Kansas	2,891	
Kentucky	424	
Missouri	116,073	9
Montana	10,685	
Nevada	3,771	
New Mexico	3,056	
New York	1,022	
North Carolina	89	
Oklahoma	4,952	
Utah	42,082	4
Virginia	2,807	
Washington	10,289	
Wisconsin	1,438	
Other States	10	
Total	292,135	26

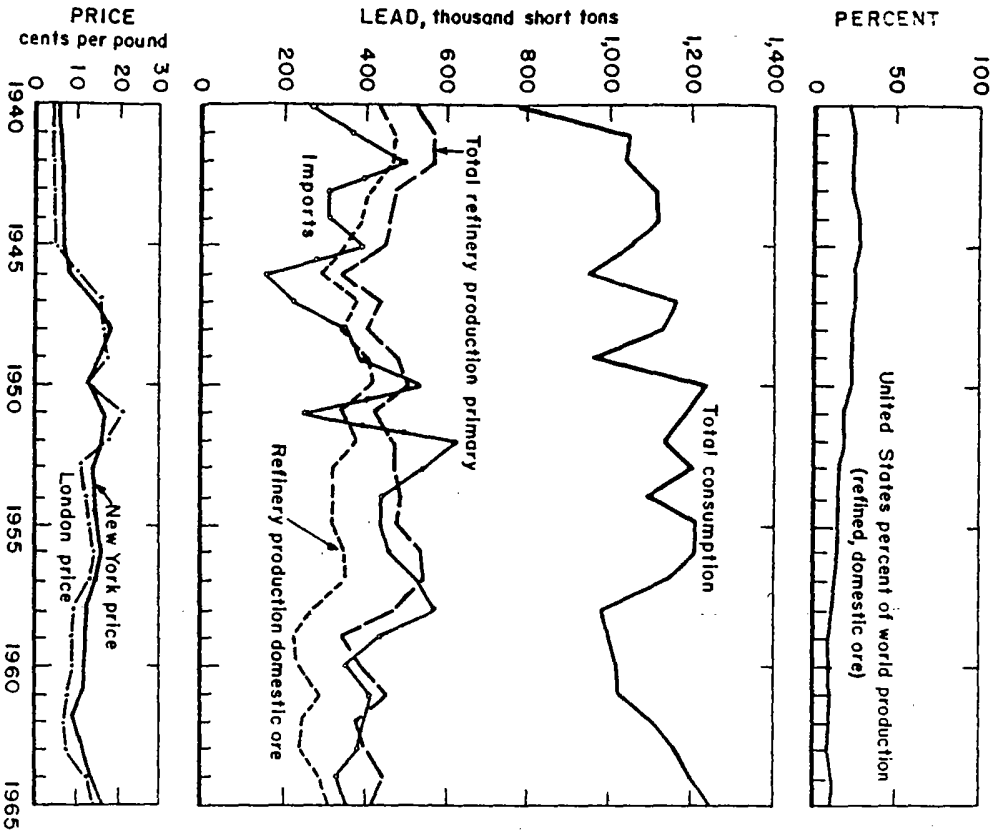

Figure 1.—Trends in the lead industry in the United States. Consumption includes primary refined, antimonial, and secondary lead, and lead pigments made directly from ore. Imports, general, are factored to include 95 percent of lead content of ore, mattes, and concentrates and 100 percent of pigs, bars, base bullion, and scrap.

Table 3.—Ore, old tailings, etc., yielding lead and zinc in the United States in 1965

(Short tons)

State	Lead ore			Zinc ore			Lead-zinc ore			Copper-lead, copper-zinc, and copper-lead-zinc ores			All other sources [1]			Total		
	Gross weight	Lead	Zinc	Gross weight	Lead	Zinc	Gross weight	Lead	Zinc	Gross weight	Lead	Zinc	Gross weight	Lead	Zinc	Gross Weight	Lead	Zinc
Arizona	1,403	55	4	2,763	56	498	336,557	5,732	15,433	85,172	11	4,699	13,990,426	59	1,123	14,416,321	5,913	21,757
California	8,881	1,706	192	W	W	W	523	101	30	W	W	W	2,825	3	3	12,229	1,810	225
Colorado	5,534	256	46	260,860	3,151	24,632	346,658	10,140	17,022	378,644	8,872	12,044	13,505	76	126	1,005,201	22,495	53,870
Idaho	221,412	21,016	1,686	96,112	978	2,507	740,111	38,630	49,060	W	W	W	640,129	5,982	4,781	1,697,764	66,606	58,034
Illinois	W	W	W	[2]	[2]	[2]	[2]	[2]	[2]	W	W	W	[2]681,130	[2]3,005	[2]18,314	681,130	3,005	18,314
Kansas	W	W	W	263,789	1,289	5,869	46,979	355	639	W	W	W	W	W	W	310,768	1,644	6,508
Kentucky	W	W	W	42,000	W	4,603	W	W	W	W	W	W	153,898	756	1,051	195,898	756	5,654
Missouri	5,279,420	133,521	4,312	W	W	W	W	W	W	W	W	W	W	W	W	5,279,420	133,521	4,312
Montana	20,465	1,100	290	1,006,871	4,617	25,938	1,123	69	63	W	W	W	111,946	1,195	7,495	1,140,405	6,981	33,786
Nevada	1,427	192	25	1,489	26	395	166,721	1,666	3,115	W	W	W	52,567	393	323	222,204	2,277	3,858
New Jersey	W	W	W	223,928	W	38,297	W	W	W	W	W	W	W	W	W	223,928	W	38,297
New Mexico	1,210	346	2	402,641	726	29,868	59,436	2,289	6,576	W	W	W	732	26	14	464,019	3,387	36,460
New York	W	W	W	159,793	W	15,915	629,168	601	53,965	W	W	W	W	W	W	788,961	601	69,880
Oklahoma	W	W	W	418,247	1,643	9,938	175,616	1,160	2,743	W	W	W	1,342	10	34	595,205	2,813	12,715
Pennsylvania	W	W	W	549,427	W	27,635	W	W	W	W	W	W	W	W	W	549,427	W	27,635
Tennessee	W	W	W	4,007,082	W	111,637	W	W	W	1,520,755	W	10,750	W	W	W	5,527,837	W	122,387
Utah	11,280	1,619	424	87	2	13	486,941	35,647	25,907	1,076	170	137	25,679	262	1,266	525,063	37,700	27,747
Virginia	W	W	W	W	W	W	666,413	3,651	20,491	W	W	W	W	W	W	666,413	3,651	20,491
Washington	1,322	36	3	(3)	(3)	(3)	[3]1,104,777	[3]6,292	[3]22,227	W	W	W	(3)	(3)	W	1,106,099	6,328	22,230
Wisconsin	W	W	W	967,083	1,645	26,993	W	W	W	W	W	W	W	W	W	967,083	1,645	26,993
Other States	39	7	W	W	W	W	W	W	W	W	W	W	3,674	7	W	3,713	14	W
Total	5,552,393	159,854	6,984	8,402,172	14,133	324,738	4,761,023	106,333	217,271	1,985,647	9,053	27,630	15,677,953	11,774	34,530	36,379,088	301,147	611,153

W Withheld to avoid disclosing individual company confidential data.
[1] Lead and zinc recovered from other ores (copper, gold, silver, etc.) and from smelter slags, mill tailings, and miscellaneous cleanups.
[2] Combined with "other sources" to avoid disclosing individual company confidential data.
[3] Combined with lead-zinc ore to avoid disclosing individual company confidential data.

and construction of a new shaft was begun at the Indian Creek mine. The Herculaneum smelter produced 105,799 tons of refined lead in 1965. Its modernization and expansion program continued on schedule for completion during the fourth quarter of 1966 and will raise refining capacity to over 200,000 tons of lead annually.[2]

The Missouri Lead Operating Co. proceeded with mine development and with the design and construction of a mine-mill complex to produce 50,000 tons per year of lead and a 100,000-ton-per-year lead refinery in the Bixby, Mo., area for completion late in 1967. This is a joint venture of American Metal Climax, Inc., and Homestake Mining Co. Shaft sinking was in progress at the Magmont mine operated by Cominco American, Inc., and jointly owned with Magnet Cove Barium Corp. This unit has a planned mine-mill capacity of 50,000 tons of lead annually, with completion early in 1968. Ozark Lead Co., a wholly owned subsidiary of Kennecott Copper Corp., started development of a mine-mill complex with a capacity of 60,000 tons of lead annually in the new lead belt and expected to have the concentrates smelted and refined in a new facility to be built by American Smelting and Refining Company. Initial work of shaft sinking was started late in July at the Higdon mine near Fredericktown, Mo., a joint venture of National Lead Co. and The Bunker Hill Co.

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

(Short tons)

Month	1964	1965
January	24,907	24,053
February	22,799	23,322
March	24,464	26,529
April	24,054	26,176
May	23,547	22,065
June	24,037	23,802
July	23,445	22,692
August	23,620	25,575
September	22,937	25,865
October	23,775	26,028
November	23,388	25,821
December	25,047	29,219
Total	286,010	301,147

The output of lead in Colorado increased some 1,900 tons in 1965 as several small mines and mills began production. The Idarado Mining Co. milled about 375,000 tons of ore, a decrease of some 10 percent, but produced approximately the same amount of lead due to the higher grade of ore. Development of the new "Cross Vein" on the 2,400- and 2,900-foot levels was a factor in increasing ore reserves some 213,000 tons during the year.[3] The New Jersey Zinc Co. maintained a high output at its Eagle mine near Gilman. Rico Argentine Mining Co. increased mill production to full capacity during the year with a substantial increase in recoverable lead in concentrates and also completed an extensive program of mine development and equipment installation. Federal Resources Corp. began limited mining and milling at the Camp Bird mine and expects to be at full operating capacity of 650 tons per day early in 1966. Dewatering of the Irene shaft in Leadville, a joint venture of American Smelting and Refining Co. and Resurrection Mining Co., was completed preparatory to development above the 1,750-foot level. The Sunnyside mine at Eureka, operated by Standard Metals Corp., produced 143,000 tons of lead-zinc ore in 1965 compared with 136,000 tons in 1964.[4]

The Hecla Mining Co. operated the Lucky Friday mine and the Star unit with production slightly below the 1964 level. Considerable development was accomplished with reserves at the Star Unit increased about 26 percent and the Lucky Friday shaft deepened preparatory to development of the 3,650-foot level.[5] The 17,000-foot crosscut from the Bunker Hill mine to the Crescent mine, driven at a depth 400 feet below sea level, was completed at midyear and development of the area started. An extensive exploration and development program was initiated in the lead-silver belt of the Coeur d'Alene area by several of the operating companies. Output of ore at the Bunker Hill mine declined and reserves of high grade lead-silver ore declined substantially. The Bunker Hill Co. concentrator operated on a 7-day-week basis treating 627,000 tons of ore from company mines, domestic purchased ore, and toll processing of high-grade ore from the Pine Point mine in Canada. Milling of the old Bunker Hill mine tailings was continued. The lead

[2] St. Joseph Lead Co. Annual Report. 1964, p. 3.
[3] Newmont Mining Corp. Annual Report. 1965, p. 7.
[4] United States Smelting, Mining and Refining Co. Annual Report. 1965, p. 6.
[5] Hecla Mining Co. Annual Report. 1965, p. 7.

