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METALS AN

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Prepared by the staff of the
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Sillimanite deposits occur in Assam. The minimum reserves were estimated at 250,000 tons. Sillimanite brick sold for US$50.36 per hundred.

TABLE 3.—Production of sillimanite in India, 1952–56, in short tons [1]

Year	Short tons	Year	Short tons
1952	5,685	1955	2,714
1953	6,150	1956	5,000
1954	3,434		

[1] Bureau of Mines, Mineral Trade Notes: Vol. 46, No. 4, April 1958, Spec. Suppl. 52, p. 8.

Kenya.—During the first part of 1957 reorganization of Kenya Kyanite, Ltd., was begun by the new owner, G. F. K. Refractories, Ltd., a subsidiary of New Consolidated Goldfields, Ltd. Kenya Kyanite, Ltd., which had been in technical difficulties for several years, went into receivership in July 1955.[4]

Union of South Africa.—The Pella corundum-sillimanite, an important reserve of refractory material with high alumina content, had been utilized since 1954 for manufacturing furnace linings in West Germany.[5]

The Pella West deposits lie between the Bushmanland Plateau in the south and the highly dissected valley of the Orange River, which passes about 8 miles to the north, on a flat, low-lying, partly sand-covered terrace in the southwestern corner of the Pella Mission Farm. The farm is in the Namaqualand district about 90 miles from Springbok and about 108 miles from the railroad at Kakamas, in the Northwestern Cape Province of the Union of South Africa.

The available reserves of the Pella deposits totaled approximately 400,000 short tons at the end of June 1955, equivalent to 33 years' production, at the rate of 1,000 tons a month.

The average chemical composition is: SiO_2, 19.68; Al_2O_3, 74.65; Fe_2O_3, 1.63; TiO_2, 2.49; and ignition loss, 1.28 percent.

TECHNOLOGY

The new Willis Mountain plant of Kyanite Mining Corp. near Dillwyn, Buckingham County, Va., was completed and began operating full scale. Potential plant capacity may double the output of kyanite concentrate by the company. Mining was by open pit, and the ore was concentrated by froth flotation. Byproducts were sand and pyrites.

Chas. Taylor Sons Co. rebuilt its batching and grinding system and its screening system, with installation of controlled batching, at the Taylor, Ky., plant. These new facilities made it possible to produce mullite brick and shapes and special mullite refractories, including high-temperature cements and ramming mixtures, using fused mullite, sintered bauxite (domestic and imported), and calcined Indian kyanite in any desired proportions. The company was preparing to produce sintered mullite from Bayer alumina and other aluminous and siliceous raw materials.[6]

[4] Bureau of Mines, Mineral Trade Notes: Vol. 45, No. 1, July 1957, p. 20.
[5] Bureau of Mines, Mineral Trade Notes: Vol. 44, No. 2, February 1957, pp. 23–24.
[6] Chas. Taylor Sons Co., Letter to the Bureau of Mines, Apr. 7, 1958.

Lead

By O. M. Bishop [1] and Edith E

CONTINUED supply in excess of impending cutback in United State of lead, and increasing industry stock both the United States and the foreign le

Lead supply in the United States was more than in 1956, and 211,000 tons Domestic mine production and secondar clined about 4 percent, but total import 14 percent from 459,000 to 522,000 tons. consumers' stocks of lead increased 54,0 tons of foreign lead acquired through ba to the Government supplemental stockpi

Other lead acquisitions to the Governm public, but on August 1 the Office of D announced that at the then current rat term objective for lead (and zinc) would In late April the Commodity Credit Co that no further lead and zinc barter co the program had been evaluated. I negotiations were again authorized, th restrictive terms that sharply delimite British Government announced it woul lead (and 27,000 tons of zinc) from its s of these announcements, growing stoc consumption, the price of lead dropped

[1] Commodity specialist.
[2] Statistical assistant.

a price that had prevailed since January 13, 1956—to 15.5 cents on May 9, 1957, 15.0 cents on May 16, 14.0 cents on June 11, 13.5 cents on October 14, and 13.0 cents on December 2. Zinc prices between May 6 and July 1 were dropped from 13.0 to 10.0 cents a pound. Almost at once domestic mining companies began to curtail operations or shut down mines, and output of recoverable lead in the last quarter of 1957 was down 13 percent from that of the first quarter. Production of 534,000 tons refined lead from domestic and foreign ores was the second greatest quantity refined since 1942.

LEGISLATION AND GOVERNMENT PROGRAMS

Government programs affecting lead chiefly related to stockpiling and mineral exploration or to mobilization plans. Under the Provisions of the Defense Production Act of 1950, as amended, exploration continued to be carried out by the Defense Minerals Exploration Administration (DMEA), and the procurement for the national stockpile was continued by the General Services Administration (GSA) while the Office of Minerals Mobilization (OMM) continued evaluation of metal and mineral supply versus requirements and the development of mobilization programs. Lead was also acquired by the Federal Government through the barter program authorized under the Agricultural Trade Development and Assistance Act of 1954.

DEFENSE MINERALS EXPLORATION ADMINISTRATION

The DMEA program to encourage exploration and increase domestic reserves of strategic and critical minerals and metals was continued throughout 1957. DMEA provided 50 percent of the approved cost of exploration contracts for lead and zinc.

During 1957, 15 new contracts were executed for exploration, altogether costing $2,150,000. Amendments to existing lead-zinc

TABLE 1.—Salient statistics of the lead industry in the United States, 1948–52 (average) and 1953–57, in short tons

	1948–52 (average)	1953	1954	1955	1956	1957
Production of refined primary lead:						
From domestic ores and base bullion	377,734	328,012	322,271	321,132	349,188	347,675
From foreign ores and base bullion	78,844	139,879	164,441	158,025	193,120	185,858
Total	456,578	467,891	486,712	479,157	542,308	533,533
Recovery of secondary lead	476,787	486,737	480,925	502,051	506,755	489,229
Imports (general):						
Lead in pigs, bars, and old	347,792	390,510	281,941	284,729	283,392	333,526
Lead in base bullion	3,143	869	41	.....	31	84
Lead in ores and matte	83,971	160,899	161,261	177,479	196,452	197,831
Exports of refined pig lead	1,432	803	596	403	4,628	4,339
Consumption of primary and secondary lead	1,120,028	1,201,604	1,004,871	1,212,644	1,209,717	1,138,115
Prices (cents per pound):						
New York:						
Average for period	16.13	13.48	14.05	15.14	16.01	14.66
Quotation at end of period	16.72	13.50	15.00	15.54	16.00	13.00
London average for period	16.89	11.48	12.08	13.19	14.52	12.05
Mine production of recoverable lead [1]	401,907	342,644	325,419	338,025	352,626	338,216
World smelter production of lead	1,780,000	2,060,000	[2]2,200,000	2,220,000	2,370,000	2,490,000

[1] Includes Alaska.
[2] Revised figure.

exploration contracts made during the
$1,095,000, or a total of $3,245,000 for
the program in 1951, 257 contracts i
executed, which authorized Governm
million and combined Government and
million. Ore discoveries were certified
explored; discoveries ranged from seve
lead ore to one of more than 35 millio
Tennessee. A list of DMEA contracts
in 1957, as in previous years, is given
volume.

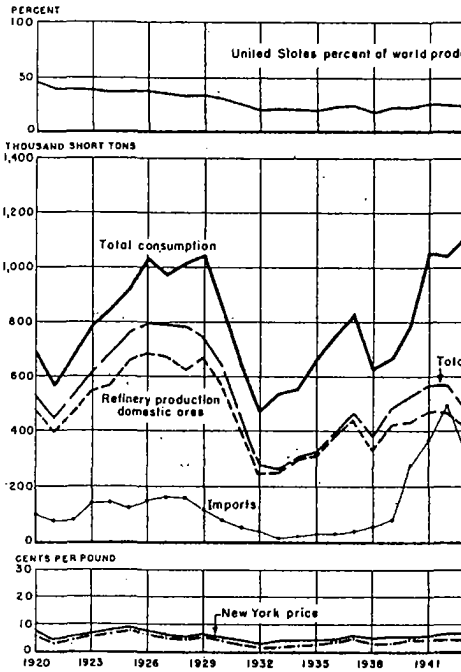

FIGURE 1.—Trends in the lead industry in th
sumption includes primary refined, antimon
in pigments made directly from ore. Impor
cent of the lead content of ores, mattes, and
pigs, bars, base bullion, and scrap.

GOVERNMENT BARTER

Under authority of Public Law 480 (1
zation of May 1956, the Department of A
the Commodity Credit Corporation, co
surplus agricultural products for zinc and
origin. In 1957 the CCC contracted fo
tons in 1956) to be added to the Governi

On April 30 the Department of Agriculture ceased making new barter agreements, pending an evaluation of its program. On May 28 the program was resumed under restrictions to assure that agricultural commodities traded were in addition to marketings that would otherwise have taken place. Relatively few barter contracts were made after April 30 under the modified program.

GENERAL SERVICES ADMINISTRATION

The General Services Administration (GSA) continued to be responsible for stockpile procurement and administration, procurement under foreign-aid programs as agent of the International Cooperation Administration (ICA), and for administration of Defense Production Act programs, including domestic purchase programs. Purchases of lead produced from domestic ores were made against the long-term stockpile objective for lead throughout 1957. The quantities purchased were not made public.

Foreign lead received at GSA warehouses under barter agreements during the year totaled 100,075 tons (29,899 tons in 1956). This lead was credited to the "supplemental" stockpile and cannot be released except by an act of Congress.

DOMESTIC PRODUCTION

Lead output is compiled on both a mine and smelter-refinery basis. Mine output is the sum of the lead recovered from all domestic lead ores, concentrates, mill tailings, and smelter residues or slags. The recovery at smelters, refineries, and other processing plants in the United States in 1957 averaged 97.8 percent of the lead content of the lead-bearing primary material processed.

Pig-lead output, as reported by smelters and refineries, represents actual lead recovered. Smelter and refinery output from domestic ores usually differs from the mine-production figure, because there is a lag between mine shipments and smelter treatment of ore and concentrate and because 3,000 to 5,000 tons of lead concentrate is used directly in manufacturing pigment.

MINE PRODUCTION

Mines in the United States produced 338,200 tons of recoverable lead in 1957—4 percent less than in 1956. The average monthly production rate through April, when lead sold at 16.0 cents a pound, was 4 percent above the monthly rate of 1956. Monthly production declined thereafter in response to drops in price; by December output was 26,000 tons or only 82 percent of that in April. Missouri for the 51st year ranked first as a lead-producing State. For the same years Idaho ranked second and Utah third (except from 1925–27, when Utah was second and Idaho third). Together these 3 States produced 72 percent of the domestic mine production of lead in 1957 and 67 percent in 1956.

Western States.—Mines of the Western States produced 56 percent of the total domestic mine output, the same proportion as in 1956. Sharp declines in Montana, California, New Mexico, Utah, and Nevada were not wholly offset by increases in Idaho, Washington,

TABLE 2.—Ores yielding lead and zinc in the United States in 1957, in short tons [1]

State	Lead ore			Zinc ore			Lead-zinc ore			Copper-lead, copper-zinc, and copper-lead-zinc ores			Total		
	Gross weight	Lead	Zinc	Gross weight	Lead	Zinc	Gross weight	Lead	Zinc	Gross weight	Lead	Zinc	Ore, gross weight	Lead	Zinc
Western States and Alaska:															
Alaska	55	9											55	9	
Arizona	9,762	1,722	132	7,072		1,464	371,412	10,497	23,542	91,059	195	8,754	479,305	12,414	33,892
California	1,669	396	2				68,153	3,042	2,961				69,762	3,438	2,963
Colorado	25,935	1,259	47	785	9	62	422,610	10,914	33,637	499,562	8,525	13,254	948,892	20,707	47,000
Idaho	55,897	2,825	148				1,157,206	61,978	48,441	22	4		1,213,125	64,807	48,589
Montana	7,003	926	114	632,397	9,706	43,574	32,964	1,841	1,641				672,364	12,473	45,329
Nevada	23,055	3,666	303	1,003	12	104	60,438	1,281	4,754	33	2		84,529	4,961	5,161
New Mexico	902	102	12	327,591	1,655	22,705	82,582	3,076	9,962				411,075	4,833	32,679
Utah	34,680	2,897	259	20	1	5	543,577	39,844	38,845	44		8	578,321	42,742	39,117
Washington	110	72					1,199,578	12,658	23,453				1,189,688	12,730	23,453
Total	159,008	13,874	1,017	968,868	11,383	67,914	3,928,520	145,131	187,236	590,720	8,726	22,016	5,647,116	179,114	278,183
West Central States:															
Kansas	2,607	49	2	531,008	1,522	10,012	399,954	2,686	5,845	[2] 354,764	6,751		933,569	4,257	15,859
Missouri	[3] 7,265,023	107,276	2,006	2,900	85		523,705	12,226	2,951				8,145,692	126,263	2,951
Oklahoma	92,607	1,480	422	236,587	722	5,246	568,779	4,981	9,283				899,973	7,183	14,951
Total	7,360,237	108,805	2,430	772,495	2,244	15,343	1,491,738	19,903	15,988	354,764	6,751		9,979,234	137,703	33,761

Colorado, and Arizona; the group as a whole produced 7,400 tons less than in 1956.