Table 5.—Twenty-five leading lead-producing mines in the United States in 1965, in order of output

Rank	Mine	State	County	Operator	Source of lead
1	Viburnum	Missouri	Crawford, Iron, and Washington	St. Joseph Lead Co.	Lead ore.
2	Federal	do	St. Francois	do	Do.
3	Bunker Hill	Idaho	Shoshone	The Bunker Hill Co.	Lead-zinc ore.
4	United States and Lark	Utah	Salt Lake	United States Smelting, Refining and Mining Co.	Lead-zinc, lead ore.
5	Lucky Friday	Idaho	Shoshone	Hecla Mining Co.	Lead ore.
6	Indian Creek	Missouri	Washington	St. Joseph Lead Co.	Do.
7	Star-Morning unit	Idaho	Shoshone	Hecla Mining Co.	Lead-zinc ore.
8	Idarado	Colorado	Ouray and San Miguel	Idarado Mining Co.	Copper-lead-zinc ore.
9	Page	Idaho	Shoshone	American Smelting and Refining Co.	Lead-zinc ore.
10	Iron King	Arizona	Yavapai	Shattuck Denn Mining Corp.	Do.
11	United Park City	Utah	Summit and Wasatch	United Park City Mines Co.	Do.
12	Mayflower	do	Wasatch	Hecla Mining Co.	Do.
13	Butte Hill Zinc Mines	Montana	Silver Bow	The Anaconda Company	Zinc ore.
14	Pend Oreille	Washington	Pend Oreille	Pend Oreille Mines and Metals Co.	Lead-zinc ore.
15	Austinville and Ivanhoe Mines	Virginia	Wythe	The New Jersey Zinc Co.	Do.
16	Sunnyside	Colorado	San Juan	Standard Metals Corp.	Do.
17	Burgin	Utah	Utah	Kennecott Copper Corp.	Lead-zinc, lead ore.
18	Eagle	Colorado	Eagle	The New Jersey Zinc Co.	Zinc ore.
19	Keystone	do	Gunnison	McFarland & Hullinger	Lead-zinc ore.
20	Silver Star-Queens	Idaho	Blaine	Federal Resources Corp.	Silver ore.
21	Ophir	Utah	Tooele	United States Smelting, Refining and Mining Co.	Lead-zinc ore.
22	Kay	[illegible]	Stevens	American Smelting and Refining Co.	Zinc ore.

smelter produced 93,800 tons of lead, including toll, compared with 86,300 tons in 1964.[6]

In Utah, production at the Mayflower mine of New Park Mining Co., operated by the Hecla Mining Co., was slightly higher in 1965 with 113,200 tons of ore mined, averaging 4.3 percent lead. The operating property was expanded by purchase of the Lucy mining claim and lease of other claims owned by New Park Mining Co. and San Diego Mining Co. Reserves of ore were increased by almost 370,000 tons.[7] Operation of the U.S. and Lark mine and Midvale concentrator by United States Smelting, Refining and Mining Co. was interrupted by a strike which began on May 4 and terminated July 22. Tonnage of company ore and receipts of custom ore was substantially reduced, although grade of ore was higher than the previous year. Concentrates were smelted at the Tooele smelter and the bullion refined at the subsidiary lead refinery in East Chicago, Ind.; 29,100 tons of lead bullion was treated at the refinery in comparison to 35,400 tons in 1964.[8] United Park City Mines Co. produced 95,000 tons of ore from company and lease operations at the Ontario and Keystone mines and produced 5,940 tons of lead. The Ontario mine production shaft was being deepened to the 2,400-foot level where improvement of grade and quantity of ore was indicated.[9] Kennecott Copper Corp. continued development on the 1,200-foot level of the Burgin No. 2 production shaft in the Tintic area and shipped development ore during the year.

In the Washington area, the Pend Oreille Mines and Metals Co. maintained output of lead at essentially the same level as in 1964. American Zinc, Lead and Smelting Co. continued development and construction of a mill at the Calhoun mine with a 1,200-ton-per-day capacity; operation was scheduled for early 1966. The Northport mines of American Smelting and Refining Co. maintained the production rate achieved in 1964 after startup in July 1964. Development was underway at the Lucky Joe Mining Co. lead-zinc property near Newport and at the Rocky Creek Silver Mine, Inc., in Pend Oreille County.

The Pan American mine, a joint venture of Grand Deposit Mining Co. and Combined Metals Reduction Co. in New Mexico, completed its first year of lead-zinc production. The ore is concentrated at the Caselton mill at a rate of about 27,000 tons per month. The Groundhog mine of American Smelting and Refining Co. near Bayard was closed by a strike in September after being reopened for production early in the year. Shattuck Denn Mining Corp. initiated production from the 2,400-foot level of the Iron King mine at Humboldt, Ariz., and the No. 7 shaft was extended 200 feet below this level.

Activity in the Tri-State area continued strong with a 12-percent increase in lead production reported for the combined Kansas-Oklahoma area in 1965. The Central Mill of The Eagle-Picher Co. continued to treat the major portion of concentrates produced. Production of lead as a byproduct of the zinc ores of Wisconsin, New York, and Virginia was lower than in 1964.

SMELTER AND REFINERY PRODUCTION

Production of refined lead at primary refineries declined in 1965 due to a decrease in feed materials of foreign origin. The domestic component of the feed materials, both primary and secondary, continued the upward trend exhibited in recent years and contributed 74 percent of the total refined lead compared with 66 percent in 1964. The increase in price of lead in December 1964 and stability at this price during the year resulted in an 11-percent increase in value of the refined lead to over $130 million, almost double the 1962 valuation. The increased production from secondary material also reflected the short supply of feed materials which reached a low of some 90,000 tons of raw material and material in process and gradually improved to about 98,000 tons at yearend. The 10 primary plants operated by the following companies—American Smelting and Refining Co., The Bunker Hill Co., St. Joseph Lead Co., The Eagle-Picher Co., International Smelting & Refining Co., and United States Smelting Lead Refinery, Inc.—operated throughout the year except for a short strike at the El Paso, Tex., smelter of American Smelting and Refining Co. Secondary smelters achieved a record-breaking production of almost 5 percent above the total output of metal and alloy in 1964 and a 26-percent increase in value to about $180 million. Secondary lead produced by both primary and secondary plants in 1965 comprised 41 percent of the domestic supply of refined and antimonial lead in comparison to 39 percent in 1964, including imports of metal. The 25 major companies producing secondary lead and reporting to the Bureau of Mines were listed in the Minerals Yearbook, 1963.

Refined Lead, Primary and Secondary.—Production of refined (soft) lead in the United States from all sources—primary, secondary, and remelt—amounted to 600,200 tons compared with 598,600 tons in 1964. Primary plants supplied 431,400 tons, of which 71 percent was from domestic ores and 3 percent from purchased scrap. Secondary plants produced a record 168,800 tons, 20 percent more than in 1964 and approximately 28 percent of the total; 38,300 tons of this secondary output was remelt lead.

Antimonial Lead, Primary and Secondary.—The lead content of domestically produced antimonial lead was 277,300 tons, slightly below the 279,100 tons produced in 1964. Of the total, 91 percent was produced at secondary plants and the remainder at

[6] The Bunker Hill Co. Annual Report, 1965, p. 8.
[7] Hecla Mining Co. Annual Report, 1965, p. 9.
[8] United States Smelting, Refining and Mining Co. Annual Report, 1965, pp. 6–12.
[9] United Park City Mines Co. Annual Report, 1965, p. 8.

Table 6.—Refined lead produced at primary
by source mate
(Short tons)

	1956–60 (average)	
Refined lead:		
From primary sources:		
Domestic ores and base bullion	284,023	2
Foreign ores and base bullion	169,850	1
Total	453,873	4
From secondary sources	3,128	
Grand total	457,001	4
Average sales price per pound	$0.130	
Calculated value of primary refined lead (thousands)[1]	$118,007	$

[1] Excludes value of refined lead produced from scrap at

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

Year	Production (short tons)	Antimony content		Lead content by difference (short tons)			
		Short tons	Percent	From domestic ore	From foreign ore	From scrap	Total
1956–60 (average)	50,515	2,548	5.1	6,586	6,366	35,020	47,972
1961	35,080	1,894	5.4	12,988	11,978	8,220	33,186
1962	33,325	2,249	6.7	14,838	12,545	3,693	31,076
1963	18,818	1,890	10.0	4,553	4,703	7,672	16,928
1964	24,023	1,995	8.3	4,522	4,085	13,421	22,028
1965	27,895	1,984	7.1	2,809	3,803	19,299	25,911

Table 8.—Stocks and consumption of new and old lead scrap in the United States in 1965
(Short tons, gross weight)

Class of consumers and type of scrap	Stocks Jan. 1	Receipts	Consumption			Stocks Dec. 31
			New scrap	Old scrap	Total	
Smelters and refiners:						
Soft lead	3,782	65,664	—	67,003	67,003	2,443
Hard lead	1,044	16,844	—	17,000	17,000	888
Cable lead	1,781	27,484	—	28,427	28,427	838
Battery-lead plates	38,294	452,660	—	468,431	468,431	22,523
Mixed common babbitt	267	3,597	—	3,679	3,679	185
Solder and tinny lead	339	13,576	—	13,722	13,722	193
Type metals	1,126	36,750	—	35,597	35,597	2,279
Drosses and residues	24,286	102,338	101,694	—	101,694	24,930
Total	70,919	718,913	101,694	633,869	735,563	54,279
Sundries and other manufacturers:						
Soft lead	27	389	—	360	360	56
Hard lead	107	—	—	64	64	43
Cable lead	12	79	—	88	88	3
Battery-lead plates	—	—	—	—	—	—
Mixed common babbitt	97	12,315	—	12,265	12,265	147
Solder and tinny lead	—	—	—	—	—	—
Type metals	—	—	—	—	—	—
Drosses and Residues	202	69	5	—	5	266
Total	445	12,852	5	12,777	12,782	515
All consumers:						
Soft lead	3,809	66,053	—	67,363	67,363	2,499
Hard lead	1,151	16,844	—	17,064	17,064	931
Cable lead	1,793	27,563	—	28,515	28,515	841
Battery-lead plates	38,294	452,660	—	468,431	468,431	22,523
Mixed common babbitt	364	15,912	—	15,944	15,944	332
Solder and tinny lead	339	13,576	—	13,722	13,722	193
Type metals	1,126	36,750	—	35,597	35,597	2,279
Drosses and residues	24,488	102,407	101,699	—	101,699	25,196
Grand total	71,364	731,765	101,699	646,636	748,335	54,794

r Revised.

Table 9.—Secondary metal recovered [1] from lead and
by type of produ
(Short tons, gross we

	Lead	Tin
Refined pig lead	143,641	
Remelt lead	38,273	
Total	181,914	
Refined pig tin	-------	3,4
Remelt tin	-------	3
Total	-------	3,8
Lead and tin alloys:		
Antimonial lead	270,653	3
Common babbitt	17,264	9
Genuine babbitt	60	2
Solder	84,723	6,0
Type metals	86,882	2,2
Cable lead	18,892	
Miscellaneous alloys	1,293	5
Total	379,767	10,8
Tin content of chemical products	-------	1,0
Grand total	561,681	15,2

[1] Most of the figures herein represent actual reported rec

Table 10.—Secondary lead recovered
(Short tons)

	1956–60 (average)	1961	
As metal:			
At primary plants	3,128	1,569	
At other plants	126,796	139,100	1
Total	129,924	140,669	1
In antimonial lead:			
At primary plants	35,020	8,220	
At other plants	182,084	197,349	2
Total	217,104	205,569	2
In other alloys	116,784	106,554	
Grand total:			
Quantity	463,812	452,792	4
Value (thousands)	$121,367	$93,275	$

Table 11.—Lead recovered from scrap proc
by kind of scrap and form
(Short tons)

Kind of scrap	1964	1965	F
New scrap:			As soft
Lead-base	64,876	72,234	At
Copper-base	6,490	7,323	At
Tin-base	555	528	
Total	71,921	80,085	T
			In anti
Old scrap:			In othe
Battery-lead plates	304,523	313,146	In copp
All other lead-base	144,900	161,963	In tin-b
Copper-base	20,233	20,621	
Tin-base	5	4	T
Total	460,661	495,734	G
Grand total	541,582	575,819	

[1] Includes 18,421 tons of lead recovered in antimonial l
plants in 1964 and 19,299 tons in 1965.