Lead output in Idaho increased to 71,600 tons, the highest level since 1953. Increased output was reported by most of the principal operators. The Bunker Hill mine of the Bunker Hill Co. and the Page mine owned by American Smelting & Refining Co., recorded the largest gains. However, the decline in lead prices during the latter half of the year caused production cutbacks and closures. Idaho mines shut down in 1957 included the Hull lease on the Frisco mine, the Nabob Silver Lead mine, and the Triumph Mining Co. operation. In mid-December the Bunker Hill Co. announced curtailment of its production in the Coeur d'Alene region.

Output of recoverable lead in Utah declined 10 percent, to 44,500 tons, because of the closing of the Eagle-Blue Bell, Chief No. 1, the Plutus mines in June, and the Mayflower-Park Galena (New Park) mines in September. The United States and Lark mine unit continued to be the largest producer in the State. Other important producers in 1957 were United Park City, Mayflower-Park Galena, Calumet, Ophir, and Eagle-Blue Bell mines.

TABLE 3.—Mine production of recoverable lead in the United States, 1948–52 (average) and 1953–57, by States, in short tons

	1948–52 (average)	1953	1954	1955	1956	1957
Western States and Alaska:						
Alaska	110	9		1	1	9
Arizona	24,753	9,428	8,385	9,817	11,099	12,441
California	12,085	8,664	2,671	8,266	9,296	3,458
Colorado	27,881	21,764	17,823	15,805	19,856	21,003
Idaho	83,600	74,610	69,302	64,163	64,321	71,637
Montana	19,721	19,949	14,820	17,028	18,642	13,300
Nevada	8,750	4,371	3,041	3,291	6,384	5,979
New Mexico	5,864	2,943	887	3,296	6,042	5,204
Oregon	8	5	5	3	5	5
South Dakota	5	10				
Texas	106					
Utah	50,887	41,522	44,972	50,452	49,555	44,471
Washington	8,720	11,064	9,938	10,340	11,657	12,734
Wyoming						
Total	242,559	194,329	171,844	182,461	197,758	190,331
West Central States:						
Arkansas	14					
Kansas	8,502	3,347	4,033	5,498	7,635	4,257
Missouri	123,476	125,895	125,250	125,412	123,783	126,345
Oklahoma	17,842	9,304	14,204	14,126	12,350	7,183
Total	149,834	138,546	143,487	145,036	143,768	137,785
States east of the Mississippi River:						
Illinois	3,534	3,301	3,232	4,544	3,832	2,070
Kentucky	127	52	80		228	411
New York	1,331	1,435	1,187	1,037	1,608	1,667
Tennessee	80	9			5	
Virginia [1]	3,314	2,788	4,324	2,090	3,045	3,152
Wisconsin	1,128	2,004	[2] 1,265	1,048	2,582	1,000
Total	9,514	9,769	10,088	10,528	11,300	10,100
Grand total	401,907	342,644	325,419	338,025	352,820	338,216

[1] Includes 4 tons from North Carolina in 1954, 2 tons in 1955, 10 tons in 1956, and 9 tons in 1957.
[2] Includes 4 tons from Iowa.

Colorado output of lead increased 6 percent to 21,000 tons in 1957. The Idarado Mining Co. mine group continued to be the largest producer in the State. Other important produ
mine of the New Jersey Zinc Co. (Eagle Co
mine of the American Smelting & Refining
Mines closed after price declines included
Rico group of Rico Argentine Mining Co., and
of Ressurrection Mining Co.

Montana mine production of lead totaled
less than in 1956 and was the smallest since 19
closed several of its lead-zinc mines in the Bu
County) in the second half of 1957 and postpo
expansion program. Production from other
cipally the Jack Waite and Hand (Maulden)
essentially the same rate as in 1956.

Lead output in Washington increased 9 pe
largest production on record. The principal
Pend Oreille Mines & Metals Co. lead-zinc
County. Other mines that produced consi
predominantly zinc producers were the Gra
Lead & Smelting Co.) in Pend Oreille Cou
(American Smelting & Refining Co.). The Va
in early July 1957.

Although several Arizona mines closed durin
of lead increased 4 percent to 12,400 tons. T
Iron King mine, operated continuously. O
producers, the San Xavier mine suspended
Head Center (Athletic) in July, and the Tren

California production dropped from 9,300 to
in 1957. The Anaconda Co. Darwin and Sho
State's only large lead producers, suspended o
year zinc and lead price declines.

In Nevada Combined Metals Reduction
Pioche in August, contributing to a 6-percent
duction during 1957. New Mexico mines re
crease in lead output. The State's principal le
the Ground Hog mine of American Smelting &
July, pending higher metal prices.

West Central States.—Kansas, Missouri,
yielded 137,800 tons of recoverable lead in 1
United States domestic total. All productio
States came from the southeast Missouri lead
district of Kansas, Oklahoma, and southweste

Mines in southeast Missouri produced 3
domestic mine output of lead in 1957—esse
1956. The St. Joseph Lead Co., the largest le
in the Nation on a mine basis, maintained stea
Terre, Desloge, Federal, and Leadwood mine-m
County and the Indian Creek mine and mill i
In Madison County the Mine La Motte C
Lead Co. each operated a mine group and m
National Lead Co. also yielded byproduct cop

Output of recoverable lead in the Tri-State zi
from 20,400 tons in 1956 to 11,500 tons in 1957
service was initiated in the 1870's. Nearly a

were closed, following the sharp declines in lead and zinc prices. The Nellie B mine of the American Zinc, Lead & Smelting Co. was closed in May, and the Eagle-Picher Co. operated its mines and central custom mill only intermittently. The National Lead Co., second largest producer in the district, operated its Ballard-mine group and mill throughout the year.

States East of the Mississippi River.—Lead was recovered from ores in Illinois, Wisconsin, Kentucky, New York, and Virginia in 1957; but production was 11 percent less than in 1956, owing to cutbacks and closures in the Illinois-Wisconsin district. American Zinc, Lead & Smelting Co. closed its Vinegar Hill Division mines and mill in Wisconsin; Eagle-Picher Co. closed the Linden mine and mill and curtailed activity elsewhere in the district. Tri-State Zinc, Inc., 1 of the 3 leading producers, maintained a fairly high production. Lead-bearing zinc ores of New York and Virginia yielded 4,800 tons of lead in 1957. St. Joseph Lead Co. operated its Balmat mine steadily

TABLE 4.—Mine production of recoverable lead in the United States, 1948–52 (average) and 1953–57, by districts or regions that produced 1,000 tons or more during any year, 1953–57, in short tons

District or region	State	1948–52 (average)	1953	1954	1955	1956	1957
Southeastern Missouri region.	Missouri	121,173	125,273	126,173	126,357	123,396	120,323
Coeur d'Alene region	Idaho	77,807	60,885	64,812	59,820	60,221	67,125
West Mountain (Bingham)	Utah	30,838	29,311	29,671	31,712	32,801	29,490
Metaline	Washington	5,173	8,604	(1)	(1)	9,440	11,071
Tri-State (Joplin region)	Kansas, southwestern Missouri, Oklahoma.	28,641	13,273	18,314	19,679	20,373	11,462
Summit Valley (Butte)	Montana	14,634	16,767	11,516	14,331	14,089	9,617
Park City region	Utah	9,601	4,735	5,432	9,054	9,147	9,421
Upper San Miguel	Colorado	6,607	7,440	5,574	5,008	(1)	7,721
Red Cliff	do	2,617	2,500	2,588	3,171	(1)	4,477
California (Leadville)	do	5,567	3,072	1,935	1,404	1,660	3,694
Upper Mississippi Valley	Iowa, northern Illinois, Wisconsin.	2,222	3,688	3,229	3,809	4,306	3,691
Central	New Mexico	3,231	1,460	5	2,604	4,682	3,519
Austinville	Virginia	3,314	2,788	4,320	2,997	3,035	3,143
Creede	Colorado	1,143	1,696	2,178	1,192	1,266	2,231
Rush Valley & Smelter (Tooele County).	Utah	2,760	2,763	2,454	1,607	2,529	1,977
Tintic	do	5,800	3,590	5,926	5,017	3,061	1,775
St. Lawrence County	New York	1,330	1,435	1,187	1,037	1,608	1,667
Kentucky-Southern Illinois.	Kentucky-southern Illinois.	2,524	1,849	1,348	2,683	2,336	1,590
Ophir	Utah	908	1,157	1,159	(1)	(1)	1,418
Bayhorse	Idaho	1,491	1,484	1,372	1,367	1,607	1,351
Warm Springs	do	2,566	2,583	2,415	2,388	1,804	1,293
Magdalena	New Mexico	1,393	-------	47	05	088	1,214
Tyndall	Arizona	86	234	202	506	894	1,162
Las Vegas	Nevada	-------	-------	-------	956	2,698	858
Pima (Sierritas, Papago, Twin Buttes).	Arizona	3,169	-------	1	1,105	1,810	760
Northport (Aladdin)	Washington	837	2,165	1,275	2,212	2,085	722
Animas	Colorado	3,063	1,212	-------	-------	-------	508
Hansonberg	New Mexico	460	1,031	800	517	413	455
Breckenridge	Colorado	300	1,056	1,000	474	553	272
Big Bug [2]	Arizona	3,707	4,339	4,336	4,612	5,776	(1)
Eureka	Nevada	18	-------	(1)	828	(1)	(1)
Coso (Darwin)	California	6,805	8,260	(1)	(1)	(1)	(1)
Harshaw	Arizona	1,813	2,104	2,135	(1)	(1)	(1)
Eagle	Montana	819	1,179	-------	706	1,207	(1)
Plochie	Nevada	5,677	3,306	(1)	(1)	(1)	(1)
Elk Mountain	Colorado	104	-------	(1)	(1)	(1)	(1)
Resting Springs	California	(1)	-------	-------	22	(1)	(1)
Pioneer (Rico)	Colorado	1,883	1,871	2,177	(1)	(1)	(1)
Sneffels	do	905	1,307	1,113	634	525	-------

[1] Figure not shown to avoid disclosure of individual company operations.
[2] The following districts or regions are not listed in order of 1957 output.

TABLE 5.—Twenty-five leading lead-producing mines in the United States in 1957, in order of output

Rank	Mine	District or region	State	Operator	Type of ore
1	Federal	Southeastern Missouri	Missouri	St. Joseph Lead Co.	Lead.
2	Bunker Hill	Coeur d'Alene	Idaho	The Bunker Hill Co.	Lead-zinc.
3	United States & Lark	West Mountain (Bingham)	Utah	U. S. Smelting, Refining & Mining Co.	Do.
4	Leadwood	Southeastern Missouri	Missouri	St. Joseph Lead Co.	Lead.
5	Indian Creek	do	do	do	Do.
6	Desloge	do	do	do	Do.
7	Butte Mines	Summit Valley	Montana	The Anaconda Co.	Lead-zinc.
8	Pend Oreille	Metaline	Washington	Pend Oreille Mines & Metals Co.	Do.
9	Bonne Terre	Southeastern Missouri	Missouri	St. Joseph Lead Co.	Lead.
10	Treasury Tunnel-Black Bear-Smuggler Union.	Upper San Miguel	Colorado	Idarado Mining Co.	Copper-lead-zinc.
11	Star	Coeur d'Alene	Idaho	The Bunker Hill Co.	Lead-zinc.
12	Iron King	Big Bug	Arizona	Shattuck-Denn Mining Co.	Do.
13	Page	Coeur d'Alene	Idaho	American Smelting & Refining Co.	Do.
14	Mine La Motte	Southeastern Missouri	Missouri	St. Joseph Lead Co.	Lead.
15	Madison	do	do	National Lead Co.	Lead-copper.
16	United Park City	Uintah	Utah	United Park City Mines Co.	Lead-zinc.
17	Eagle	Red Cliff (Battle Mountain)	Colorado	The New Jersey Zinc Co.	Copper, lead-zinc.
18	Lucky Friday	Coeur d'Alene	Idaho	Lucky Friday Silver-Lead Mines, Inc.	Lead-zinc,
19	Austinville	Austinville	Virginia	The New Jersey Zinc Co.	Zinc-lead.
20	Grandview	Metaline	Washington	American Zinc, Lead & Smelting Co.	Lead-zinc.
21	Mayflower	Blue Ledge	Utah	New Park Mining Co.	Do.
22	Darwin Group	Darwin (Coso)	California	The Anaconda Co.	Do.
23	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
24	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

throughout 1957, and the New Jersey Zinc Co. operated its Austinville mine in Virginia continuously, except for a 3-week shutdown caused by a labor dispute in midyear. Mines in the western Kentucky fluorspar district produced 400 tons of recoverable lead from lead-bearing fluorspar-zinc ores in 1957.

The 25 leading lead-producing mines in the United States in 1957 yielded 79 percent of the total domestic output—the 10 leading mines, 59 percent, and the 4 largest mines, 43 percent.

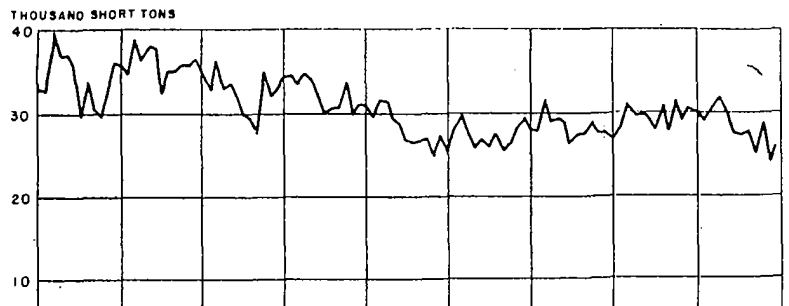

FIGURE 2.—Mine production of recoverable lead in the United States, 1949–57, by months.

TABLE 6.—Mine production of recoverable lead in the United States,[1] 1956–57, by months, in short tons

Month	1956	1957	Month	1956	1957
January	26,813	30,218	August	30,727	27,806
February	28,221	29,061	September	27,781	25,006
March	30,865	30,962	October	31,503	28,663
April	29,540	31,700	November	29,277	24,042
May	29,802	30,104	December	30,480	25,082
June	29,480	27,306			
July	28,242	27,306	Total	352,826	338,216

[1] Includes Alaska.

SMELTER AND REFINERY PRODUCTION

Refined lead produced in the United States was derived from three sources—domestic mine production, imports of foreign ore and base bullion, and scrap material (treated largely at secondary smelters). It was recovered at primary refineries that treat ore, base bullion, and small quantities of scrap and at secondary plants that process scrap exclusively. Refined lead and antimonial (hard) lead were produced by both primary and secondary plants. Because of the large quantity of hard lead (such as battery scrap) melted at secondary smelters, the output from this type of operation was principally antimonial lead.

The 5 smelters, 6 combination smelters
eries treating ore, base bullion, and other
are listed below:

Smelters:
Arkansas Valley, American Smelting & Refin
East Helena, American Smelting & Refining
El Paso, American Smelting & Refining Co.,
Midvale, United States Smelting, Refining &
Tooele, International Smelting & Refining Co

Smelter-Refineries:
Selby, American Smelting & Refining Co., Se
Bunker Hill, Bunker Hill Co., Bradley, Idaho
Federal, American Smelting & Refining Co.,
Herculaneum, St. Joseph Lead Co., Herculan
Galena, Eagle-Picher Co., Galena, Kans.
Perth Amboy, American Smelting & Refining

Refineries:
East Chicago, U. S. S. Lead Refinery, Inc., E
Omaha, American Smelting & Refining Co.,

In addition to primary plants operatin
plants smelted lead scrap, and 58 foundries
and cast or otherwise directly used lead scra
lead. These firms variously produced soft
alloys in pig or other commercial shapes
incomplete list of major secondary smelting
follows:

American Smelting & Refining Co. (including
Plants: Los Angeles, San Francisco, and Selby,
Nebr.; Newark and Perth Amboy, N. J.; Hou
Bers & Co., Inc., Philadelphia, Pa.
The Bunker Hill Co., Seattle, Wash.
Continental Smelting & Refining Co., McCook, Il
Detroit Lead Corp., Detroit Mich.
Eastern Smelting & Refining Co., Los Angeles, Ca
Electric Storage Battery Co., Philadelphia, Pa.
Goldsmith Bros. Smelting & Refining Co., Chicag
Gopher Smelting & Refining Co., St. Paul, Minn.
Imperial Type Metals Co. Plants: Chicago, Ill.,
Inland Metals Refining Co., Chicago, Ill.
Nassau Smelting & Refining Co., Inc., Tottenville
National Lead Co. (including Magnus Metal Divisi
and Master Metals, Inc.). Plants: Los Angeles,
Ga.; Chicago and Granite City, Ill.; Indianapol
more, Md.; Boston and Fitchburg, Mass.; St.
Mo.; Omaha, Nebr.; Perth Amboy, N. J.; Albany
and Cleveland, Ohio; Portland, Oreg.; Phila
Dallas and Houston, Tex.; Milwaukee, Wis.
National Metal & Smelting Co., Fort Worth, Tex.
North American Smelting Co., Wilmington, Del.
Pennsylvania Smelting & Refining Co., Philadelp
Price Battery Corp., Hamburg, Pa.
Revere Smelting & Refining Co., Newark, N. J.
Schuylkill Products Co., Baton Rouge, La.
Thos. F. Seitzinger's Sons, Inc., Atlanta, Ga.
Southern Lead Co., Dallas, Tex.
U. S. S. Lead Refinery, Inc., East Chicago, Ind.
Hyman Viener & Sons, Richmond, Va.
Western Lead Products Co., Los Angeles, Calif.
Willard Smelting Co., Inc., Charlotte, N. C.

Refined Lead—Primary and Secondary

The 13 primary lead smelters and refineries operating in the United States in 1957 consumed about 565,000 tons of lead in primary raw materials and 46,000 tons in secondary materials to produce 536,800 tons of refined lead and 64,700 tons of lead in 67,800 tons of antimonial lead. Standard specifications for pig lead (ASTM Standard Specification B 29–55) were published in the Lead chapter of Volume 1, 1956, Minerals Yearbook.

Of the 536,800 tons of refined lead, 3,300 tons was from scrap and the remainder from ores and bullion, of which 65 percent was domestic

TABLE 7.—Refined lead produced at primary refineries in the United States, 1948–52 (average) and 1953–57, by source material, in short tons

Source	1948–52 (average)	1953	1954	1955	1956	1957
Refined lead:						
From domestic ores and base bullion	377,734	328,012	322,271	321,132	349,188	347,675
From foreign ores	75,912	139,711	164,353	157,803	193,084	185,798
From foreign base bullion	2,932	168	88	102	36	60
Total from primary sources	456,578	467,891	486,712	479,157	542,308	533,533
From scrap	8,120	4,211	5,066	4,079	4,069	3,263
Total refined lead	464,698	472,102	491,778	483,236	540,377	536,796
Average sales price per pound	$0.161	$0.131	$0.137	$0.149	$0.157	$0.143
Total calculated value of primary refined lead [1]	$147,018,000	$122,587,000	$133,369,000	$142,780,000	$170,285,000	$152,590,000

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

TABLE 8.—Refined primary lead produced in the United States, 1948–52 (average) and 1953–57, by source material and country of origin, in short tons

Source	1948–52 (average)	1953	1954	1955	1956	1957
Domestic ore and base bullion	377,735	328,012	322,271	321,132	349,188	347,675
Foreign ore:						
Australia	7,024	19,880	17,311	26,701	23,811	38,579
Canada	5,983	26,073	47,150	39,910	26,558	20,694
Europe	109	199	865	109		
Mexico	4,972	5,876	16,790	10,123	11,183	23,462
South America	35,590	50,828	58,341	44,855	76,073	75,196
Other foreign	22,224	36,249	23,896	36,156	55,459	27,867
Total	75,911	139,711	164,353	157,803	193,084	185,798
Foreign base bullion:						
Australia	1,418					
Mexico	1,241	42				
South America	153	126	88	162	36	60
Other foreign	120					
Total	2,932	168	88	162	36	60
Total foreign	78,843	139,879	164,441	158,026	193,120	185,858
Grand total	456,578	467,891	486,712	479,157	542,308	533,533

and 35 percent foreign. South America
ore, followed by Australia, Mexico, a
Refined lead recovered from scrap a
additional 123,300 tons.

Antimonial Lead—Primary

Antimonial lead produced at primary
and refineries in 1957 totaled 278,400 t
lead—about 2 percent less than the 269
1956. The output of 67,800 tons fro
highest since 1948; about two-thirds wa
tery lead plates. Production of antimo
totaled 210,600 tons containing 195,300

**TABLE 9.—Antimonial lead produced at prim
States, 1948–52 (average)**

Year	Production (short tons)	Antimony conte	
		Short tons	Perce
1948–52 (average)	64,727	4,491	
1953	62,373	4,537	
1954	50,873	3,521	
1955	04,044	3,555	
1956	00,826	3,348	
1957	67,788	3,064	

Other Secondary

In addition to 126,600 tons of refined
monial lead containing 240,200 tons of
lead scrap also produced 114,900 tons
cable lead, miscellaneous alloys, and
lead.

Considerable lead (35,900 tons) was r
base scrap at secondary copper smelters
makers.

In summation, secondary lead recov
1957 totaled 489,000 short tons, a de
507,000 tons reclaimed in 1956. The le
tic mine production (338,000 tons) for
was considerably less than the 598,00
antimonial lead produced at primary sm
ported primary materials. The more t
ers and remelters recovered 405,200 to
ary lead recovered; primary lead smelt
percent), and secondary copper plants

TABLE 10.—Stocks and consumption of new and old lead scrap in the United States in 1957, gross weight in short tons

Class of consumers and type of scrap	Stocks beginning of year[1]	Receipts	Consumption			Stocks end of year
			New scrap	Old scrap	Total	
Smelters and refiners:						
Soft lead	3,448	48,812	.....	49,397	49,397	2,863
Hard lead	2,344	19,821	.....	20,259	20,259	1,906
Cable lead	3,781	26,492	.....	27,000	27,000	3,273
Battery-lead plates	26,142	376,504	.....	385,149	385,149	17,497
Mixed common babbitt	1,183	10,550	.....	10,083	10,083	1,650
Solder and tinny lead	306	10,222	.....	10,303	10,303	315
Type metals	898	22,888	.....	22,225	22,225	1,561
Drosses and residues	21,825	74,949	74,402	.....	74,402	22,372
Total	60,017	590,238	74,402	524,416	598,818	51,437
Foundries and other manufacturers:						
Soft lead	232	987	0	1,118	1,124	95
Hard lead	2	281	2	174	176	107
Cable lead	96	466	.....	519	519	43
Battery-lead plates	12	.....	.....	.....	.....	12
Mixed common babbitt	281	9,262	.....	9,431	9,431	112
Solder and tinny lead	98	975	971	47	1,018	55
Type metals	.....	.....	.....	.....	.....	.....
Drosses and residues	307	.....	3	.....	3	304
Total	1,088	11,971	982	11,289	12,271	788
Grand total:						
Soft lead	3,680	49,799	0	50,515	50,521	2,958
Hard lead	2,346	20,102	2	20,433	20,435	2,013
Cable lead	3,877	26,958	.....	27,519	27,519	3,316
Battery-lead plates	26,154	376,504	.....	385,149	385,149	17,509
Mixed common babbitt	1,464	19,812	.....	19,514	19,514	1,762
Solder and tinny lead	404	11,197	971	10,350	11,321	370
Type metals	898	22,888	.....	22,225	22,225	1,561
Drosses and residues	22,132	74,949	74,405	.....	74,405	22,736
Total	61,105	602,209	75,384	535,705	611,089	52,225

[1] Revised.

TABLE 11.—Secondary metal recovered [1] from lead and tin scrap in the United States in 1957, by type of products, gross weight in short tons

Products	Lead	Tin	Antimony	Other	Total
Refined pig lead	109,480	.....	.....	.....	109,480
Remelt lead	16,880	.....	.....	.....	16,880
Lead foil	193	.....	.....	.....	193
Total	126,571	.....	.....	.....	126,571
Refined pig tin	.....	3,610	.....	.....	3,610
Remelt tin	.....	350	.....	.....	350
Total	.....	3,960	.....	.....	3,960
Lead and tin alloys:					
Antimonial lead	240,151	549	15,722	216	256,638
Common babbitt	18,212	1,200	2,005	349	21,766
Genuine babbitt	96	311	35	15	457
Solder	23,610	5,703	372	721	30,406
Type metals	26,962	1,904	4,110	58	33,094
Cable lead	25,560	11	256	4	25,831
Miscellaneous alloys	1,715	788	35	136	2,674
Total	336,306	10,016	22,535	1,490	370,956
Composition foil	461	150	30	.....	641
Tin content of chemical products	.....	627	.....	.....	627
Grand total	463,338	15,353	22,565	1,499	502,755

[1] Most of the figures herein represent actual reported recovery of metal from scrap rather than secondary metal content of shipments as in years before 1956.