CONSUMPTION AND USES

Industrial requirements for lead in the United States increased for the fourth successive year and, at 1,241,000 tons, exceeded the previous high of 1,238,000 tons established in 1950. The 1965 gain amounted to 3.3 percent, identical with the 1964 gain. Consumption exceeded 100,000 tons in each month, except for the normal seasonal decline in July, and amounted to a daily average requirement of 3,401 tons of lead. Percentage increase was approximately equal for soft lead, antimonial lead, and lead in other alloys with soft lead representing 67 percent and antimonial lead 27 percent of the total, excluding direct use of scrap and lead in leaded zinc oxide and other nonspecified pigments. An increased requirement was also reported for these direct and unclassified uses and, in fact, the only decrease was as lead consumed in copper-base scrap products.

Total consumption of lead in metal products, after almost identical consumption in 1963–64, resumed the upward trend. The increase in recent years in use of lead in ammunition, brass-bronze, foil, solder, and storage batteries continued in 1965. A significant change was the increased amount used in cable covering and type metal which had previously shown a downward trend. The decline continued in calking lead and casting metals. Use in bearing metals, collapsible tubes, pipes and bends, and sheet lead decreased in 1965 after a slight recovery in demand in 1964.

Pigments required 109,000 tons, an increase of 5,200 tons, essentially all in the form of red lead and litharge and a small gain was reported for gasoline antiknock compounds. The use of lead in chemicals, essentially all for gasoline antiknock compounds, was 226,000 tons compared with a 169,000-ton average for the relatively stable period 1957–61. Miscellaneous and unclassified uses of lead increased slightly, with weights and ballast accounting for most of the enlarged need.

Storage batteries accounted for the largest quantity of lead, 455,300 tons compared with 429,300 tons in 1964, both in the form of soft lead and lead oxide. The Association of Battery Manufacturers, Inc., reported shipments of S.L.I. type batteries (starting-lighting-ignition) of 41.7 million units, a record number exceeding the 41.1 million in 1963 and some 3 million more than in 1964. Of the batteries shipped, about 73 percent were designated as replacement batteries and 26 percent as original equipment.

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

(Short tons)

Product	1964	1965
Metal products:		
Ammunition	56,493	57,822
Bearing metals	22,754	21,600
Brass and bronze	23,328	23,699
Cable covering	56,225	59,645
Calking lead	73,628	66,584
Casting metals	6,961	5,046
Collapsible tubes	14,904	10,893
Foil	3,976	4,805
Pipes, traps, and bends	20,480	19,837
Sheet lead	29,605	27,569
Solder	71,186	77,819
Storage batteries:		
Battery grids, posts, etc.	221,594	235,641
Battery oxides	207,754	219,706
Terne metal	1,609	2,109
Type metal	25,374	33,416
Total	836,871	865,691
Pigments:		
White lead	8,802	8,414
Red lead and litharge	74,802	79,853
Pigment colors	11,921	12,563
Other [1]	8,111	8,063
Total	103,636	108,883
Chemicals:		
Gasoline antiknock additives	223,466	225,203
Miscellaneous chemicals	451	346
Total	223,917	225,549
Miscellaneous uses:		
Annealing	5,699	5,719
Galvanizing	1,592	1,775
Lead plating	179	240
Weights and ballast	12,760	14,135
Total	20,230	21,869
Other, unclassified uses	18,484	19,490
Grand total [2]	1,202,138	1,241,482

[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	1964	1965
January	107,603	104,881
February	94,425	100,024
March	92,844	104,192
April	98,081	100,748
May	98,786	100,762
June	102,448	104,363
July	91,438	90,886
August	99,676	101,417
September	101,765	107,198
October	105,571	113,162
November	101,985	110,509
December	106,616	103,395
Total [1]	1,202,138	1,241,482

[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 and types of m

(Short tons)

Product	Soft lead	Lead antim lea
Metal products	211,013	88,
Storage batteries	227,134	228,
Pigments	104,944	
Chemicals	226,548	
Miscellaneous	11,686	9,
Unclassified	15,869	2,
Total	796,188	324,

[1] Excludes 47,535 tons of lead which went directly from s of lead contained in leaded zinc oxide and other nonspecifi

Table 15.—Lead consumption in the U

(Short tons)

State	Refined soft lead	Lead antim lea
California	80,839	25,
Colorado	1,512	2,
Connecticut	13,038	13,
District of Columbia	189	
Florida	4,185	4,
Georgia	82,859	10,
Illinois	79,275	41,
Indiana	74,558	44,
Kansas	8,646	9,
Kentucky	3,047	4,
Maryland	6,438	15,
Massachusetts	6,270	3,
Michigan	21,248	19,
Missouri	37,226	6,
Nebraska	4,795	
New Jersey	138,552	19,
New York	89,867	8,
Ohio	12,899	5,
Pennsylvania	51,549	36,
Rhode Island	1,808	
Tennessee	131	8,
Virginia	2,197	1,
Washington	6,781	
West Virginia	15,786	3,
Wisconsin	1,767	3,
Alabama and Mississippi	682	1,
Arkansas and Oklahoma	8,896	8,
Hawaii and Oregon	467	2,
Iowa and Minnesota	4,666	8,
Louisiana and Texas	131,608	15,
Montana and Idaho	7,769	
New Hampshire, Maine, Delaware	6,071	3,
North and South Carolina	651	4,
Utah, Nevada, Arizona	131	
Total	796,188	324,

[1] Excludes 47,535 tons of lead which went directly from sc of lead contained in leaded zinc oxide and other nonspecifi

Missouri was of interest because of its position as the leading producer.

Most of the increase in lead consumption was related to the sophisticated needs of modern society with respect to transport, communications, and nuclear power. Lead-acid batteries remained the most compact, economical source of packaged power for automotive starting, lighting, and ignition and continued progress was made in the employment of battery-powered vehicles in the industrial and recreational fields. The greater number of vehicles used in transportation and the increasing mileage per vehicle continued to raise the amount of lead required for batteries and gasoline additives. Expansion of the use of lead pigments for corrosion resistance and highway traffic marking paints was notable. In the nuclear area, the need for the radiation shielding properties of lead for reactors was also accompanied by a mounting need for lead in nuclear-fuel shipping casks and other special applications requiring space saving and portability, as well as temporary shielding achieved by use of lead shot and lead in brick form. The development of dispersion strengthening techniques using lead oxide as the dispersed phase for rolled or extruded lead products has enabled adoption of new fabrication techniques and manufacture of thinner, stronger lead sheaths for cables, lighter battery grids, and stronger sheet and tube. The ability of lead to maintain its competitive position in the transportation, communication, nuclear, and construction areas was thus further strengthened in 1965.

LEAD PIGMENTS

Production of lead pigments in the United States increased in all categories except white lead and consumed 321,200 tons of lead, 7 percent more than in 1964 and the fifth successive annual increase in use of lead for pigments. Requirements for black oxide, a mixture of litharge and metallic lead for battery plates, represented the largest increase in pig lead use, followed by litharge and red lead. Use in white lead and leaded zinc oxide continued to decline. Production of basic lead sulfate is not published and lead silicate for enamels and glazes derived from litharge is included with litharge.

White Lead.—The production of white lead, both dry and in oil, totaled 11,500 tons and continued its downward trend after a slight increase in 1964. The decline was especially reflected in the paint and ceramics industries. Other uses of white lead in various chemicals, greases, stabilizers, and plasticizers, however, increased significantly again in 1965.

Red Lead.—Requirements increased in 1965 thus continuing the upward trend of recent years. Only 46 percent was used in paints and the predominant requirement was by the oil and rubber industries along with many small industrial applications.

Litharge.—Shipments of litharge were 7 percent more than in 1964. An increase was registered in all categories except varnish which is predominantly reported as used in paints rather than varnish. To avoid disclosing company confidential data, a large percentage of the litharge shipped is designated "Other." Production of leaded litharge, known to the trade as "black oxide" and used by battery manufacturers, increased more than 8 percent and the 184,800 tons of lead consumed in production of this item compared with 133,600 tons in 1960.

Prices.—The quoted price of lead pigments was unchanged during the year in line with the stable domestic price of lead metal. The price of white lead in carload lots, freight allowed, was 20.5 cents per pound, established on November 2, 1964. The average value per ton of white lead at the plant was $425 for the dry type and $646 for the oil mixed in terms of weight of white lead. Red lead was quoted at 19.75 cents per pound, effective December 28, 1964, and the average value per ton at plant was $375. The price of litharge was 19.25 cents per pound, effective December 28, 1964, and the average value per ton at plant was $359. The value of the shipments of white lead, red lead, and litharge in 1965 was $56.3 million, 21 percent more than the 1964 value.

Foreign Trade.—The individual export classification of lead arsenate was discontinued beginning in calendar year 1965

Table 16.—Production and shipments of l

Pigment	1964			
	Production (short tons)	Shipments		
		Short tons	Value [2]	
			Total	A
White lead:				
Dry	9,298	10,432	$3,997,056	
In oil [1, 3]	3,298	5,014	2,600,233	
Total	12,596	15,446	6,597,289	
Red lead	27,812	28,090	9,172,654	
Litharge	100,230	99,393	30,663,873	
Black oxide	178,088	-----	----------	

[1] Except for basic lead sulfate, figures withheld to data.
[2] At plant, exclusive of container.
[3] Weight of white lead only, but value of paste.

Table 17.—Lead content of lead and by domestic manu

(Short t

Pigment	1964		
	Lead in pigments produced from—		
	Ore		Pig lead
	Domestic	Foreign	
White lead	----	-----	10,077
Red lead	----	-----	25,212
Litharge	----	-----	93,214
Black oxide	----	-----	170,894
Leaded zinc oxide	1,398	593	------
Total	1,398	593	298,897

[1] Excludes lead in basic lead sulfate; figures with fidential data.

Table 18.—Distribution of white lead

(Short t

Industry	1956–60 (average)	1961
Paints	16,824	12,086
Ceramics	406	141
Other	3,729	3,996
Total	20,959	16,223

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

Table 19.—Distribution of r

(Short t

Industry	1956–60 (average)	1961
Paints	13,810	12,895
Storage batteries	W	W
Ceramics	W	W
Other	10,490	9,961
Total	24,300	22,856

W Withheld to avoid disclosing individual compan

Table 20.—Distribution of litharge shipments, by industries

(Short tons)

Industry	1956–60 (average)	1961	1962	1963	1964	1965
Ceramics	W	14,398	17,752	17,762	20,508	21,018
Chrome pigments	W	W	W	5,763	6,426	W
Floor covering	W	W	W	W	W	W
Insecticides	W	W	W	W	W	1,161
Oil refining	2,989	2,147	2,404	1,973	2,142	2,886
Rubber	1,598	1,248	1,792	1,702	1,978	2,168
Storage batteries	W	W	W	W	W	W
Varnish	3,644	3,894	4,088	4,240	4,004	3,763
Other	98,795	77,778	77,366	72,394	64,335	74,916
Total	107,026	98,950	103,397	103,834	99,393	105,892

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

Table 21.—U.S. exports of lead pigments and compounds

Kind	1964		1965	
	Short tons	Value (thousands)	Short tons	Value (thousands)
Lead pigments [1]	1,680	$608	2,286	$890
Lead arsenate	936	278	NA	NA
Total	2,616	886	2,286	890

NA Not available.
[1] Includes white lead, red lead, and litharge.

Table 22.—U.S. imports for consumption of lead pigments and compounds

Kind	1964		1965	
	Short tons	Value (thousands)	Short tons	Value (thousands)
White lead	2,674	$748	1,631	$581
Red lead	1,613	851	524	145
Litharge	19,768	4,001	22,208	5,375
Other lead pigments	5	13	5	15
Other lead compounds	195	61	203	67
Total	24,250	5,174	24,571	6,183

and this compound was to be included with pigments and oxides. Total exports thus declined 13 percent in tonnage, although the value increased slightly. The import of litharge, accounting for 90 percent of the total imports of lead pigments, oxides, and compounds, increased 12 percent in comparison to 1964 receipts while a substantial decrease occurred in deliveries of white lead and red lead. The total import tonnage in 1965 was, however, only 320 tons above the 1964 total. Value per ton of imports increased for each type of material and the total valuation of $6.2 million was almost 20 percent above the 1964 amount.