TABLE 12.—Secondary lead recovered in the and 1953–57, in sho

	1948–52 (average)	1953	1
As refined metal:			
At primary plants	8,120	4,211	
At other plants	136,452	122,363	
Total	144,572	126,574	
In antimonial lead:			
At primary plants	38,012	36,749	
At other plants	180,958	199,806	
Total	218,970	236,555	
In other alloys	113,245	123,608	
Grand total:			
Short tons	476,787	486,737	
Value	$154,102,445	$127,525,094	$131,

TABLE 13.—Lead recovered from scrap proce of scrap and form of recovery, 1

Kind of scrap	1956	1957	
New:			As soft
Lead-base	54,435	51,536	At
Copper-base	6,205	5,487	At
Tin-base	599	323	
Total	61,239	57,346	
Old:			In antl
Battery-lead plates	260,757	255,208	In othe
All other lead-base	161,439	146,265	In cop
Copper-base	23,313	30,404	In tin-
Tin-base	7	6	
Total	445,516	431,883	
Grand total	506,755	489,229	

[1] Included 40,821 tons of lead recovered in antimonial lead 1956 and 44,852 tons in 1957.

Lead Pigments

The principal lead pigments marketed red lead, basic lead sulfate, and leaded were manufactured chiefly from metal, in ore and concentrate was converted di pigments production is reviewed in the Zinc Salts chapter of this volume.

CONSUMPTION AN

Domestic consumers used 1.14 million less than in 1956. Of the total consum was soft lead, both secondary and prima was in antimonial lead; 50,900 tons (4 18,400 tons (2 percent) in copper-base s which went directly from scrap to a fini (1 percent) recovered from ore in prod other pigments.

Approximately 71 percent of all lead was consumed in metal products (including storage batteries), 10 percent in pigments, 16 percent in chemicals, and 3 percent in miscellaneous and unclassified uses, including lead used for molding rubber, making lead powder, supplying AEC requirements, and that added to steel. Storage batteries alone took 32 percent of all lead consumed in 1957, tetraethyl fluid 16 percent, and cable covering 10 percent—a total of 58 percent and about 51,000 tons less than was required for these 3 products in 1956. October was the month of highest consumption (105,300 tons) and December the lowest (79,300 tons).

The Association of American Battery Manufacturers, Inc.,[3] reported shipments of 25.9 million units of replacement batteries in 1957, compared with 25 million (revised) in 1956 and 25.4 million in 1955.

New Jersey was again the largest lead-consuming State with 15 percent of total consumption (excluding that going directly from scrap and ore to end products). Illinois follo
9 percent, Indiana 7, Pennsylvania 6, N
and Louisiana and Texas together 13
consumed in the 9 States.

TABLE 14.—Consumption of lead in the United States in 1956–57, by products, in short tons

	1956	1957		1956	1957
Metal products:			Pigments:		
Ammunition	44,438	42,500	White lead	16,051	15,701
Bearing metals	28,321	20,997	Red lead and litharge	79,190	78,323
Brass and bronze	27,003	24,491	Pigment colors	13,866	12,449
Cable covering	134,339	108,225	Other [1]	10,354	8,888
Calking lead	64,970	65,634	Total	120,370	115,361
Casting metals	12,032	12,672			
Collapsible tubes	10,045	10,316	Chemicals:		
Foil	4,503	4,839	Tetraethyl lead	191,090	177,001
Pipes, traps, and bends	28,028	24,739	Miscellaneous chemicals	3,146	3,556
Sheet lead	30,249	27,474	Total	195,130	180,557
Solder	75,290	70,694			
Terne metal	1,709	1,642	Miscellaneous uses:		
Type metal	26,700	28,720	Annealing	5,899	5,317
Total	489,686	448,948	Galvanizing	1,658	1,354
			Lead plating	916	670
Storage batteries:			Weights and ballast	7,250	7,526
Antimonial lead	191,668	185,617	Total	15,723	14,867
Lead oxides	179,203	175,398	Other, unclassified uses	18,131	17,367
Total	370,771	361,015	Grand total	[2]1,209,717	[2]1,138,115

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

TABLE 15.—Consumption of lead in the United States, 1956–57, by months, in short tons [1]

Month	1956	1957	Month	1956	1957
January	110,562	102,952	August	107,711	103,442
February	100,201	95,788	September	96,676	95,700
March	97,756	98,822	October	112,179	105,337
April	97,836	96,180	November	102,408	86,385
May	104,418	96,443	December	91,176	79,298
June	100,571	92,100			
July	88,325	86,569	Total	1,209,717	1,138,115

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

[3] American Metal Market, vol. 65, No. 25, Feb. 5, 1958, p. 6.

TABLE 16.—Consumption of lead in the Un
product and types of mate

	Soft lead	I an
Metal products	228,503	
Storage batteries	175,398	
Pigments	106,805	
Chemicals	180,524	
Miscellaneous	9,802	
Unclassified	14,256	
Total	715,288	

[1] Excludes 42,056 tons of lead that went directly from scra
contained in leaded-zinc oxide and other nonspecified pigme

TABLE 17.—Lead consumption, by St

State	Refi so lea
California	60,
Colorado	1,
Connecticut	14,
District of Columbia	
Florida	1,
Illinois	87,
Indiana	45,
Kansas	5,
Kentucky	
Maryland	16,
Massachusetts	5,
Michigan	10,
Missouri	49,
Nebraska	10,
New Jersey	114,
New York	31,
Ohio	21,
Pennsylvania	38,
Rhode Island	4,
Tennessee	
Virginia	1,
Washington	8,
West Virginia	14,
Wisconsin	
Alabama and Georgia [2]	22,
Iowa and Minnesota	
Montana and Idaho	8,
New Hampshire, Maine, and Delaware	2,
Arkansas and Oklahoma	2,
Hawaii and Oregon	
North and South Carolina	
Louisiana and Texas	131,
Utah, Nevada, and Arizona	
Undistributed	
Total	715,

[1] Excludes 42,056 tons of lead, which went directly from
lead contained in leaded-zinc oxides and other nonspecified
[2] The following States are grouped to avoid disclosure of i

STOCKS

National Stockpile.[4]—Under authority of the Strategic and Critical Materials Stockpiling Act of 1946 and supplemental legislation and in accord with directives from ODM monthly purchases of domestic lead and zinc continued to be made throughout 1957. All domestic lead was acquired to meet the long-term objective, since the minimum stockpile objective for lead and the procurement priority level had been equaled or exceeded. In addition to domestic lead, there also were deliveries of lead to the stockpile in repayment of ICA advances under several contracts. On August 1 Director Gray of ODM stated that at the current rate of procurement the long-term stockpile objective for lead and zinc would soon be met.

During 1957 GSA [5] received 100,075 tons of foreign lead (29,899 in 1956), which was acquired under barter contracts authorized under the Agricultural Trade Development and Assistance Act of 1954 and amendments. Lead acquired under this program was placed in the supplemental stockpile and was in addition to quantities acquired under the minimum and long-term-stockpile lead objectives.

Producers' Stocks.—Stocks at the end of 1957 at primary producing plants had reached the highest level since the survey was begun in 1943. Lead in bullion declined almost 2,300 tons but increased 3 percent in antimonial lead and 11 percent in ore, and stocks of refined lead more than doubled during the year. The overall increase over 1956 was 48 percent, and the total (143,900 tons) was 4 percent higher than at any time in the past 10 years. These data represent physical inventories at the plants, irrespective of ownership, and do not include material in process or in transit. However, data from the American Bureau of Metal Statistics show an additional 2,800 tons of bullion in transit to refineries, 23,200 tons of bullion in process at refineries, and approximately 30,000 tons of ore in process at smelting plants—a grand total of primary material at these plants of 205,000 tons.

TABLE 18.—Stocks of lead at primary smelters and refineries in the United States at end of year, 1948–52 (average) and 1953–57, in short tons

	1948–52 (average)	1953	1954	1955	1956	1957
Refined pig lead	33,738	65,035	78,928	21,871	30,237	74,194
Lead in antimonial lead	8,190	14,414	13,253	9,084	10,740	11,079
Lead in base bullion	10,699	13,545	14,034	16,685	11,141	8,855
Lead in ore and matte	45,299	43,734	29,924	42,903	44,925	49,788
Total	97,926	136,728	137,039	89,443	97,043	143,916

Consumers' Stocks.—Consumers' stocks of lead (including those secondary smelter plants that also are consumers of lead) increased 4 percent during the year. Lead in antimonial lead, in alloys, and in copper-base scrap all decreased, but stocks of soft lead increased by about 7,000 tons.

[4] Stockpile Report to the Congress, January–June 1957 and July–December 1957, by Office of Defense Mobilization.

[5] United States Tariff Commission, Lead and Zinc—Report to the President on Escape-Clause Investigation No. 65 Under the Provisions of Sec. 7 of the Trade Agreements Extension Act of 1951, as amended, April 1958, table 9.

TABLE 19.—Consumer stocks of lead in the U by type of material, in short

Year	Refined soft lead	Antimonial lead	Unmelted white scrap	L
1953	75,801	14,867	3,607	
1954	82,039	17,573	3,199	
1955	73,480	23,081	2,914	
1956 [1]	73,673	40,226		
1957	80,708	39,375		

[1] Beginning 1956, consumer stocks of scrap were added to s smelter metal stocks were included with consumer metal st

PRICES

The quoted New York price for con cents per pound through most of 1956 months of 1957. However, reduced ventories, and announced cutbacks in C a downward movement in May, which the end of the year. The first reductior followed by an additional ½ cent on M cent on October 14, and another ½ cer 13.0 cents, held through the remainder

The London Metal Exchange quot £118¼ per long ton on January 3 (equi U. S. currency, computed on the aver to a low of £69 on December 12 (8.(price on December 31 was £73 per long the average for 1957 was £96.7 (12.1 c

TABLE 20.—Average monthly and yearly qu York, and London, 1956–57, i

Month	1956			
	St. Louis	New York	London [2]	S Lo
January	14.80	15.00	12.94	15
February	14.80	15.00	12.88	15
March	14.80	15.00	12.96	15
April	14.80	15.00	13.04	15
May	14.80	15.00	12.88	15
June	14.80	15.00	12.80	15
July	14.80	15.00	13.17	15
August	14.80	15.00	13.25	15
September	14.92	15.12	13.38	15
October	15.30	15.50	13.32	15
November	15.30	15.50	13.53	15
December	15.34	15.54	14.18	15
Average	14.94	15.14	13.10	15

[1] St. Louis: Metal Statistics, 1958, p. 513. New York: Metal and Mineral Markets.

[2] Conversion of English quotations into American money Federal Reserve Board.

FOREIGN TRADE [6]

Imports.—General imports of primary lead totaled 522,200 tons in 1957—an increase of 14 percent over imports in 1956 and the largest quantity of primary lead imported since 1953. Lead in pigs and bars was 62 percent of the total and lead in ore and concentrate 38 percent. Of the pigs and bars, Mexico supplied 32 percent, Australia 29 percent, Yugoslavia 12 percent, Peru 11 percent, Canada 9 percent, and all other countries 7 percent. Of the lead in ore and concentrate, 28 percent came from Peru, 22 percent from Union of South Africa, 19 percent from Australia, 13 percent from Canada, 9 percent from Bolivia, and the remaining 9 percent from all other countries.

Exports.—Lead exported in 1957 consisted of 4,300 tons of pigs and bars, 900 tons in ore, matte, and bullion, and 900 tons in scrap, a total of 6,100 tons.

TABLE 21.—Total lead imported into the United States in ore, matte, base bullion, pigs, bars, and reclaimed, by countries, 1948–52 (average) and 1953–57, in short tons, in terms of lead content [1]

[Bureau of the Census]

Country	1948–52 (average)	1953	1954	1955	1956	1957
Ore, flue dust, and matte:						
North America:						
Canada-Newfoundland and Labrador	9,473	39,242	40,593	33,090	30,602	25,193
Guatemala	2,213	5,391	2,680	5,208	6,904	8,023
Honduras	383	1,090	1,636	2,757	2,969	2,955
Mexico	3,792	3,443	2,167	2,201	3,860	3,835
Other North America	360		(2)	3	8	113
Total	16,221	49,166	47,082	43,259	44,439	40,719
South America:						
Argentina	9				6	974
Bolivia	18,205	18,984	14,946	13,812	17,177	18,319
Chile	3,162	3,341	173	409	118	35
Colombia	25	255	356	546	1,440	(2)
Peru	16,938	32,842	38,734	44,223	55,174	55,450
Other South America	289	90	110	82	178	105
Total	38,628	55,512	54,319	59,072	74,093	74,883
Europe	109		696		24	264
Asia:						
Korea [3]	165				422	246
Philippines	896	2,980	2,160	2,635	2,222	783
Other Asia	172	92				
Total	1,233	3,072	2,160	2,635	2,644	1,029
Africa:						
Morocco	[4] 1,837	[4] 2,633				
Union of South Africa	17,043	29,777	35,507	41,575	44,208	43,916
Other Africa	32	63	19			25
Total	18,912	32,473	35,526	41,575	44,208	43,941
Oceania:						
Australia	8,835	20,676	21,478	30,938	31,044	36,905
Other Oceania	33					
Total	8,868	20,676	21,478	30,938	31,044	36,905
Total ore, flue dust, and matte	83,971	160,899	161,261	177,479	196,452	197,831

See footnotes at end of table.

[6] Figures on imports and exports compiled by Mae B. Price and Elsie D. Jackson, Division of Foreign Activities, Bureau of Mines, from records of the U. S. Department of Commerce, Bureau of the Census.

TABLE 21.—Total lead imported into the Unit pigs, bars, and reclaimed, by countries, short tons, in terms of lead content [1]—Con

Country	1948–52 (average)	19
Base bullion:		
North America:		
Canada		
Guatemala	100	
Mexico	1,206	
Total	1,306	
South America	192	
Europe	(2)	
Asia	200	
Africa	6	
Oceania: Australia	1,349	
Total base bullion	3,143	
Pigs and bars:		
North America:		
Canada-Newfoundland and Labrador	75,914	49,
Mexico	136,297	140,
Other North America	18	
Total	212,229	189,
South America:		
Bolivia	127	
Peru	32,774	52,
Other South America	(2)	
Total	32,901	52,
Europe:		
Belgium-Luxembourg	2,281	2,
Germany [5]	4,753	4,
Italy	4,954	
Netherlands	1,055	1,
Spain	1,520	
United Kingdom	1,066	1,
Yugoslavia	32,098	51,
Other Europe	202	1,
Total	47,929	62,
Asia:		
Burma	752	
Japan	1,564	
Other Asia	299	
Total	2,615	
Africa:		
Morocco	[4] 1,790	[4] 9,
Other Africa	101	
Total	1,891	9,
Oceania: Australia	33,214	70,
Total pigs and bars	330,779	385,
Reclaimed, scrap, etc.:		
North America:		
Canada-Newfoundland and Labrador	4,527	
Mexico	1,277	
Other North America	1,202	
Total	7,006	1,
South America:		
Peru	91	
Venezuela	196	
Other South America	44	
Total	331	

See footnotes at end of table.

TABLE 21.—Total lead imported into the United States in ore, matte, base bullion, pigs, bars, and reclaimed, by countries, 1948–52 (average) and 1953–57, in short tons, in terms of lead content [1]—Continued

Country	1948–52 (average)	1953	1954	1955	1956	1957
Reclaimed, scrap, etc.—Continued						
Europe:						
Belgium-Luxembourg	266	202		576	117	
Denmark	21	14		282	1,000	84
Germany [6]	191		50	3	348	168
Italy	530					
Netherlands	707	502		112	167	
Spain				431		
Yugoslavia	190	103	110			
Other Europe	417	442	103	136	179	32
Total	2,331	1,263	269	1,540	1,801	284
Asia:						
Japan	3,670	21	13		4	
Other Asia	1,259		47	26	1	
Total	4,929	21	60	26	5	
Africa	165	17				
Oceania:						
Australia	2,164	2,666		2,009	1,255	3,079
Other Oceania	87	97				
Total	2,251	2,763		2,009	1,255	3,079
Total reclaimed, scrap, etc	17,013	5,439	5,655	20,580	20,738	9,247
Grand total	434,906	552,278	443,243	462,208	479,875	531,441

[1] Data are "general imports," that is, include lead imported for immediate consumption plus material entering the country under bond.
[2] Less than 1 ton.
[3] Republic of Korea, effective Jan. 1, 1952.
[4] Morocco.
[5] West Germany, effective Jan. 1, 1952.

TABLE 22.—Lead imported for consumption in the United States, 1948–52 (average) and 1953–57, by classes [1]

[Bureau of the Census]

Year	Lead in ores, flue dust or fume, and mattes, n. s. p. f.		Lead in base bullion		Pigs and bars		Sheets, pipe, and shot		Not otherwise specified (value)	Total value
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value		
1948–52 (average)	77,908	$20,085,486	3,231	$989,052	328,259	$98,822,519	166	$82,307	$108,024	$125,304,085
1953	67,030	15,214,084	742	204,068	370,119	95,285,223	178	58,291	242,925	111,019,588
1954	196,054	[2]47,067,269	41	10,149	274,286	[2]68,419,607	397	[2]128,812	[2]149,208	[2]118,125,081
1955	156,433	[2]38,142,741			263,977	73,032,055	2,048	534,031	[2]163,610	[2]115,804,005
1956	191,302	50,621,209	31	11,311	262,204	[2]77,718,626	7,654	2,017,086	[2]184,107	[2]135,820,762
1957	228,783	60,459,319	25	7,557	327,236	86,937,198	5,917	1,377,249	[2]360,199	[2]150,787,201

[1] In addition to quantities shown (value included in total value), "reclaimed, scrap, etc.," imported as follows—1948–52 (average): 16,075 tons, $4,310,607; 1953: 3,660 tons, $824,907; 1954: 7,217 tons, [2] $1,450,036; 1955: 18,944 tons, [2] $3,930,668; 1956: 20,461 tons, [2] $5,208,423; 1957: 7,610 tons, [2] $1,646,760.
[2] Owing to changes in tabulating procedures by the Bureau of the Census, data are not comparable with years before 1954.

TABLE 23.—Miscellaneous products contai in the United States, 1948–52

[Bureau of the

Year	Babbitt metal, solder, wh and other combination ing lead	
	Gross weight (short tons)	Lead content (short tons)
1948–52 (average)	1,592	1,008
1953	2,375	1,343
1954	2,309	1,572
1955	2,286	1,283
1956	4,106	2,526
1957	3,502	2,100

[1] Owing to changes in tabulating procedures by the Bu years before 1954.

Tariff.—The duties on pig lead an centrate remained at 1½ cents and throughout 1957.

In May Secretary Seaton, United St presented to Congress a program fo support to the domestic mining indust a graduated excise tax on entries of fo scale adjustment was designed to di to permit unhampered entry of the q to supplement the domestic supply. adjourned without decisive action on

In September the Emergency Lea senting domestic mining groups, petiti regulation of imports, claiming that States under the Trade Agreements A the domestic industry. Formal hea Commission in November, and a stud the end of the year.

TABLE 24.—Total lead exported from the United States in ore, matte, base bullion, pigs, bars, anodes and scrap, by destination, 1948–52 (average) and 1953–57, in short tons [1]

[Bureau of the Census]

Destination	1948–52 (average)	1953	1954	1955	1956	1957
Ore, matte, base bullion (lead content):						
North America:						
Canada	630	1,038	18	12	6	64
Mexico				1,322	1,049	861
Total	630	1,038	18	1,334	1,055	906
Europe: Belgium-Luxembourg	(2)					
Asia			84			1
Total ore, matte, base bullion	630	1,038	102	1,334	1,055	906
Pigs, bars, anodes:						
North America:						
Canada	101	32	18	13	38	266
Cuba	54	28	23	36	44	62
Mexico	6	8	34	10	2	18
Other North America	88	135	89	26	53	136
Total	249	203	164	90	137	482
South America	691	101	202	167	300	104
Europe:						
Belgium-Luxembourg	23				2,128	660
Other Europe	49	2	2	13		
Total	72	2	2	13	2,128	660
Asia:						
India	28			5	644	
Japan	5	12			1,770	2,305
Nansei and Nanpo				5	5	10
Philippines	91	405	192	90	180	451
Other Asia	289	13	34	27	46	330
Total	413	430	220	133	2,051	3,102
Africa	7	6	2		6	1
Oceania	(2)	1				
Total pigs, bars, anodes	1,432	803	590	403	4,628	4,339
Scrap:						
North America:						
Canada	(3)	27		1	11	
Mexico	(3)		370			
Total	(3)	27	370	1	11	
South America	(3)		(3)			
Europe:						
Belgium-Luxembourg	(3)		103	764	20	
Germany	(3)	[4] 39	[4] 29	[4] 495	[4] 563	[4] 264
Netherlands	(3)			148	788	304
United Kingdom	(3)	2,000	1,060	880	554	126
Other Europe	(3)		318	219	14	55
Total	(3)	2,039	1,510	2,496	1,039	748
Asia:						
Japan	(3)	640	2,014	486	180	137
Lebanon	(3)					
Total	(3)	640	2,014	486	180	137
Total scrap	(3)	2,706	3,894	2,983	2,136	885
Grand total		4,647	4,502	4,720	7,819	6,130

In addition, foreign lead was reexported as follows: Ore, matte, base bullion, 1948–52 (average): less than 1 ton; 1953–54: none; 1955, 3 tons; 1956: 6 tons; 1957: 4 tons. Pigs, bars, anodes, 1948–52 (average): 28 tons; 1953: 709 tons; 1954–55: none; 1956: 50 tons; 1957: 300 tons. Scrap: 1948–52 (average): less than 1 ton; 1953: none; 1954: 121 tons; 1955–57: none.

[2] Less than 1 ton.

[3] 1948 not separately classified—1940—Belgium-Luxembourg, 362 tons; Canada, 95 tons; Lebanon, 11 tons; United Kingdom, 279 tons; total scrap, 747 tons. 1950—Canada, 41 tons; United Kingdom, 1,271 tons; Germany, 264 tons; total scrap, 1,670 tons. 1951—Canada, 203 tons; Belgium-Luxembourg, 31 tons; Germany 145 tons; United Kingdom, 20 tons; Japan, 195 tons; total scrap, 594 tons. 1952—Canada, 20 tons; United Kingdom, 55 tons; total scrap, 75 tons.

[4] West Germany.

WORLD REV

World mine production of lead in
successive year to 2.54 million tons c
1956. Of the larger producers, A
U. S. S. R., Morocco, Mexico, and P
Canada and the United States each dro
8 countries produced more than 100,00
plied 71 percent of total world product

Smelter production also increased fr
tons in 1957. In Canada, United Sta
less by 4, 2, and 3 percent, respective
Mexico, U. S. S. R., and West Germa
substantial 18 percent. Smelter produ
71 percent of total output.

Total world consumption of lead is
based on available information, estimat
that consumer requirements were of t
tons less than supply. In the United
imports of lead exceeded consumption

TABLE 25.—World mine production of lead and 1953–57 in sh

[Compiled by Augusta W. Junn an

Country	1948–52 (average)	19
North America:		
Canada	163,959	103,
Cuba	22	
Greenland		
Guatemala	3,385	7,
Honduras	411	
Mexico	247,723	244,
Salvador [5]	400	
United States [4]	401,907	342,
Total	817,807	789,
South America:		
Argentina	21,821	17,
Bolivia (exports) [4]	31,673	26,
Brazil	3,241	3,
Chile	5,811	[5] 3,
Ecuador	225	
Peru	78,073	126,
Total	140,844	[5] 177,
Europe:		
Austria	4,844	5,
Bulgaria [5]	10,400	11,
Czechoslovakia [5]	1,100	1,
Finland	171	
France	11,785	13,
Germany:		
East [5]	2,690	3,
West	46,646	69,
Greece [4]	3,986	6,
Ireland	[7] 949	1,
Italy	40,741	44,
Norway	358	
Poland [5]	20,000	23,
Portugal	1,375	1,
Rumania [5] [6]	8,500	11,
Spain	39,430	59,
Sweden	24,348	28,
U. S. S. R. [5]	[5] 123,200	[5] 202,

See footnotes at end of table.

Lead and Zinc Pigments

By Arnold M. Lansche [1] and E

PRODUCTION of lead and zinc pigme
was adequate for all demands, and th
zinc, their ores and scrap—were in sur
pigments declined despite increased activ
were the major consumers, but shipme
increased.