STOCKS

The continuing high level of demand for lead and limitation on imports of foreign concentrates until termination on October 22 resulted in a decline in producer stocks of refined and antimonial lead from 38,100 tons at the end of 1964 to a low of 24,300 tons at the end of September and only a small buildup thereafter to end the year at 25,200 tons. In comparison, producer stocks at the close of 1961 totaled 205,600 tons. Stocks of ore and base bullion for smelting and refining, amounting to 46,300 tons at the end of 1964, reached a low of 41,000 tons at the end of May and then gradually increased at yearend to 58,200 tons.

Stocks reported by the American Bureau of Metal Statistics indicate an additional 18,000 tons of lead in base bullion in process at refineries or in transit to refineries and about 30,300 tons of ore and matte in process at primary smelters. The total stocks of lead in metal, primary and secondary materials at primary plants was thus 131,700 tons at the end of 1965 compared with 141,900 tons at the close of 1964.

Consumer and secondary smelter stocks of lead in all forms—soft lead, antimonial

Table 23.—Stocks of lead at primary smelters a

(Short to

Stocks	1956–60 (average)	1961
Refined pig lead	107,325	195,200
Lead in antimonial lead	11,095	10,354
Lead in base bullion	13,669	16,978
Lead in ore and matte	47,205	39,570
Total	179,294	262,102

Table 24.—Consumer stocks of lead in the Un

(Short tons, lead

Year	Refined soft lead	Lead antimon lead
1961	55,951	33,63
1962	61,121	34,38
1963	71,558	40,60
1964	69,361	36,16
1965	61,586	36,19

PRICES

The quoted New York price for common lead remained at 16 cents per pound, effective December 11, 1964, throughout the year. Government sales of stockpile-surplus lead in April were made at 15.75 cents per pound for common, corroding, and common desilverized lead and 15.85 cents per pound for chemical grade. Sales conducted

Table 25.—Average monthly and yearly New York and

(Cents per p

Month	1964		
	St. Louis	New York	Lon
January	12.80	13.00	
February	12.80	13.00	1
March	12.80	13.00	1
April	12.80	13.00	1
May	12.80	13.00	1
June	12.80	13.00	1
July	12.80	13.00	1
August	13.04	13.24	1
September	13.80	14.00	1
October	14.32	14.52	1
November	14.80	15.00	1
December	15.46	15.66	1
Average	13.42	13.62	1

[1] St. Louis: Metal Statistics, 1966. New York: Mineral Markets.
[2] Based on monthly rates of exchange by Federal Re

Table 26.—U.S. exports of lead, by countries [1]

(Short tons)

Destination	1956–60 (average)	1961	1962	1963	1964	1965
Ore, matte, base bullion (lead content): [2]						
North America	621	8	------	4	------	------
South America	------	------	------	------	12	------
Europe	6	77	7	------	------	------
Asia	272	4,357	2,891	------	7	------
Total ore, matte, base bullion	899	4,437	2,898	4	19	------
Pigs, bars, anodes:						
North America:						
Canada	72	80	39	112	104	218
Mexico	22	24	25	23	10	128
Other	152	89	66	95	209	426
Total	246	143	130	230	323	767
South America	141	794	588	188	105	1,053
Europe	546	3	28	153	7,330	4,366
Africa	2	12	9	10	33	42
Asia:						
Japan	697	------	------	------	553	585
Philippines	313	227	81	26	130	129
Taiwan	849	874	950	------	575	73
Other	216	78	821	478	1,116	778
Total	2,075	1,179	1,352	504	2,373	1,565
Oceania	(3)	2	1	3	11	18
Total pigs, bars, anodes	3,010	2,133	2,108	1,088	10,175	7,811
Scrap:						
North America	249	54	37	14	400	243
South America	------	2	15	8	------	------
Europe:						
Belgium-Luxembourg	5	688	828	1,182	1,566	------
Germany, West	260	263	119	498	632	161
Italy	40	162	289	------	15	2,348
Netherlands	401	251	159	72	296	235
Spain	------	------	53	12	112	------
United Kingdom	485	1,167	786	519	1,293	83
Yugoslavia	------	------	------	------	2,943	584
Other	46	------	63	29	42	126
Total	1,237	2,521	1,797	2,312	6,899	3,537
Asia:						
Japan	65	2,579	593	85	5,847	12
Other	(3)	7	19	2	2	1
Total	65	2,586	612	87	5,849	13
Total scrap	1,551	5,163	2,461	2,421	13,148	3,793
Grand total	5,460	11,783	7,467	3,513	23,342	11,604

[1] In addition foreign lead was reexported as follows: Ore, matte, and base bullion, 1956–60 (average), 2 tons; 1961–64, none; 1965, class no longer separately classified. Pigs, bars, anodes, 1956–60 (average), 91 tons; 1961, 294 tons; 1962–63, none; 1964, 4,367 tons; 1965, 659 tons. Scrap, 1956–60 (average), 2 tons; 1961–64, none; 1965, 99 tons.
[2] Effective Jan. 1, 1965, no longer separately classified.
[3] Less than ½ unit.

Table 27.—U.S. imports [1] of lead, by countries

(Short tons)

Country	1956–60 (average)	1961	1962	1963	1964	1965
Ore, flue dust, and matte (lead content):						
North America:						
Canada	27,371	84,361	27,728	23,634	27,951	43,622
Guatemala	4,670	9,817	2,135	305	5	18
Honduras	8,610	5,512	4,965	6,809	6,375	8,712
Mexico	2,245	1,166	1,180	1,071	1,069	760
Other	1,127	------	------	------	------	------
Total	38,923	50,956	36,008	31,819	35,400	53,112
South America:						
Bolivia	14,091	11,370	8,242	9,791	6,073	5,096
Colombia	713	722	439	9	------	677
Peru	50,953	28,970	32,999	43,950	28,243	26,419
Other	696	610	------	------	------	------
Total	66,453	41,672	41,680	53,750	34,316	32,192
Europe	196	300	280	------	------	------

Table 27.—U.S. imports [1] of lead, by

Country	1956–60 (average)	
Ore, flue dust, and matte (lead content)—Continued		
Africa:		
Morocco	1,053	
South Africa, Republic of	40,914	
Total	41,967	
Asia:		
Philippines	942	
Other	303	
Total	1,245	
Oceania: Australia	27,428	
Total ore, flue dust, and matte	176,211	1
Base bullion (lead content):		
North America	65	
South America	124	
Europe	------	
Asia	(3)	
Oceania	------	
Total base bullion	189	
Pigs and bars (lead content):		
North America:		
Canada	30,675	
Mexico	91,933	
Other	67	
Total	122,675	1
South America:		
Peru	33,104	
Other	349	
Total	33,453	
Europe:		
Belgium-Luxembourg	2,209	
Denmark	------	
Germany, West	1,656	
Spain	7,513	
United Kingdom	2,522	
Yugoslavia	86,742	
Other	2,629	
Total	52,271	
Africa	6,339	
Asia: Japan	------	
Oceania: Australia	70,229	
Total pigs and bars	284,967	2
Reclaimed scrap, etc. (lead content):		
North America:		
Canada	3,335	
Mexico	3,814	
Other	605	
Total	7,254	
South America	151	
Europe	420	
Asia: Japan	9	
Oceania: Australia	2,654	
Total reclaimed scrap, etc.	10,488	
Grand total	471,865	4

[1] Data are general imports; that is, they include lead material entering the country under bond.
[3] Less than ½ unit.

Table 28.—U.S. Imports for consumption [1] of lead, by countries
(Short tons)

Country	1956–60 (average)	1961	1962	1963	1964	1965
Ore, flue dust, and matte (lead content):						
North America:						
Canada	29,001	31,439	29,523	30,037	27,973	33,637
Guatemala	4,872	5,527	4,691	387	5	18
Honduras	4,162	4,803	5,959	8,692	6,489	7,406
Mexico	2,834	1,060	1,809	1,850	458	577
Other	1,063	------	------	------	------	------
Total	41,932	42,829	42,072	41,866	34,925	41,638
South America:						
Bolivia	15,710	10,470	7,479	10,055	8,373	3,885
Colombia	740	514	480	95	------	439
Peru	54,668	32,318	32,327	32,140	32,314	30,732
Other	1,279	401	6	------	------	------
Total	72,397	43,703	40,292	42,290	40,687	35,056
Europe	30	------	220	------	------	------
Africa:						
Morocco	1,048	------	2	------	------	23
South Africa, Republic of	39,684	29,736	29,756	29,740	29,760	28,712
Other	369	------	------	------	------	------
Total	41,101	29,736	29,758	29,740	29,760	28,735
Asia:						
Philippines	938	380	111	31	86	96
Other	252	------	------	223	121	------
Total	1,190	380	111	254	207	96
Oceania:						
Australia	30,792	20,132	20,627	21,295	22,488	23,408
Other	32	------	------	------	------	------
Total	30,824	20,132	20,627	21,295	22,488	23,408
Total ore, flue dust, and matte	187,474	136,780	133,080	135,445	128,067	128,933
Base bullion (lead content):						
North America	65	134	5	964	3,094	93
South America	95	102	2,078	854	603	25
Europe	------	[2]	------	3	560	[2]
Oceania	------	------	------	1,937	2,786	448
Total base bullion	160	236	2,083	3,758	7,043	566
Pigs and bars (lead content):						
North America:						
Canada	30,677	54,902	56,807	29,674	30,777	31,697
Mexico	89,980	71,289	68,147	78,254	72,078	73,386
Other	58	6	------	------	45	69
Total	120,715	126,197	124,954	107,928	102,900	105,152
South America:						
Peru	33,116	26,195	22,103	22,224	23,114	27,484
Other	349	------	------	35	------	38
Total	33,465	26,195	22,103	22,259	23,114	27,522
Europe:						
Belgium-Luxembourg	2,193	41	1,685	4,366	4,375	422
Denmark	1,093	------	------	------	700	514
Germany, West	1,599	911	614	577	3,692	2,161
Spain	7,330	8,775	3,968	7,713	847	22
United Kingdom	2,501	16	------	1,462	1,697	425
Yugoslavia	35,697	30,230	32,240	31,063	30,544	28,639
Other	1,362	------	12	------	834	531
Total	51,688	39,973	38,509	45,181	42,689	32,714

Table 28.—U.S. Imports for consumption [1]
(Short tons)

Country	1956–60 (average
Pigs and bars (lead content)—Continued	
Africa:	
Morocco	6,096
South Africa, Republic of	548
Other	------
Total	6,644
Asia: Japan	------
Oceania: Australia	69,818
Total pigs and bars	282,330
Reclaimed scrap, etc. (lead content):	
North America:	
Canada	3,335
Mexico	3,816
Other	648
Total	7,799
South America	202
Europe	512
Asia: Japan	9
Oceania: Australia	1,509
Total reclaimed scrap, etc.	10,031
Sheets, pipe, and shot:	
North America:	
Canada	231
Mexico	2,432
Other	4
Total	2,667
Europe	1,865
Asia	[2]
Oceania	------
Total sheets, pipe, and shot	4,532
Grand total	484,527

[1] Excludes imports for manufacture in bond and exp
by the Bureau of the Census.
[2] Less than ½ unit.

FOREIGN TR

Exports of lead material other than scrap decreased to 7,800 tons. Scrap exports amounted to only 3,800 tons compared with 13,100 tons in 1964 and only slightly more than the 3,500 tons of scrap imported for consumption in 1965.