TABLE 1.—Salient statistics of the lead [1] and zinc
States, 1948–52 (average) a

	1948–52 (average)	1953	195
Shipment of principal pigments:			
White lead (dry and in oil)—short tons	36,136	26,217	25,
Red lead—do	31,401	31,333	27,
Litharge—do	149,807	164,518	139,
Black oxide [2]—do	71,306	81,831	79,
Zinc oxide—do	142,369	148,627	140,
Leaded zinc oxide—do	50,074	39,712	33,
Lithopone—do	97,737	52,439	44,
Value of products:			
All lead pigments	$78,168,000	$64,303,000	$61,756,
All zinc pigments	63,714,000	56,475,000	50,438,
Total	141,882,000	120,778,000	112,194,
Value per ton received by producers:			
White lead (dry)	373	378	
Red lead	364	312	
Litharge	346	285	
Zinc oxide	266	264	
Leaded zinc oxide	272	259	
Lithopone	125	132	
Foreign trade:			
Lead pigments:			
Value of exports	998,800	790,000	872,
Value of imports [3]	673,600	16,000	140,
Zinc pigments:			
Value of exports	4,397,200	1,468,000	1,351,
Value of imports	470,800	287,000	515,
Export balance	4,251,600	1,964,000	1,550,

[1] Excludes basic lead sulfate; figure withheld to avoid disclosi
[2] Production by battery manufacturers.
[3] Figure withheld to avoid disclosing individual company conf
[4] Excludes lithopone value; figure withheld to avoid disclosing
[5] Revised figure.
[6] Includes "other lead pigments."

[1] Commodity specialist.
[2] Statistical assistant.

DOMESTIC PRODUCTION

The value of reported shipments of lead and zinc pigments in 1957 excluding basic lead sulfate and zinc sulfide was $102 million. Of the total value, lead pigments comprised 54 percent and zinc pigments, 46 percent.

Lead and zinc pigments and zinc salts manufacturers, their plants and products, were listed in Minerals Yearbook, volume 1, 1953, and subsequent changes have been noted annually in the Yearbooks.

LEAD PIGMENTS

Total shipments of lead pigments in 1957 declined about 13 percent to 161,000 tons worth $55.4 million.

The quantity of dry white lead shipped was down 15 percent from that of 1956, but the "in oil" variety increased 5 percent. The total 1957 white lead shipments declined 8 percent below those in 1956 and were 15 percent of the total lead pigments shipped compared with 14 percent in 1956.

Shipments of red lead and litharge declined 34 and 16 percent, respectively.

In addition to these pigments (production and shipments are shown in table 2), 128,000 tons of black or gray suboxide of lead was manufactured by battery makers for their own use in 1957. The suboxide, sometimes called a leady litharge, is used in place of litharge. Suboxide production required 124,000 tons of pig lead in 1957.

White lead, red lead, litharge, and the suboxide were made directly or indirectly from refined lead and constituted 98 percent of all lead used in pigments. The lead content of leaded zinc oxide made up the remaining 2 percent. Basic lead sulfate is not reported herein, except as it enters leaded zinc oxide; lead silicate is included with white lead.

TABLE 2.—Production and shipments of lead pigments [1] in the United States, 1956–57

Pigment	1956				1957			
	Production (short tons)	Shipments			Production (short tons)	Shipments		
		Short tons	Value [2]			Short tons	Value [2]	
			Total	Average			Total	Average
White lead:								
Dry	17,248	17,448	$7,206,068	$413	15,280	14,808	$6,193,571	$416
In oil [3]	7,203	8,250	4,133,509	501	7,404	8,676	4,072,920	469
Red lead	28,612	27,075	[4] 10,195,102	364	27,004	26,998	9,566,000	354
Litharge	132,659	131,525	46,571,080	346	110,303	110,779	35,597,815	321
Black oxide	106,966				127,583			

[1] Except for basic lead sulfate and orange mineral; figures withheld to avoid disclosing individual company confidential data.
[2] At plant, exclusive of container.
[3] Weight of white lead only, but value of paste.
[4] Corrected figure.

TABLE 3.—Lead pigments [1] shipped by ma
1948–52 (average) and 1953-

Year	White lead		
	Dry	In oil	T
1948–52 (average)	21,083	14,153	
1953	10,784	9,433	
1954	17,235	8,336	
1955	17,858	7,717	
1956	17,448	8,250	
1957	14,808	8,676	

[1] Excludes basic lead sulfate and orange mineral; figures wi
confidential data.
[2] Production by battery manufacturers.

TABLE 4.—Lead content of lead and zinc p
manufacturers, by sources, 19

Pigment	1956			Tot
	Lead in pigments produced from—			lead pig- men
	Ore		Pig lead	
	Domestic	Foreign		
White lead			19,660	19,
Red lead			25,937	25,
Litharge			123,373	123,
Black oxide			102,494	102,
Leaded zinc oxide	4,332	2,063		6,
Total	4,332	2,063	271,364	277,

[1] Excludes lead in basic lead sulfate and orange mineral;
company confidential data.

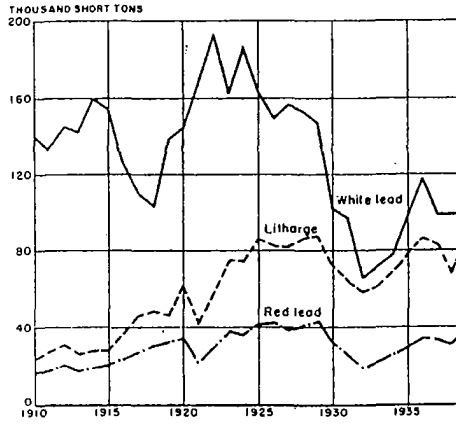

FIGURE 1.—Trends in shipments of

ZINC PIGMENTS AND SALTS

Combined shipments of the reported zinc pigments totaled about 175,000 pounds in 1957. Shipments of zinc oxide and leaded zinc oxide declined 2 and 11 percent, respectively. Shipments of zinc chloride and zinc sulfate increased 10 and 4 percent, respectively.

A mixed trend was displayed in the average values of the zinc pigments and salts as reported by producers in 1957 compared with the general advance in values in 1956 over those of 1955. Compared with 1956 values, zinc oxide remained unchanged at $271 per ton, leaded zinc oxide declined $33 to $249, zinc chloride (50° B.) was up $3 to $127, and zinc sulfate increased $7 to $160.

Zinc ore, refined metal, and secondary materials—scrap metal, residues, drosses, skimmings, and zinc ashes—serve as source materials for manufacturing zinc pigments and salts.

Lead-free zinc oxide was made by several processes; 24 percent was produced from metal by the French process, 67 percent from ores and residues by the American process, and 9 percent by "Other" processes from scrap residues and scrap materials. Zinc sulfate was made from ores and scrap; leaded zinc oxide was made from ores only. Zinc oxide production derived from metal and scrap was 34 percent in 1957 compared with 31 percent in 1956.

Zinc Oxide.—About 151,000 tons of lead-free zinc oxide was shipped—2 percent less than in 1956.

Leaded Zinc Oxide.—Four grades of leaded zinc oxide classified according to lead content were produced in the United States. The 5- to 35-percent grade constituted the bulk of production; smaller quantities were produced as less than 5-percent grade, over 35- to 50-percent grade, and over 50-percent grade. Total shipments of leaded zinc oxide were 24,000 tons, down 11 percent from 1956. Output in 1957 (comparison with 1956 in parentheses) for the 35-percent

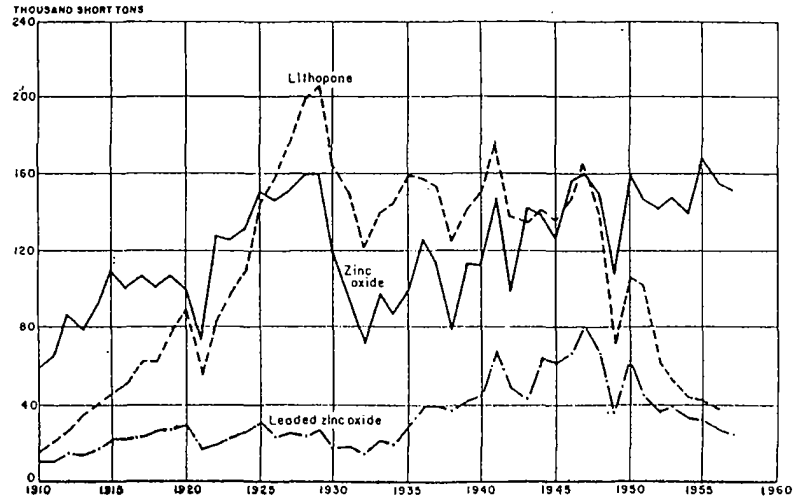

FIGURE 2.—Trends in shipments of zinc pigments, 1910–57.

lead and under was 24,800 (24,100) to
over 35-percent lead.

Lithopone.—Both ordinary lithopone
were made in 1957.

TABLE 5.—Production and shipments of zinc
States, 1956–5

Pigment or salt	1956			
	Production (short tons)	Shipments		
		Short tons	Value [1]	
			Total	Avera
Zinc oxide [2]	158,982	154,955	$41,960,858	$27
Leaded zinc oxide [2]	20,219	27,164	7,647,169	28
Lithopone	80,039	38,434	5,030,991	14
Zinc chloride, 50° B.	54,503	53,201	6,500,815	12
Zinc sulfate	32,861	32,200	4,917,073	15

[1] Value at plant, exclusive of container.
[2] Zinc oxide containing 5 percent or more lead is classed as le
zinc oxide include a small quantity containing less than 5 per
[3] Figure withheld to avoid disclosing individual company c

TABLE 6.—Zinc pigments and salts [1] shipped
States, 1948–52 (average) and 1

Year	Zinc oxide	Le zinc
1948–52 (average)	142,369	
1953	148,627	
1954	140,285	
1955	168,541	
1956	154,955	
1957	151,267	

[1] Excludes zinc sulfide, figures withheld to avoid disclosing
[2] Figure withheld to avoid disclosing individual company c

TABLE 7.—Zinc content of zinc pigments [1]
manufacturers, by sources, 195

Pigment or salt	1956				
	Zinc in pigments and salts produced from—				Total zinc in pigments and salts
	Ore		Slab zinc	Secondary material [2]	
	Domestic	Foreign			
Zinc oxide	57,320	20,831	18,804	21,083	127,128
Leaded zinc oxide	9,535	5,362			14,897
Lithopone	(3)	(3)		(3)	[4] 18,839
Total pigments			18,804		160,864
Zinc chloride				12,133	12,133
Zinc sulfate	(3)	(3)		(3)	(3)

[1] Excludes zinc sulfide; figures withheld to avoid disclosing
[2] These figures are higher than those shown in the report on S
include zinc recovered from byproduct sludges, residues, etc.,
[3] Figure withheld to avoid disclosing individual company co
[4] Includes zinc sulfate production. [5] Included

CONSUMPTION AND USES

Shipments of all lead and zinc pigments to consumers declined despite greater activity in the industries that use large quantities of pigments. This divergence of pigment shipments from the upward trend in activity of the consuming industries was attributed to reduction in consumer stocks and to increasing use of substitutes. Among the major pigment-consuming industries there were increases in the production of automobiles, trucks, and paint; the consumption of natural and synthetic rubber; and in the value of public and private construction.

The paint industry, the principal consumer received 82, 59, and 99 percent of white lead, red lead, and leaded zinc oxide, respectively; it ranked second in quantity (22 percent) of zinc oxide used and received only 6 percent of litharge (chrome pigments and in varnish) shipments. Of the total quantity of lead and zinc pigments shipped, the paint industry received 99,000 tons in 1957 compared with 101,000 tons in 1956, a decline of 2 percent (for comparability lithopone shipments are not included in the 1956 figure, which totaled 129,000 tons with it).

Titanium pigments continued to furnish the chief competition to lead and zinc pigments in paintmaking. Production and shipments of titanium pigments, based on the titanium dioxide content, decreased about 7 and 10 percent, respectively, from the high in 1956. The use of titanium pigments in paint has about doubled over the past 12 years.

Shipments of replacement automotive batteries increased 4 percent to 25.9 million units.

The rubber industry was in first place for shipments of lead-free zinc oxide, taking 54 percent of the total. The rubber industry also took about 1,900 tons of litharge and a small quantity of leaded zinc oxide. The quantity of natural and synthetic rubber consumed for all purposes increased 2 percent.

The ceramics industry received 3 percent of the white lead, 16 percent of the litharge, and 6 percent of the lead-free zinc oxide shipped. A small quantity of red lead went to the ceramics industry.

LEAD PIGMENTS

White Lead.—Paintmaking required 82 percent of the white lead shipments in 1957 compared with 79 percent of the total in 1956. Shipments to ceramics makers furnished 3 percent of total distribution

TABLE 8.—Distribution of white lead (dry and in oil) shipments,[1] by industries, 1948–52 (average) and 1953–57, in short tons

Industry	1948–52 (average)	1953	1954	1955	1956	1957
Paints	30,808	21,030	20,020	19,825	20,288	19,253
Ceramics	1,341	785	487	484	633	607
Other	3,987	[2] 4,402	[2] 4,155	[2] 5,266	[2] 4,777	[2] 3,654
Total	36,136	26,217	25,671	25,575	25,698	23,574

[1] Excludes basic lead sulfate; figures withheld to avoid disclosing individual company confidential data.
[2] Includes the following tonnages for plasticizers and stabilizers: 1952—980; 1953—1,089; 1954—1,133; 1955—1,355.
[3] Figures for plasticizers and stabilizers withheld to avoid disclosing individual company confidential data.

in 1957. Other uses for the pigmer
base for dry colors, and unspecified
the unspecified category belongs pr

Basic Lead Sulfate.—Substantia
used as an intermediate product in r

Red Lead.—The paint industry r
shipped in 1957 compared with 5
The "Other" classification, consisti
rubber, and unspecified uses, compo

TABLE 9.—Distribution of red-lead shipr
and 1953–57,

Industry	1948–52 (average)
Paints	12,408
Storage batteries	16,003
Ceramics	816
Other	3,084
Total	31,401

[1] Included with "Other."

Orange Mineral.—This pigment w
ink.

Litharge.—Battery makers contir
shipped to industry. The cerami
chrome pigment manufacturers 4 p
rubber obtained 3, 3, and 2 perc
classification, composed of storage
ings, driers, friction materials, lead
received 72 percent. Total shipm
percent.

Battery makers produced 128,000
termed black or gray suboxide, for r
interstices of battery plates.

TABLE 10.—Distribution of litharge shipr
and 1953–57,

Industry	1948–52 (average)
Storage batteries	95,017
Ceramics	19,954
Varnish	4,843
Chrome pigments	9,105
Oil refining	5,921
Insecticides	6,000
Rubber	2,406
Floor coverings	599
Other	5,872
Total	149,807

[1] Included with "Other."

ZINC PIGMENTS

Zinc Oxide.—The zinc oxide requ
the leading user of this pigment, inc

to 82,000 tons. The rubber industry took 54 percent of the total zinc oxide shipped. The quantity of zinc oxide shipped to the paint industry rose less than 1 percent in 1957.

Shipments to the ceramic, coated-fabric, and floor-covering industries declined 17, 57, and 13 percent, respectively, in 1957. Shipments to the petroleum, agriculture, chemical, and printing industries and to dealers, who resell and export, increased 7 percent above 1956; this category received 16 percent of the zinc oxide shipped. The total zinc oxide distributed was 2 percent less than in 1956.

TABLE 11.—Distribution of zinc oxide shipments, by industries, 1948–52 (average) and 1953–57, in short tons

Industry	1948–52 (average)	1953	1954	1955	1956	1957
Rubber	73,723	78,439	71,058	86,677	80,460	81,745
Paints	31,408	31,020	31,157	33,032	32,485	32,605
Ceramics	10,016	8,802	8,990	10,617	10,160	8,459
Coated fabrics and textiles [1]	6,901	8,718	6,322	11,263	8,447	3,623
Floor coverings	3,360	2,234	1,740	2,281	1,436	1,249
Other	16,962	18,464	21,099	23,771	21,998	23,586
Total	142,369	148,027	140,285	168,641	154,955	151,267

[1] Includes the following tonnages for rayon: 1953—7,388; 1954—5,603; 1955—4,584; 1956—7,721; 1957—2,838

Leaded Zinc Oxide.—Paint manufacturing used 99 percent of the leaded zinc oxide. Rubber and miscellaneous minor uses required the remainder.

TABLE 12.—Distribution of leaded zinc oxide shipments, by industries, 1948–52 (average) and 1953–57, in short tons

Industry	1948–52 (average)	1953	1954	1955	1956	1957
Paints	49,027	39,276	33,600	32,178	26,825	23,904
Rubber	135	41	7			
Other	912	395	275	483	330	299
Total	50,074	39,712	33,972	32,661	27,104	24,203

TABLE 13.—Distribution of lithopone shipments, by industries, 1948–52 (average) and 1953–57, in short tons

Industry	1948–52 (average)	1953	1954	1955	1956	1957
Paint, varnish, and lacquers [1]	72,129	37,462	32,177	30,622	28,238	
Coated fabrics and textiles	6,699	5,806	3,995	4,242	(2)	
Floor coverings	6,346	2,676	2,351	2,378	1,600	
Rubber	3,260	1,723	1,701	2,163	(2)	(3)
Paper	4,112	2,096	1,841	1,970	(2)	
Printing ink	5,182	716	195	1,570	8,596	
Other		2,071	1,751			
Total	97,737	52,439	44,011	42,845	38,434	

[1] Includes a small quantity, not separable, used for printing ink, except in 1950, 1951, and 1952.
[2] Included with "Other."
[3] Figure withheld to avoid disclosing individual company confidential data.

Lithopone.—Lithopone was used in industry and in coated fabrics, rub printing inks.

Zinc Chloride.—Statistics on end-u are not available. The principal use and tinning fluxes, battery making, preserving wood, refining oil, and fun

Zinc Sulfate.—Rayon and agricult the zinc sulfate, receiving 60 and 28 basis), respectively. The remainde vanizing, dyeing and printing, paint cellaneous uses.

TABLE 14.—Distribution of zinc sulfate (average) and 1953–5

Industry	1948–52 (aver-age)	1953		1954	
	Gross weight	Gross weight	Dry basis	Gross weight	D ba
Rayon	9,993	9,008	7,612	6,615	5,
Agriculture	5,236	6,773	5,894	7,067	6,
Chemicals	1,871	2,539	2,105	2,300	1,
Glue	476	601	501	648	
Electrogalvanizing	278	337	225	454	
Flotation reagents	1,087	736	648	367	
Paint and varnish processing	236	106	70	130	
Textile dyeing and printing	405	155	138	4	
Other	2,139	1,965	1,219	1,462	1,
Total	21,720	22,220	18,412	19,027	16,

[1] Included with "Other."

PRICES

Total and average values received pigments and zinc salts are shown in value of dry white lead increased $3 p and the in-oil variety of white lead de respectively. The average quoted p York declined from 16 cents per po weighted sales price of lead was 14.3 15.7 cents in 1956 and 14.9 cents in 1

The average value of zinc oxide did of 1956. Leaded zinc oxide per ton 1956. The average price per ton of sulfate increased $3 and $7, respec quoted price of Prime Western zinc de to 10 cents. The average weighted was 11.6 cents a pound compared wit

)LE 15.—Range of quotations on lead pigments, and zinc pigments and salts at New York (or delivered in the East), 1953–57, in cents per pound

[Oil, Paint and Drug Reporter]

Product	1953	1954	1955	1956	1957
e lead (basic lead carbonate), dry, lots, bags	16. 25–17. 25	16. 00–17. 50	17. 50–18. 00	18. 00–19. 00	17. 50–19. 50
lead sulfate (sublimed lead), less n carlots, bags	15. 00–15. 75	15. 75–16. 75	16. 75–17. 25	17. 25–18. 50	18. 25
lead, dry, 95 percent or less, less n carlots, barrels	15. 75–18. 50	15. 50–18. 00	18. 00–18. 50	18. 50–20. 00	16. 25–20. 00
ge mineral, American, less than lots, barrels	18. 10–20. 85	17. 85–20. 60	20. 35–21. 10	21. 10–22. 35	18. 60–22. 35
arge, commercial, powdered, less n carlots, barrels	14. 75–17. 50	14. 50–17. 00	17. 00–17. 50	17. 50–19. 00	15. 75–19. 00
oxide:					
American process, lead-free, bags, carlots	13. 50–14. 25	13. 50	13. 50–14. 00	14. 00–14. 50	14. 50
American process, 5 to 35 percent lead, bags, carlots	14. 00–14. 40	14. 00–14. 25	14. 25–14. 63	14. 63–15. 50	15. 50
French process, red seal, bags, carlots	14. 75–15. 50	14. 75	14. 75–15. 25	15. 25	15. 25
French process, green seal, bags, carlots	15. 25–16. 00	15. 25	15. 25–15. 75	15. 75	15. 75
French process, white seal, bags, carlots	15. 75–16. 50	15. 75	15. 75–16. 25	16. 25	16. 25
opone, ordinary, less than carlots, gs	8. 25– 8. 50	8. 25– 8. 50	8. 25– 8. 50	8. 50– 8. 75	8. 75– 9. 13
sulfide, less than carlots, bags, rrels	25. 30–26. 30	25. 30	25. 30	25. 30	25. 30
chloride, works:					
Solution, tanks	4. 10– 4. 85	4. 85	4. 85	4. 85– 5. 15	5. 15
Fused, drums	9. 85–10. 85	10. 10–10. 85	10. 10	10. 10–10. 70	10. 70
sulfate, crystals,[1] less than carlots, rrels	8. 10–10. 30	7. 90– 8. 60	8. 60–10. 60	8. 60– 9. 75	9. 75

[1] cludes granulated.

FOREIGN TRADE [3]

Imports of lead and zinc pigments and salts in 1957 increased in lue and quantity 21 and 33 percent, respectively, over 1956. The lue of imports was $3.2 million compared with $2.7 million in 1956. he value of major classes of exports was $2.8 million, an increase less than 1 percent over 1956.

Imports of litharge rose to 8,000 tons, about 51 percent over 1956. 1957 litharge supplied 95 percent of the lead pigments and salts eived. Lead products imported in 1957 increased 46 percent above 56.

About 5,000 tons of zinc oxide was imported in 1957, a 43-percent rease over 1956. Total imports of all the zinc pigments and salts orted was about 7,000 tons, a 20-percent increase over 1956. ier components of the total were about 60 tons of lithopone, 340 s of zinc sulfide, 600 tons of zinc chloride, and 700 tons of zinc sulfate. o total value of these imports increased almost 17 percent.

Litharge exports advanced to 2,500 tons, rising 25 percent over 1956. otal exports of the lead pigments and salts were nearly 4,600 tons, an ncrease of 6 percent.

[3] Figures on imports and exports compiled by Mae B. Price and Elsie D. Jackson, Division of Foreign ctivities, Bureau of Mines, from records of the U. S. Department of Commerce, Bureau of the Census.

Exports of zinc oxide increased nearly about 3,000 tons. Those of lithopone d percent) to almost 1,000 tons. The qua ported was the same as in 1956, but the va

TABLE 16.—Value of foreign trade of the United and salts, 1955–5

[Bureau of the Census]

	Imports for consum	
	1955	1956
Lead pigments:		
White lead		$5, 980
Red lead	$923	30, 706
Litharge	174, 895	[1] 1, 388, 733
Other lead pigments	18, 708	39, 241
Total	194, 526	[1] 1, 464, 660
Zinc pigments:		
Zinc oxide	685, 180	770, 156
Zinc sulfide	83, 732	150, 075
Lithopone	4, 356	[1] 19, 931
Total	773, 273	[1] 946, 762
Lead and zinc salts:		
Lead arsenate		
Other lead compounds	72, 089	65, 610
Zinc arsenate	1, 760	2, 670
Zinc chloride	72, 369	112, 702
Zinc sulfate	56, 301	84, 058
Total	202, 519	264, 940
Grand total	1, 170, 318	[1] 2, 676, 362

[1] Owing to changes in tabulating procedures by the Bureau of parable to earlier years.
[2] Revised figure.
[3] Data not available.

TABLE 17.—Lead pigments and salts imported States, 1948–52 (average) a

[Bureau of the Census]

Year	Short tons				
	White lead (basic carbonate)	Red lead	Litharge	Lead suboxide	pi n.
1948–52 (average)	855	111	730	44	
1953	(1)	(1)	60	1	
1954		2	596	28	
1955		3	751	34	
1956	20	113	5, 371	78	
1957	92	258	8, 118	33	

[1] Less than 1 ton.
[2] Owing to changes in tabulating procedures by the Bureau of parable with earlier years.

TABLE 18.—Zinc pigments and salts imported for consumption in the United States, 1948–52 (average) and 1953–57

[Bureau of the Census]

Year	Short tons							Total value
	Zinc oxide		Lithopone	Zinc sulfide	Zinc chloride	Zinc arsenate	Zinc sulfate	
	Dry	In oil						
1948–52 (average)	1,461	2	404	7	243	(1)	145	$543,461
1953	1,157	29	30	23	179	(1)	40	316,604
1954	2,348	------	65	106	260	------	399	[2] 581,832
1955	3,220	------	30	265	500	(1)	634	903,703
1956	3,667	------	143	510	632	17	824	[2] 1,146,092
1957	5,245	------	57	342	601	------	722	1,335,891

[1] Less than 1 ton.
[2] Owing to changes in tabulating procedures by the Bureau of the Census, data known to be not comparabl with earlier years.

TABLE 19.—Lead pigments and salts exported from the United States, 1948–52 (average) and 1953–57

[Bureau of the Census]

Year	Short tons					Total value
	White lead	Red lead	Litharge	Lead arsenate	Other lead compounds	
1948–52 (average)	724	713	1,177	482	(1)	[2] $1,227,488
1953	818	417	1,238	152	12	892,904
1954	951	336	1,284	355	31	1,056,764
1955	957	325	1,459	540	33	1,212,731
1956	654	352	[3] 2,000	1,282	28	[3] 1,704,742
1957	812	622	2,502	008	17	1,663,942

[1] Classification established 1949; quantity and value not included in averages.
[2] In addition, lead acetate and sugar of lead exported as follows: 1949—108,533 pounds, $39,505; 1950—64,135 pounds, $19,973; 1951—140,427 pounds, $46,191.
[3] Revised figure.