General imports of lead in all materials amounted to 348,900 tons in 1965, a gain of 8,000 tons, although primary materials for domestic smelting and refining decreased 4,300 tons to 123,800 tons. A substantial decline in deliveries from the Republic of South Africa due to expanded operation of the new Tsumeb smelter and refinery and decreased deliveries of smelting materials from Bolivia, Mexico, and Peru more than offset substantial imports of Canadian ores for toll smelting and increased deliveries from Australia and Honduras. Receipts of lead bullion decreased

Table 29.—U.S. imports for consumption of lead, by classes [1]

Year	Lead in ore, flue dust or fume, and matte, n.s.p.f. (lead content)		Lead in base bullion (lead content)		Pigs and bars (lead content)		Reclaimed scrap etc. (lead content)		Sheets, pipe, and shot		Not otherwise specified value (thousands)	Total value (thousands)
	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)	Short tons	Value (thousands)		
1956–60 (average)	187,474	$43,706	160	$47	282,330	$66,800	10,031	$2,138	4,532	$1,107	$457	$114,255
1961	136,780	24,332	236	51	247,427	45,881	3,894	592	2,845	641	807	72,304
1962	133,080	21,003	2,083	710	257,866	41,570	2,078	269	2,276	474	978	65,004
1963	135,445	21,534	3,758	1,792	220,398	40,126	15,405	2,009	2,429	513	792	66,766
1964	128,067	21,789	7,043	2,058	211,140	45,790	1,907	350	1,523	369	713	71,069
1965	128,933	26,923	566	380	221,519	60,391	3,612	793	880	273	329	89,089

[1] Excludes imports for consumption in bond and export, classified as "imports for consumption" by the Bureau of the Census.

Table 30.—U.S. imports for consumption of misc

Year	Babbitt metal, solder, white met and other combinations containi lead		
	Gross weight (short tons)	Lead content (short tons)	Valu (thousar
1956–60 (average)	6,593	2,888	$8,79
1961	7,930	1,409	14,20
1962	2,438	1,030	8,44
1963	2,535	1,246	8,20
1964	r2,805	r1,228	r5,07
1965	8,299	986	8,12

r Revised. NA Not available.
[1] Due to changes in classification, effective Sept. 1, 1
January-August data tabulated.

WORLD REVIE

The upward trend in world mine production in 1965 resulted in a record output approaching 3 million tons. Free world output of about 2.25 million tons was almost 8 percent above the 1964 total and reflected major increases in Canada, Japan, and Zambia, as well as additional output by several countries. Australia and Peru were the major suppliers recording a decrease in output. Smelter production also increased in the free world with major increases indicated for the Republic of South Africa, Canada, and Zambia and additional output recorded in several countries to more than offset the production declines in Australia, Spain, and a few other countries.

Lead consumption continued at the high level of 1964 with increases in Europe and North America offsetting an indicated decline in Japan and Australia. The strong demand for metal, plus a production curtailment in Australia in the first quarter of the year, provided an upward pressure on London Metal Exchange (LME) cash price for lead, which reached a post-Korean war high at the morning session of February 22 when £157 was bid, equivalent to 19⅞ cents per pound. The monthly average price on the LME ranged from £98.7 to £126.6, and the December average was £109.4 per long ton.

Producer stocks of lead, as published by the International Lead and Zinc Study Group, increased during the year from 173,000 tons to 187,000 tons. Of this total, the European area held 57,000 tons; the United States, 34,000 tons; and other countries, 96,000 tons.

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AFRICA

Algeria.—A production increase of almost 10 percent in lead concentrates resulted from modernization and development efforts in 1965. The mines were operating at full capacity, and there was considerable exploration and capital investment in 1965 which was expected to further improve production. A deposit discovered at the El Abed in 1964 was being developed and two lead deposits were discovered at the Ouarsenis mine.

South-West Africa.—The Tsumeb mine of Tsumeb Corp. Ltd., produced, during fiscal year 1965, a total of 812,100 tons of ore assaying 3.98 percent copper, 13.08 percent lead, and 3.90 percent zinc, and the Kombat mill processed 343,000 tons of ore containing 4.31 percent copper and 1.6 percent lead. Various improvements made in the lead smelter and refinery resulted in lower costs and an increase in the production of refined lead at Tsumeb to 72,790 tons in 1965 compared with 52,660 tons in 1964. Some of the lead concentrates, as well as 58,400 tons of accumulated copper-lead slimes, were shipped to foreign custom smelters.[15]

The Berg Aukas mine of the South West Africa Co. Ltd. treating a complex lead-zinc-vanadium ore, continued to expand and improve mill recovery of the contained minerals in the ore mined. During fiscal year 1965, about 12,000 tons of lead-vanadate concentrate and 32,000 tons of lead-zinc sulfide concentrate was recovered. Mine development was expanded and assured reserves were estimated at 305,000 tons averaging 7 percent lead, 33 percent zinc, and 1.5 percent vanadium pentoxide.

Tunisia.—During the first half of 1965, an increase of 70 percent in lead ore production compared with the same period in 1964 was reported. The major producers were the Djebel and Sidi Bou Aouane mines. The two lead smelters, Djebel Hallouf and Megrine, produced, in the first half, 8,800 tons of lead compared with 5,800 tons during the same period in 1964. The Djebel Hallouf plant accounted for 93 percent of the metallic lead.

Zambia.—Zambia Broken Hill Development Corp. Ltd., substantially expanded output in 1965 with mine production of lead amounting to about 38,000 tons and refined lead output approximately 24,000 tons. The Imperial smelting process was used and metallurgical difficulties resulting from the high lead input to the smelter, which curtailed lead output in 1964, were smoothed out in 1965.

ASIA

India.—India's only lead producer, the Metal Corporation of India Ltd., was nationalized on October 22 in order to enable the Government to develop and exploit the lead and zinc deposits to the fullest possible extent with major emphasis on development and expansion of refinery capacity. The company has been producing about 4,000 tons of lead at the Zawar lead-zinc mines near the town of Vdaipur, Rajasthan, and refining the concentrates in its smelter and refinery at Tundoo, Bihar. The zinc concentrate was shipped to Japan for refining and return of metal to India.

Japan.—Mine production of ore and production of metal in Japan was relatively unchanged. Total rated capacity for refined lead, predominantly electrolytic, was approximately 130,000 tons annually. Proven ore reserves for the 24 lead-zinc mines totaled 39 million tons containing 427,000 tons of lead and 2 million tons of zinc and there was an additional 35 million tons of probable and inferred ore. Mitsubishi Cominco Smelting Co. Ltd., in which COMINCO has a 45-percent interest, continued construction of a 40,000-ton-annual-capacity lead smelter at Naoshima scheduled for completion in mid-1966.[16]

OCEANIA

Australia.—The production of lead ore and refined lead was substantially below the record level of 1963 and also the 1964 production. The lengthy strike at Mount Isa and a labor situation at the Broken Hill mines contributed to the decline. Mine production was about 398,000 tons and refined lead output 216,000 tons. Production at Mount Isa Mines Ltd. curtailed by a labor strike initiated in the fourth quarter of 1964, was not resumed until February 17 and operations did not regain normal levels until the second quarter. In fiscal year 1965, production of lead amounted to 58,900 tons compared with 71,600 tons in fiscal year 1964. The planned expansion of concentrator capacity was also delayed.[17]

North Broken Hill Ltd., mined a slightly larger tonnage of ore in 1965, with 44 percent of the ore from the new No. 3 shaft area, and ore reserves increased slightly. Production of lead concentrates decreased about 7 percent as the grade of ore declined. Recovery of 97.4 percent of the lead in ore was achieved by improvements in milling.[18] New Broken Hill Consolidated Ltd., completed the first stage of an expansion program to increase annual mill capacity to 1 million tons of ore by the end of 1967. Amount of ore milled in 1965 was 7 percent above the 1964 total while lead production was up only 2 percent due to decreased ore grade.[19] Production of ore at Broken Hill South Ltd., decreased about 7 percent during fiscal year 1965 and lead recovered in concentrates decreased 5 percent as improvement in ore grade offset slightly the reduced tonnage treated.[20] Pro-

[16] Newmont Mining Corp. Annual Report, 1965, p. 6.
[17] Consolidated Mining & Smelting Co. of Canada, Ltd. Annual Report, 1965, p. 9.

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TECHNOLOGY

The physical, chemical and electrical properties of lead, one of the oldest metals used by man, have been continuously explored and utilized to meet developing needs. Many of the technological discoveries and advances made in the field of atomic energy have been possible only through accompanying advances in the technique of radiation shielding with lead. This field of nucleonics is continuing to receive major research attention. The subject of dispersion strengthening of lead has only recently been explored,[23] but commercial usage in cable sheaths, battery grids, and sound attenuating panels offer research and development incentives. The successful application of evaporated lead-oxide layers as photosensitive was described as a breakthrough in color broadcasting,[24] and was the incentive for a published study of the properties of lead monoxide.[25] The advantages of lead-platinum anodes for a seawater anticorrosive system were demonstrated,[26] and lead dioxide-coated graphite anodes now make possible electrolysis of sodium pe
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[17] America
Report, 196
[18] North
1965, p. 4.
[19] New Br
Report, 196
[20] Broken
1965, p. 5.
[21] Rio Tin
p. 34.
[22] E.Z. Inc
p. 5.
[23] Light M
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[24] Lead In
formation
pp. 1–2.
[25] van den
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1965, pp. 67
[26] Lead In
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[27] Lead I
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methyllead was reported.[28] Investigation of electrochemical characteristics of crystal growth was reported for the lead fluoride-lead oxide system,[29] and for electrodeposited lead dendrites.[30] The technologic aspects of recovery and refining of lead continued to receive industrial attention as plants were expanded and new plants designed. The difficult metallurgy of treating the mixed oxide-sulfide ores of Sardinia, Italy, was reported,[31] and the flotation flowsheet of the Parc mill near Llanrwst, Wales, United Kingdom, was described.[32] A progress report on the Imperial smelting process in the various operating installations through 1964 was published,[33] and process changes in the electrolytic refining of lead in Sardinia to compensate for increasing bismuth content of concentrates was described.[34] The use of oxygen to increase production and recovery of lead in blast furnace was an active area in metallurgical research.[35]

The Second International Conference on Lead was held October 4–7 in Arnhem, Netherlands. This conference, sponsored by the European Lead Development Committee, presented 32 papers[36] relative to technical developments in lead material and products. Worldwide coordination of lead and zinc research and development was announced at the International Lead and Zinc Study Group meeting in Tokyo, November 1–5, by incorporation of the International Lead and Zinc Research Organization sponsored by a group of leading companies located in Australia, Canada, Italy, Japan, Mexico, Peru, South-West Africa, the United Kingdom, and the United States.

U.S. patents were issued for a process of recovering lead from byproduct materials by mixing with sodium hydroxide and treating in a reverberatory furnace[37] and for a process for preparing elemental fluorine and a sodium-lead alloy simultaneously.[38]

[28] Chemical Engineering. Electrolysis: New Route to Alkyl Lead Compounds. V. 72, No. 13, June 21, 1965, pp. 102–104.
Chemical Engineering. NALCO Achievement. V. 72, No. 23, Nov. 8, 1965, pp. 249–250.
[29] Oliver, C. B. The Viscosity of Some Molten Lead Compounds. J. Electrochem. Soc., v. 112, No. 6, June 1965, pp. 629–631.
[30] Ogburn, F., C. Bechtoldt, J. B. Morris, and A. de Koranyi. Structure of Electrodeposited Lead Dendrites. J. Electrochem. Soc., v. 112, No. 6, June 1965, pp. 574–577.
[31] World Mining. Milling Four Types of Oxidized Lead-Zinc Ores at Monteponi. V. 18, No. 9, August 1965, pp. 32–35.
[32] South African Mining and Engineering Journal (Johannesburg). Process Variables in Flotation. V. 76, No. 3789, Sept. 3, 1965, pp. 2059–2062.
[33] Woods, S. E., and D. A. Temple. The Present Status of the Imperial Smelting Process. Bull. Institution of Min. and Metall., v. 74, No. 703, pt. 9, June 1965, pp. 564–570.
[34] Freni, Elio R. Electrolytic Lead Refining in Sardinia. J. Metals, v. 17, No. 11, November 1965, pp. 1206–1214.
[35] Hase, E. A. Oxygen Enriched Blast at Asarco's Lead Smelter. J. Metals, v. 17, No. 12, December 1965, pp. 1334–1337.
[36] Metal Bulletin (London). No. 5036, Oct. 5, 1965, pp. 21–28.
[37] Mattison, Edwin L., and Richard Wolfe (assigned to E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.). Process for Recovering Lead From Byproduct Lead Materials. U.S. Pat. 3,188,199. June 8, 1965.
[38] Mastrangelo, Sebastian V. R. (assigned to E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.). Process for Producing Fluorine and Sodium-Lead Alloy. U.S. Pat. 3,196,091. July 20, 1965.

Lim

By Paul L. A

Lime production in 1965 was a record 16.8 million tons, 4 percent more than in 1964. Lime for use in basic-oxygen-furnace

Table 1.—Salient lime statisti
(Thousand short tons an

	1956–60 (average)	1961
Number of active open-market plants	151	220
Sold or used by producers		
Quicklime	6,603	8,998
Hydrated Lime	2,352	2,269
Dead-burned dolomite	2,054	1,982
Total[1]	11,099	13,249
Value[2]	$145,777	$177,468
Average value per ton	$18.13	$18.39
Open-market	8,299	8,072
Captive	[r]2,800	5,177
Imports for consumption	37	37
Exports	62	30

[r] Revised.
[1] Data may not add to totals shown because of round
[2] Selling value, f.o.b. plant, excluding cost of contain
[3] Incomplete figures. Before 1961 the coverage of ca

DOMESTIC PRO

The Warner Co. of Bellefonte, Pa. added 200 tons of daily capacity to its lime plant for basic-oxygen-furnace steelmaking. The plant produces Bell-Mine pebble lime. The company also opened a 1,000-ton distribution center in the Pittsburgh area.

The Detroit Lime Co., a subsidiary of Edward C. Levy Co., erected a 600-ton-per-day vertical lime kiln, said to be the largest of its kind. Also being installed was a 500-ton-per-day rotary kiln. A major portion of the lime production was to go to the basic-oxygen-furnace plant of Great Lakes Steel Corp. in Ecorse, Mich.[2]

Bethlehem Steel Corp. was building a 600 ton-per-day lime-burning plant for basic-oxygen-steelmaking furnaces at its Lackawanna, N.Y. plant. The plant will be

Titanium

By John W. Stamper [1]

Growing domestic requirements for high performance, civilian and military aircraft resulted in a 23 percent increase in shipments of titanium mill products. Output of titanium pigment also increased markedly. A new ilmenite mine was opened in Georgia, however, two producers of ilmenite and rutile shut down mining operations in Florida and total output declined. Rutile output for the year was the lowest in 13 years.

Resurging demand for titanium metal in the United States and Europe resulted in increased output in all producing countries. Productive capacity was expanded 24 percent in Japan ar
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Table 1.—Salient titanium statistics

	1956-60 (average)	1961	1962'	1
United States:				
Ilmenite concentrate:				
Mine shipments short tons	702,005	782,629	809,037	8
Value...thousands	$14,783	$13,320	$13,974	$
Imports short tons	361,022	207,151	166,434	2
Consumption...do	844,636	929,147	944,797	8
Titanium slag:				
Consumption...do	132,060	130,184	138,205	1
Rutile concentrate:				
Mine shipments do	8,489	7,664	8,033	
Value...thousands	$1,067	$778	$933	
Imports short tons	44,554	27,497	35,966	
Consumption...do	33,979	29,548	31,749	
Sponge metal:				
Production...do	9,128	6,727	6,780	
Imports for consumption...do	2,289	2,490	925	
Consumption...do	6,549	6,991	7,136	
Price: Dec. 31 per pound	$2.00	$1.60	$1.50	
World production:				
Ilmenite concentrate short tons	1,923,860	2,331,500	2,170,220	2,1
Rutile concentrate...do	120,440	128,700	150,200	2

W Withheld to avoid disclosing individual company confidential dat

Legislation and Government Programs.—The Food and Drug Administration approved the use of titanium dioxide—synthetically prepared and free from admixtures of other substances—for coloring foods. The manufactured titanium dioxide may be used in p
by weight, with

[1] Commodity spe

[2] Oil, Paint and
From Paints Into
No. 5, Jan. 31, 19

DOMESTIC PRODUCTION

Concentrates.—Titanium Alloy Manufacturing Division of National Lead Co. (TAM) ceased production of ilmenite and rutile at Skinner, near Jacksonville, Fla., and the Florida Minerals Co. stopped production at Vero Beach, Fla. As a result total ilmenite output dropped below the record of 1 million tons produced in 1964 and rutile production was the lowest in 13 years.

In addition to TAM and Florida Minerals, American Cyanamid Co., Piney River, Va.; E. I. du Pont de Nemours & Co., Inc., Starke and Lawtey, Fla.; Humphrey Mining Co., Skinner, Fla.; and Folkston, Ga.; M&T Chemicals, Inc., Hanover County, Va.; National Lead Co., Tahawus, N.Y.; and The Glidden Co., Lakehurst, N.J. also produced ilmenite. Porter Brothers Corp. shipped ilmenite from stockpiles at Boise, Idaho. Rutile was produced by M&T Chemicals, Inc., at Beaver Dam, Hanover County, Va., and Florida Minerals at Vero, Fla.

The Humphrey Mining Co. began producing a mixed product containing ilmenite, rutile, and leucoxene at Folkson, Ga., for Du Pont. The plant operated on a 3-shift, 7-day week schedule with about 110 full-time workers. Mining was by dredging.

The Bureau of Mineral Research of Rutgers University and Mineral Sands, Inc., were studying the heavy minerals in certain areas of Barnegat Bay in New Jersey as a potential economic source of ilmenite.

Metal.—Output of titanium sponge metal increased for the 6th successive year.

Reactive Metals, Inc. began a program to double its titanium sponge metal capacity at Ashtabula, Ohio, to 5,000 tons per year. A number of new reduction vessels was to be installed, and capacity of its vacuum annealing furnaces at Niles, Ohio, will be doubled. New machines to be installed at Niles include a slab grinder, a large billet cutting machine, and two round bar straighteners. Part of the new facilities being added were expected to be in operation by January 1966. The company which is jointly owned by United States Steel Corp. and National Distillers & Chemical Corp. started operations at Niles in a new forge shop for production of titanium blooms, slabs, bars, and billets.

Oregon Metallurgical Corp. (Ormet), a titanium casting and ingot producer announced it would build a plant of undisclosed size to make titanium sponge metal at Albany, Oreg. Earlier in the year Ormet indicated that it expected a continuing high rate of growth in demand for titanium castings.

Howmet Corp. (formerly Howe Sound Co.) was expected to complete construction of a $650,000 plant to produce titanium castings at White Hall, Mich. The company reportedly will use graphite molds

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

Year	Production, short tons (gross weight)	Shipments		
		Short tons (gross weight)	Short tons TiO_2 content	Value (thousands)
Ilmenite: [1]				
1956–60 (average)	685,346	702,005	370,122	$14,783
1961	782,412	782,629	410,191	13,320
1962	807,725	809,037	420,606	13,974
1963	888,400	890,071	470,983	16,529
1964	r 1,001,132	1,003,997	526,042	19,178
1965	969,459	948,832	494,353	18,058
Rutile:				
1956–60 (average)	9,676	8,489	8,007	1,067
1961	9,045	7,664	7,251	778
1962	9,981	8,033	7,617	933
1963	11,915	11,311	10,839	1,262
1964	8,062	10,547	10,112	1,016
1965	W	W	W	W

W Withheld to avoid disclosing individual company confidential data.
[1] Includes a mixed product containing rutile, leucoxene, and altered ilmenite.

Table 3.—Titanium-meta

(Short tons)

	1961	1962
Sponge metal:		
Production	6,727	6,73(
Imports for consumption	2,490	92
Industry stocks	1,200	1,30(
Government stocks (DPA inventories)	22,461	22,46
Consumption	6,991	7,13(
Scrap-metal consumption	2,501	3,16(
Ingot: [1]		
Production	9,371	10,40(
Consumption	8,878	9,77
Mill shape production [2]	5,147	[3] 6,52

r Revised.
W Withheld to avoid disclosing individual company confide
[1] Includes alloy constituents.
[2] Bureau of the Census and Business and Defense Services
ports Series BDSAF-263(65).
[3] Net shipments derived by subtracting the sum of producer
industry's gross shipments of that shape. Data not comparal

in a process developed by Misco Precision Castings Co., Whitehall, and Péchiney Enterprises, Inc. (a U.S. subsidiary of Péchiney, Compagnie de Produits Chimiques et Electrometallurgiques of France). Péchiney also owns 40 percent of Howmet.

Titanium Metals Corporation of America (TMCA) completed the major portion of a new strip finishing facility at its Toronto, Ohio, titanium rolling mill and acquired a new sendzimir rolling mill, capable of producing titanium sheet up to 48 inches in width and down to 0.010 inch in thickness. Because of a strike at the end of the year, the company experienced a temporary work stoppage at its Henderson, Nev., facilities.

Aluminum Company of America (Alcoa), the world's largest producer of primary aluminum, announced that it would begin producing large titanium forgings at its special facilities at Cleveland, Ohio. Construction of the titanium facility was scheduled to start in 1965 and commercial production begun in mid–1967.

G. O. Carlson, Inc., began producing titanium plate and plate products at Thorndale, Pa.; Cameron Iron Works, Inc., Houston, Tex., reportedly made available heavy wall titanium pipe up to 30 inches in diameter and 30 feet in length.

Commercial producers of titanium sponge metal were Reactive Metals Inc., Ashtabula, Ohio, and TMCA, Henderson, Nev. Titanium melters were Harvey Aluminum, Inc., Torrance, Calif.; Reactive Metals Inc., Niles, Ohio; Oregon Metallurgical

Table 4.—Titanium pigment data (TiO_2 content)

Year	Production (short tons)	Shipments [1]	
		Quantity (short tons)	Value, f.o.b. (thousands)
1956–60 (average)	459,999	445,961	$238,673
1961	502,879	491,122	262,255
1962	523,201	513,822	270,438
1963	519,458	528,416	278,477
1964	r 558,536	549,329	288,031
1965	[2] 575,295	NA	NA

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

Source: Bureau of the Census.

rom its new chloride titanium dioxide plant, which when fully operated is expected to add about 45,000 tons per year to the company's titanium pigment capacity.

Welding-Rod Coating.—A total of 326,000 tons of welding rods, containing titaniferous materials in their coatings, was produced. Of the total output, 51 percent contained rutile; 15 percent, ilmenite; 21 percent, a mixture of rutile and manufactured titanium dioxide; 9 percent, manufactured titanium dioxide; 1 percent, slag; and 3 percent, miscellaneous mixtures.

CONSUMPTION

Concentrates.—Consumption of ilmenite, which was used chiefly for making titanium dioxide pigment, decreased 6 percent. The use of titanium slag, which is used mainly for the same purpose, increased. Rutile consumption, which is used principally for producing titanium metal and pigment and also in welding rod coatings, increased 48 percent.

Metal.—According to information on shipments of titanium mill products, the use of titanium metal was 23 percent higher than in 1964.

Demand for titanium compressor wheels, hubs, spacers, shafts, and blades for aircraft engines increased substantially because of increased requirements for both military and civilian aircraft. About 20,000 to 40,000 pounds (flight weight) of titanium per airplane was expected to be used in each of the frames and engines of the new C–5A air cargo carriers. Lockheed Aircraft Corp. scheduled production of 58 of the 350-ton C–5A's by 1968 or 1970.

Missile and space uses of titanium continued to be significant, although this sector comprised only 30 percent of the total market compared with about 50 percent in 1964 because of the completion of production schedules for the Mercury and Gemini spacecraft.

Following the trend of recent years industrial uses of titanium increased.

A 750,000-gallon-per-day water desalting plant reportedly utilized about 100 miles of titanium tubing. The plant was being built on St. Croix, Virgin Islands, by Westinghouse Electric Corp. and was said to be the first such plant to use titanium in the multistage flash evaporation section.

Titanium rods, 20 feet in length, were used to mark a 2-mile-long entrance to a deep-water port being built in the Caribbean.

Porous titanium metal filters for applications involving high temperatures, rapid thermal cycling and high differential pressures were available in disk, cylinder, tube, and sheet form and in pore sizes ranging from 30 microns to 1.0 micron. A large titanium producer offered complex or hollow extrusions of titanium with a maximum cross section of 5.25 inches, in weights to 100 pounds, and lengths to 30 feet.

The four principal outlets for titanium metal scrap were export, remelting (for ingot), steelmaking, and anodizing and electroplating accessory equipment.[3] Titanium scrap consists chiefly of trim from flat stock, mandrel wound bundles of sheet and strip edges, turnings, and slab ends. About one-half of the 7,000 tons of scrap generated in 1965 was remelted with titanium sponge metal and about one-fourth was exported. The rest was used in steelmaking and in the electroprocess industries.

The growing use of titanium castings, which have been produced in significant quantities only since 1956, was described.[4] By the end of 1962 the dollar volume of production of titanium castings for anticorrosive applications had jumped 1,100 percent over the comparable figure for 1959. In 1963 the price of titanium castings was lowered by an order of magnitude of 50 percent and sales were 15 times greater than in 1959. In 1964, sales were double those in 1963.

Pigments.—Consumption of titanium dioxide pigments on a gross weight basis and using shipments as a gage increased 5 percent.

[3] American Metal Market. Titanium Scene. Sec. 2 of v. 72, No. 53, Mar. 19, 1965. p. 29.

Table 5.—Consumption of titanium concentrates in the

(Short tons)

Year and product	Ilmenite [1]		Titaniu
	Gross weight	Estimated TiO_2 content	Gross weight
1956–60 (average)	844,636	443,825	132,060
1961	929,147	497,514	130,184
1962	944,797	501,196	138,205
1963	874,986	459,506	152,416
1964:			
Pigments	977,178	509,403	128,100
Titanium metal	[5]	[5]	----
Welding-rod coatings	576	341	103
Alloys and carbide	2,625	1,282	[6]
Ceramics	[3]	[3]	----
Fiberglas	----	----	----
Miscellaneous	47	27	----
Total	980,426	511,053	128,203
1965:			
Pigments	920,168	481,364	148,184
Titanium metal	----	----	----
Welding-rod coatings	[3]	[3]	[3]
Alloys and carbide	2,589	1,311	[6]
Ceramics	[3]	[3]	----
Fiberglas	----	----	----
Miscellaneous	547	327	----
Total	923,304	483,002	148,184

[1] Includes a mixed product containing rutile, leucoxene, and al
ments and metal.
[2] Included with "Miscellaneous" to avoid disclosing individual co
[3] Included with "Pigments" to avoid disclosing individual compa
[4] Included with "Fiberglas" to avoid disclosing individual compa
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of the Department of the Interior and Rand Corp. of Cleveland had been signed for the construction of a pilot plant using coal filters to purify municipal sewage wastes now being discharged into the Potomac River.

At the Meramec Mining Co. Pea Ridge mine 75 miles southwest of St. Louis, Mo., a water settler was installed when it was realized that mining the magnetite ore resulted in abrasive solids in the mine water that would cause rapid pump wear and fill the sumps with settled sludge. It was reported that the settling system did a good job and justified the cost of construction.[38]

A summarization was published[39] on the methods available for the treatment of liquid and gaseous effluents, and methods and processes that have been used or proposed to recover valuable products from plant wastes and to abate water pollution. Water recovered for reuse was reported to be ultimately the major valuable product because of increasing water supply and water treatment costs and mounting charges for using municipal sewage facilities.

In the past, in the treatment of mining wastes, attention was concentrated on pH control and on the removal of oil and other visible and nuisance pollutants. Few mines had availed themselves of biological methods for treating their wastes. An upsurge of interest in the use of these methods has been shown to solve a number of the oil industry's disposal problems. Recent studies established the usefulness of these methods in achieving satisfactory reduction in the biochemical oxygen demand (BOD) and in the phenols, residual oils, and other organics of the refinery waste liquors. The various methods and results of biological treatment available for dealing with aqueous mining wastes were reported.[40]

A study of the design and operation of thickening equipment for closed-water circuits in coal preparation plants indicated that they were justified from two standpoints: economical operation and prevention of stream pollution.[41] From this survey of 14 operating plants using thickeners for water recovery and refuse solid concentration, it was apparent that the gravitational thickener represented a dependable device for these two purposes. Chemical flocculants were required. Average cost of water recovery was 2½ cents per 1,000 gallons of water treated, or 23 cents per ton of dry refuse solids handled. It was concluded that by using gravitational thickeners, water was recovered at a very reasonable price, stream pollution was prevented, and a closed water circuit was achieved requiring a minimum of makeup water.

The National Aeronautics and Space Administration (NASA) drilled the second-deepest disposal well in the United States at its Michoud plant in New Orleans, La., where the gigantic Saturn launch vehicles for the Apollo program were being assembled. It is reported to be the only well that discharges into a water-sand stratum. Some 400,000 gallons per day of waste cleaning solutions and rinse water from cleansing of Saturn components was being injected in the disposal well. The cleaning agents include chromate as well as various acids and alkalis and could not be discharged to a nearby industrial canal because the chromates would harm oyster beds in the bay. Studies showed that the easiest and cheapest alternative for disposal of waste was in a deep well. Chemical and mineral industrial companies can profit by the reported experiences of NASA, the first to discharge their waste materials into a sand strata.[42]

The demand for fuller use of water resources dictated increased performance by waste treatment processes and the development of strong interest concerning the removal of constituents passed by biological processes. The means were reported[43] to be available to design units that will closely reproduce laboratory performance in the field, and that the scope of the chemical treatment has been expanded by the advent of a host of organic polymer coagulants.

[38] Monroe, H. K. Design of a Mine Water Settler at Pea Ridge. Min. Eng., v. 17, No. 12, December 1965, pp. 81–84.
[39] Rickles, Robert N. Waste Recovery and Pollution Abatement. Chem. Eng., v. 72, No. 20, Sept. 27, 1965, pp. 133–152.
[40] Sherwood, Peter W. Treatment of Waste Liquors. Min. Mag. (London), v. 112, No. 5, May 1965, pp. 304–309.
[41] Dale, L. A., and D. A. Dahlstrom. Design and Operation of Thickening Equipment for Closed-Water Circuits in Coal Preparation Plants. Trans. Soc. Min. Eng., v. 232, No. 2, June 1965, pp. 141–149.
[42] Chemical Week. Learning to Whip Well Woes. V. 96, No. 15, Apr. 10, 1965, pp. 113, 115.
[43] Parsons, William A. Chemical Treatment of Sewage and Industrial Wastes. Nat. Lime Assoc. Bull. 215, 1965, 139 pp.

Zinc

By Harold J. Schroed

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Record zinc consumption and smelter output highlighted an active year for the domestic zinc industry. Consumption in excess of new supplies reduced the stock level at producers to a 14-year low by April, leading to emergency releases from the Government stockpile.

The record smelter production was 1,078,000 tons, and in response to the demand for smelter feed, mine production increased 6 percent to 611,000 tons, the largest quantity since 1952. Producer stocks dropped from 31,000 to 29,000 tons while consumer stocks rose from 108,000 to 152,000 tons during the year.

Import quotas, established in 1958, were terminated during the latter part of the year. General imports of 428,000 tons for ores and concentrates and 153,000 tons for metal were the largest since 1962 and 1959, respectively. Exports of slab zinc decreased from 26,500 to 5,900 tons, the lowest since 1958.

Government stockpiles were reduced by 193,000 tons to a yearend total of 1.31 million tons.

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Rolling mills used 45,900 tons of slab zinc and remelted and rerolled 17,000 tons of metallic scrap produced in fabricating plants operated in connection with the rolling mills. In addition, a small quantity of purchased scrap (new clippings and old zinc) was melted and rolled. Small quantities of alloying metals were added for some uses. The rolled-zinc industry, however, classified these alloys as rolled zinc.

Net output of salable rolled zinc increased 4 percent to 44,700 tons. Stocks of rolled zinc at the mills declined to 1,600 tons by yearend. Besides shipments of 23,500 tons of rolled zinc, the rolling mills consumed 38,400 tons of rolled zinc in manufacturing 21,400 tons of semifabricated and finished products.

Rolled zinc was produced in the form of sheet, strip, ribbon, plate, rod, and wire. Its major domestic use was for dry-cell battery cases and similar cases for radio condensers and tube shields. Photoengraving plates, weatherstripping, roof flashing, and household electric fuses were other uses.

CONSUMPTION OF SLAB ZINC BY GEOGRAPHIC AREAS

Ohio, Pennsylvania, Indiana, and Illinois accounted for 58 percent of the slab zinc used in galvanizing. The iron and steel industry used zinc to galvanize steel sheets, wire, tube, pipe, cable, chain, bolts, railway-signal equipment, building and poleline hardware, and other items.

Table 15.—Consumption of zinc in the United States

(Short tons)

	1956–60 (average)	1961	1962	1963	1964	1965
Slab zinc	929,863	931,213	1,031,821	1,105,118	1,207,268	1,354,092
Ores (recoverable zinc content)	102,989	[1] 97,251	[1] 101,582	[1] 104,705	[1] 105,948	[1] 122,892
Secondary (recoverable zinc content)[2]	194,459	179,005	199,908	204,398	222,535	265,083
Total	1,226,811	1,207,469	1,333,311	1,414,216	1,535,751	1,742,067

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

Table 16.—Slab zinc consumption in the United States, by industry use

(Short tons)

Industry and product	1956–60 (average)	1961	1962	1963	1964	1965
Galvanizing:						
Sheet and strip	187,576	211,300	213,970	238,919	257,328	270,826
Wire and wire rope	37,181	37,608	38,208	39,466	42,798	43,884
Tubes and pipe	68,114	54,957	54,003	56,563	62,166	63,224
Fittings	9,804	6,540	8,039	7,787	8,802	8,641
Other	81,476	[1] 71,672	[1] 74,855	[1] 77,552	[1] 85,247	[1] 95,846
Total	384,150	382,077	388,570	420,287	456,336	482,421
Brass products:						
Sheet, strip, and plate	52,680	60,018	61,210	61,462	64,701	58,864
Rod and wire	35,190	41,018	41,875	43,517	47,246	45,510
Tube	11,108	10,168	10,627	10,786	10,402	10,030
Castings and billets	5,249	4,061	4,923	3,969	3,268	3,050
Copper-base ingots	8,253	12,874	10,884	7,784	8,565	7,402
Other copper-base products	784	384	286	719	923	1,992
Total	113,214	128,523	129,805	128,237	135,095	126,848
Zinc-base alloy:						
Die casting alloy	347,382	387,227	419,042	462,543	517,854	629,809
Dies and rod alloy	6,411	1,629	850	720	604	535
Slush and sand casting alloy	2,423	2,910	3,716	5,356	6,624	7,626
Total	356,216	341,766	423,608	468,619	524,582	637,970
Rolled zinc	42,178	41,204	42,233	42,166	44,181	45,882
Zinc oxide	17,352	18,137	18,517	16,037	19,991	26,781
Other uses:						
Wet batteries	1,184	1,058	1,133	1,216	1,168	1,188
Desilverizing lead	2,548	2,630	2,302	2,095	2,393	2,444
Light-metal alloys	4,198	4,347	4,920	5,660	4,769	8,124
Other[2]	8,324	11,471	20,733	20,796	18,753	23,434
Total	16,254	19,505	29,088	29,767	27,083	35,190
Grand total	929,364	931,213	1,031,821	1,105,118	1,207,268	1,354,092

[1] Includes 30,954 tons used in job galvanizing in 1961, 34,871 tons in 1962, 39,223 tons in 1963, 44,354 tons in 1964, and 51,011 tons in 1965.
[2] Includes zinc used in making zinc dust, bronze powder, alloys, chemicals, castings, and miscellaneous uses not elsewhere mentioned.

Table 17.—Slab zinc consumption in the United States in

(Short tons)

Industry	Special High Grade	High Grade	Intermediate	Brass Special	Se
Galvanizing	27,517	34,601	1,880	104,821	1,
Brass and bronze	26,247	67,425	264	3,771	1,
Zinc-base alloys	631,748	2,788	99		
Rolled zinc	22,187	10,360	5,844	7,945	
Zinc oxide	7,035	4			
Other	15,981	1,629	252	10,117	
Total	730,715	116,807	7,839	126,654	2,

Table 18.—Rolled zinc produced and quantity available for

	1964		
	Short tons	Value Total	Value Aver per poun
Production: [1]			
Photoengraving plate	(2)	(2)	(2)
Other plate [2]	W	W	W
Sheet [2]	15,588	$7,929,548	$0.25
Strip and foil	25,580	11,269,881	.22
Rod and wire	W	W	W
Total rolled zinc	42,964	20,201,411	.23
Imports	1,774	526,990	.14
Exports	6,569	3,978,434	.60
Available for consumption	38,819		
Value of slab zinc (all grades)			.13
Value added by rolling			.09

W Withheld to avoid disclosing individual company confidential
[1] Figures represent net production. In addition, 14,550 tons in rerolled from scrap originating in fabricating plants operating in
[2] Included in sheet category in 1964.
[3] In 1964 material 0.1 inch or thicker was classed as plate and was classed as sheet. In 1965 material 0.375 inch or thicker was less than 0.375 inch thick was classed as sheet.

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Table 19.—Slab zinc consumption in the United States in 1965, by industries and States
(Short tons)

State	Galvanizers	Brass mills [1]	Die casters [2]	Other [3]	Total
Alabama	40,952	W	------	W	42,576
Arizona	W	------	------	W	W
Arkansas	------	------	------	W	W
California	33,825	2,502	10,700	618	47,645
Colorado	W	W	W	W	3,698
Connecticut	3,580	39,391	W	W	46,084
Delaware	W	W	W	W	W
Florida	2,572	------	W	------	W
Georgia	W	------	W	------	W
Hawaii	W	------	------	------	W
Idaho	------	------	W	W	W
Illinois	47,865	18,441	89,886	W	178,052
Indiana	64,656	W	54,467	W	146,176
Iowa	825	------	------	W	W
Kansas	------	------	W	------	W
Kentucky	W	W	------	W	16,334
Louisiana	1,917	------	------	W	W
Maine	W	------	------	------	W
Maryland	W	W	------	W	32,632
Massachusetts	8,888	W	------	W	8,174
Michigan	4,724	12,853	170,810	W	189,798
Minnesota	2,281	------	------	------	2,281
Mississippi	W	------	------	------	W
Missouri	6,728	W	7,588	W	17,723
Nebraska	W	W	------	W	1,766
New Hampshire	------	W	------	------	W
New Jersey	3,764	6,140	W	3,041	W
New York	5,898	7,497	71,712	W	93,156
North Carolina	W	------	W	------	W
Ohio	94,728	W	99,678	1,257	W
Oklahoma	3,643	------	W	W	8,078
Oregon	499	W	W	W	600
Pennsylvania	70,448	W	22,151	W	134,725
Rhode Island	553	W	------	W	588
Tennessee	864	------	W	W	2,692
Texas	14,487	W	W	W	50,263
Utah	W	W	------	------	W
Virginia	356	W	W	W	1,396
Washington	1,165	------	------	W	2,266
West Virginia	13,468	W	------	W	15,395
Wisconsin	1,722	W	W	W	17,128
Undistributed	53,551	38,521	110,382	101,447	287,139
Total [4]	478,339	125,345	636,258	106,363	1,346,305

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

Table 20.—Production and shipments of zinc pigments and compounds [1] in the United States

Pigment or compound	1964				1965			
	Production (short tons)	Shipments			Production (short tons)	Shipments		
		Short tons	Value [2]			Short tons	Value [2]	
			Total	Average per ton			Total	Average per ton
Zinc oxide [3]	163,305	174,308	$41,970,758	$241	187,829	186,570	$48,751,733	$261
Leaded zinc oxide [4]	12,237	13,613	3,246,038	238	12,554	11,850	3,736,226	315
Zinc chloride, 50° B [5]	50,977	49,624	W	W	52,635	54,296	W	W
Zinc sulfate	46,814	46,606	7,021,601	151	53,104	50,544	7,340,632	145

W Withheld to avoid disclosing individual company confidential data.
[1] Excludes lithopone; figure withheld to avoid disclosing individual company confidential data.
[2] Value at plant, exclusive of container.
[3] Zinc oxide containing 5 percent or more lead is classed as leaded zinc oxide.
[4] Includes zinc chloride equivalent of zinc ammonium chloride and chromated zinc chloride.

Pigments and compounds were made from various zinc-bearing materials including ore, slab zinc, scrap, and residues. Plants producing zinc pigments and compounds numbered 16 for zinc oxide, 8 for zinc sulfate, 8 for zinc chloride, and 1 for lithopone.

Lead-free zinc oxide was made by several processes; 67 percent was made from ores and residues by the American process, 20 percent from metal by the French process, and 13 percent from scrap residues and secondary materials by other processes.

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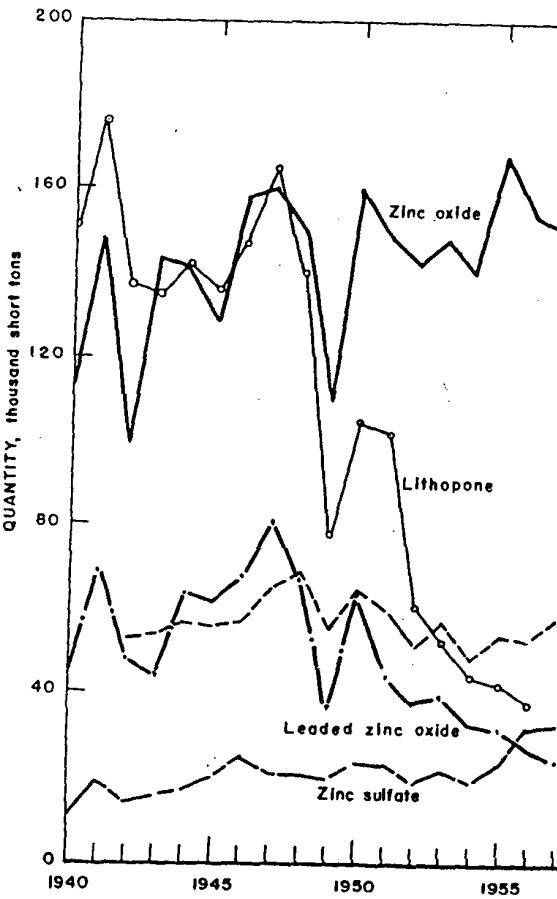

Figure 2.—Trends in shipments of zinc pi

and barium sulfate, was produced but figures are withheld to avoid disclosing individual company confidential data.

Consumption and Uses.—Shipments of lead-free zinc oxide were 186,600 tons, 7 percent more than in 1964 with most of the increase in shipment to the rubber industry. The quantity received by the rubber, paint, and ceramic industries accounted for 77 percent of the total shipped.

The paint industry received 92 percent of the 11,900 tons of leaded zinc oxide shipped.

Lithopone was used principally in paint, varnish and lacquer, chemicals, paper, rubber, and floor coverings.

The principal uses of zinc chloride were for battery making, galvanizing, vulcanizing fiber, preserving wood, and refining oil, as well as for fungicides, solder, and tinning fluxes.

The chief uses of zinc sulfate were in rayon and agriculture. Other uses were in glue manufacture, flotation reagents, rubber, and medicine.

Prices.—Prices for French process, lead-free zinc oxides advanced 0.50 cent in March to a yearend quotation in cents per pound in carlots, freight allowed, of 17.00 cents for Green Seal grade and 17.25 cents for White Seal grade. American process, lead-free zinc oxide, leaded zinc oxide of the 35-percent grade, and leaded zinc oxide of the 50-percent grade were quoted at 14.75, 15.75, and 16.00 cents, respectively, throughout the year.

Zinc chloride (50° Baumé) was quoted at 5.55 cents per pound throughout the year. Zinc sulfate (monohydrate, 36 percent) in less than carlots was quoted at 9.50 cents per pound until March 29 when it increased to 10.25 cents where it remained for the balance of the year.

Foreign Trade.—Exports of zinc oxide increased 9 percent with shipments to 43 countries. Canada, Turkey, and Colombia received 31, 17, and 14 percent of the total, respectively. Lithopone exports declined to half the since 196

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Table 21.—Zinc content of zinc pigments[1] and compounds produced by domestic manufacturers, by sources
(Short tons)

Pigment or compound	1964					1965				
	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	
	Domestic	Foreign				Domestic	Foreign			
Zinc oxide	70,728	18,487	19,991	26,136	130,342	80,899	19,064	25,782	24,683	149,918
Leaded zinc oxide	4,714	2,780	-----	-----	7,494	4,942	2,854	-----	-----	7,796
Total	75,442	16,267	19,991	26,136	137,836	85,841	21,908	25,782	24,688	157,714
Zinc chloride[2]	-----	-----	W	W	12,315	-----	-----	W	W	12,740
Zinc sulfate	W	W	-----	6,206	14,921	W	W	-----	9,059	17,925

W Withheld to avoid disclosing individual company confidential data.
[1] Excludes zinc sulfide and lithopone; figures withheld to avoid disclosing individual company confidential data.
[2] Includes zinc content of zinc ammonium chloride and chromated zinc chloride.

Table 22.—Distribution of zinc oxide and leaded zinc oxide shipments, by industries
(Short tons)

Industry	1956–60 (average)	1961	1962	1963	1964	1965
Zinc oxide:						
Rubber	77,001	71,534	80,247	82,776	98,568	108,057
Paints	32,748	30,405	31,881	34,382	31,176	30,249
Ceramics	9,608	10,068	11,092	9,381	9,447	10,009
Chemicals	NA	NA	NA	NA	NA	11,365
Agriculture	NA	NA	NA	NA	NA	977
Photocopying	NA	NA	NA	NA	NA	W
Coated fabrics and textiles[1]	8,571	1,185	202	W	W	W
Floor covering	1,236	1,174	457	W	438	868
Other and unspecified	24,081	30,852	31,470	35,732	39,674	30,550
Total	148,245	145,208	154,849	162,271	174,303	186,570
Leaded zinc oxide:						
Paints	22,428	16,533	14,959	14,899	13,124	10,951
Rubber	889	1,474	735	574	489	899
Other and unspecified						
Total	23,312	18,007	15,694	15,473	13,613	11,850

W Withheld to avoid disclosing individual company confidential data, included with "Other."
NA Not available.
[1] Figures for 1959–62 for rayon withheld to avoid disclosing individual company confidential data.

Table 23.—Distribution of zinc sulfate shi
(Short tons)

Year	Rayon		Agriculture	
	Gross weight	Dry basis	Gross weight	Dry basis
1956–60 (average)	20,514	18,362	7,595	6,683
1961	12,284	11,007	5,678	5,086
1962	W	W	8,544	7,818
1963	W	W	10,785	9,407
1964	18,066	16,103	11,248	9,807
1965	21,204	18,886	14,381	12,449

W Withheld to avoid disclosing individual company confiden

Table 2

Kind	
Zinc oxide	
Lithopone	
Total	

Table 25.—U.S. imports for consumption of zinc

Kind	1964	
	Short tons	V (thou
Zinc oxide	8,708	$1,
Zinc sulfide	893	
Lithopone	172	
Zinc chloride	1,200	
Zinc sulfate	1,246	
Zinc cyanide	59	
Zinc compounds, n.s.p.f.	653	
Total	12,480	2,

STOCKS

Producer Stocks.—Stocks of slab zinc at producer plants were 31,200 tons at the beginning of the year, declined to a low of about 20,000 tons at the end of April, then increased to 28,600 tons by yearend. This was the lowest yearend stocks recorded since 1951.

Consumer Stocks.—Stocks of slab zinc at consumer p of the year tons by th rapid build 151,900 ton ment stock reversing th stocks durin