TABLE 20.—Zinc pigments exported from the United States, 1948–52 (average) and 1953–57

[Bureau of the Census]

Year	Short tons		Total value	Year	Short tons		Total value
	Zinc oxide	Lithopone			Zinc oxide	Lithopone	
1948–52 (average)	6,657	15,058	$4,397,271	1955	2,649	1,892	$1,072,581
1953	2,971	3,927	1,468,100	1956	2,748	1,387	1,086,775
1954	3,111	3,013	1,351,526	1957	3,144	901	1,163,216

TECHNO

In 1957 the E. & E. Maier Solu Nuremberg, West Germany, was rep red-lead plant with a capacity of 1,[illegible] used an electrothermal process and red lead directly from metallic lea high temperature required for evapo with oxygen to form red lead. Preci sation produced the desired flaky fo

Japanese scientists tested various find which types protect metal again and can be easily stripped for decon dry film of oil paint pigmented wit was higher on scratch hardness, was displayed considerable flaking. Th to give the metal good protection. ing white lead subjected to the san increased in the scratch hardness test or bending test; vinyl chloride pai both pigmented with white lead, d test; there was some tendency tow chlorinated rubber paint, and neith bending test.

[4] Terai, Ichiro, Damage to Various Films by Gamma No. 2, Jan. 23, 1958, pp. 6, 7, 9.

Titanium

By John W. Stamper

THE RAPID growth since 1948 of th
industry in the United States halted abr
to sharp cutbacks in military requireme
metal industry, as a whole, was operating at
estimated 28,000-ton-per-year capacity by
spite of this, sponge production for the entir
peak of 17,000 short tons. Ingot productio
the preceding year, and producers incre
civilian applications of the metal.

Other segments of the domestic titanium
Rutile production was slightly lower than
and shipments of titanium pigments decr
respectively.

Ilmenite production increased 11 percen
titanium pigments, the principal market fo

The United States continued to be the
and consumer of ilmenite and was also th
rutile. Australia, Canada, and India still
titanium concentrates imported into the U

LEGISLATION AND GOVERNME

In September 1957 the Business and Defe
tion (BDSA), United States Departmen
Amendment 2 to BDSA Order M–107. T
the required acceptance of defense-rated o
90 percent of scheduled production to 75
September titanium sponge was designated
Mobilization as a Group II material in the
and Critical Materials for Stockpiling. Ma
acquired principally through transfer of
pluses, pursuant to section 6 (a) of Public
and were not under procurement.

DOMESTIC PRODUCTI

Concentrates.—Ilmenite production increa
to a new peak of 757,000 short tons, but s
5 percent. Production came from the follow
Cyanamid Co., Piney River, Va.; E. I. d
Inc., Starke and Lawtey, Fla.; Marine Mi
National Lead Co., Tahawus, N. Y.; Rutil

[1] Commodity specialist.

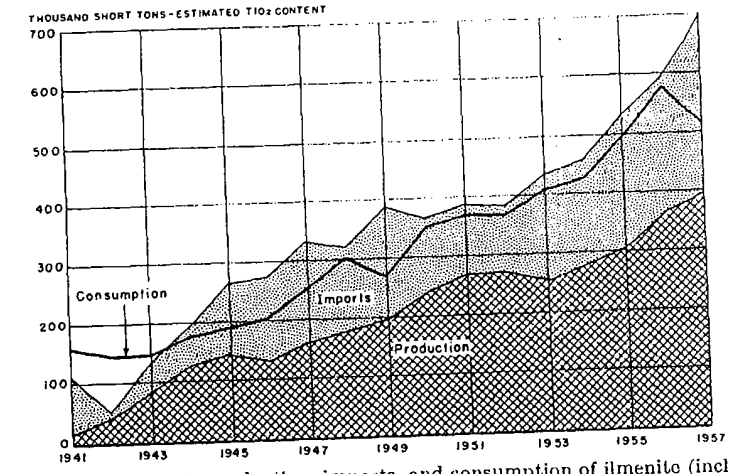

FIGURE 1.—Domestic production, imports, and consumption of ilmenite (includes titanium slag and a mixed product), 1941–57, in short tons.

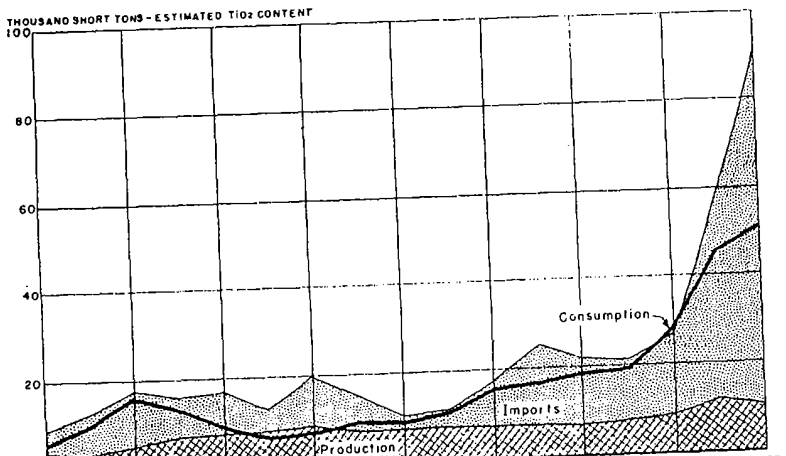

FIGURE 2.—Domestic production, imports, and consumption of rutile, 1941–57, in short tons.

Jacksonville, Fla.; Metal & Thermit Corp., Beaver Dam, Va.; and The Florida Minerals Co., Wabasso, Fla. Included in shipments was 28,400 short tons of ilmenite from stockpiles at Boise, Idaho.

Rutile production decreased 11 percent below the output of 1956, and shipments decreased 12 percent. A total production of 10,700 short tons of rutile was reported from the following companies: The Florida Minerals Co., Wabasso, Fla.; Marine Minerals, Inc., Bath,

S. C.; Metal & Thermit Corp, Beaver Da
Co. of Florida, Jacksonville, Fla.

TABLE 1.—Production and mine shipments o
domestic ores in the United States, 1948–52 (
tons

Year	Produ tion (gross weigh
ILMENITE [1]	
1948–52 (average)	464,
1953	513,
1954	547,
1955	583,
1956	684,
1957	757,
RUTILE	
1948–52 (average)	7,
1953	6,
1954	7,
1955	8,
1956	11,
1957	10,

[1] Includes a mixed product containing rutile, leucoxene, and al

Metal & Thermit Corp. began mining
ilmenite at its plant at Beaver Dam, Va.,
at the plant, scheduled to be 5,000 tons
scribed.[2]

In April, Union Carbide & Carbon Cor
Electro Metallurgical Co., a titanium-sp
plans to mine a deposit of titanium miner
northeast coast of Florida. The company
the island and planned to begin mining by
of 1958.[3]

Discovery of ilmenite-containing sand i
central New Jersey was reported by geo
Geological Survey.[4] Several firms eng
manufacturing have reportedly conducted

Metal.—The United States continued to
producer of titanium sponge, with a new
short tons in 1957. Sponge consumption
preceding year. Much of the excess spo
General Services Administration (GSA) u
ment contracts. In 1957 deliveries to GS
for a cumulative total of 19,821 short tons

Commercial producers of titanium spon
Cramet, Inc., Chattanooga, Tenn.; Dow
Mich.; Electro Metallurgical Co., Ashtab

[2] Engineering and Mining Journal, Virginia Heavy Minerals P
pp. 94–95.
[3] Mining Congress Journal, Union Carbide to Mine Titanium
[4] Markowicz, F. J., Parrillo, D. G., and Johnson, M. E., The
Prepr. 5818A5, Soc. Min. Eng., AIME, 13 pp. (pres. at the annua
16–20, 1958).
[5] Engineering and Mining Journal, Ilmenite in New Jersey: V

Nemours & Co., Inc., Newport, Del.; and Titanium Metals Corp. of America, Henderson, Nev.

The Electro Metallurgical Co., a division of Union Carbide & Carbon Corp., was the only producer using the sodium process in reducing titanium tetrachloride to titanium metal. All other domestic producers used a magnesium-reduction process.

The following data represent activity in various branches of the titanium-metal industry in 1956 and 1957 in short tons:

	1956	1957
Titanium tetrachloride consumption [1]	66, 500	79, 000
Sponge production	14, 595	17, 249
Sponge consumption	10, 936	8, 221
Scrap consumption	2, 033	1, 743
Ingot production [2]	11, 688	10, 009
Ingot consumption	10, 860	10, 428
Mill product production	5, 166	5, 658

[1] Estimated.
[2] Includes alloying constituents.

TABLE 2.—Salient statistics of the titanium-metal industry, 1948–57, in short tons

Year	Sponge-metal production	Sponge in revolving-fund stockpile December 31	Mill-shape production	Year	Sponge-metal production	Sponge in revolving-fund stockpile December 31	Mill-shape production
1948	[1] 10		(2)	1953	2, 241	30	[3] 1, 114
1949	[1] 25		(2)	1954	5, 370	2, 894	[3] 1, 299
1950	[1] 75		(2)	1955	7, 398	6, 647	1, 898
1951	495		[1] 75	1956	14, 595	9, 289	5, 166
1952	1, 075	303	[1] 250	1957	17, 249	10, 821	5, 653

[1] Estimate.
[2] Data not available.
[3] Shipments.

Plant expansions proposed and in progress in mid-1957 were either suspended or activity greatly reduced as military orders for titanium metal decreased. Titanium producers laid off workers toward the end of 1957, and in December the industry as a whole was operating at less than one-fifth its estimated yearly capacity of 28,000 tons.

Late in 1957 Mallory-Sharon Titanium Corp. combined with U. S. Industrial Chemical Co. (U. S. I.) a division of National Distillers & Chemical Corp., to form Mallory-Sharon Metals Corp. The Mallory-Sharon Titanium Corp. has for many years melted titanium sponge and produced mill products at Niles, Ohio. During 1957 U. S. I. was constructing a 5,000-ton-per-year titanium-sponge plant in the same building with its zirconium plant at Ashtabula, Ohio.

On November 12, 1957, Crucible Steel Co. of America announced that, subject to Securities and Exchange Commission approval, it had acquired full ownership of Rem-Cru Titanium, Inc. The transfer was reportedly accomplished through exchange of 150,000 shares of Crucible common stock for the entire half interest owned by Remington Arms Co.[6]

[6] American Metal Market, Crucible Steel Now Full Owner of Rem-Cru Firm: Vol. 64, No. 218, Nov. 13, 1957, pp. 1, 3.

Titanium Metals Corp. of America (T
at its Toronto, Ohio, rolling plant in
T. M. C. A., this is the first fully integ
voted to rolling and forging titanium.
have been shipped, and rolling facilities f
ready early in 1958.

The six titanium melters in 1957 w
Torrance, Calif.; Mallory-Sharon Metals
Metallurgical Corp., Albany, Oreg.; Re
land, Pa.; Republic Steel Corp., Massil
Titanium Metals Corp. of America, Hen

Oregon Metallurgical Corp. produced
other companies produced and processe
such as sheet, strip, plate, forging billets,

Pigments.—In 1957 production and s
pigments decreased 7 and 10 percent,
This was the first decrease in titanium pi
when production and shipments were 4 a
below 1951.

Titanium pigments were produced in t
lowing companies: American Cyanamid
Savannah, Ga.; E. I. duPont de Nemou
Del., and Baltimore, Md.; Glidden Co
Point, Md.; National Lead Co., St. Louis
and New Jersey Zinc Co., Gloucester Cit

Early in 1957 E. I. duPont de Nemour
it would build a 125-ton-per-day titaniu
a 1,500 acre site near New Johnsonville
produced by the chloride route whereb
converted to titanium dioxide rather tha
by all the other domestic producers. Th
operation by early 1959.

Welding-Rod Coatings.—A total of 26
rods containing titaniferous material in t
in 1957. This was a 6-percent decrease
ing rods similarly coated in the preceding

Of the total welding rods produced, 4
only; 28 percent, ilmenite only; 13 perce
manufactured titanium dioxide only;
titanium dioxide only; and 5 percent, slag

CONSUMPTION AN

Concentrates.—During 1957 the cons
titanium slag for making titanium pigme
cent, respectively. This was reflected by
production of 7 percent. Consumption
14 percent over 1956, owing partly to the
metal production. Of the 53,000 short
United States in 1957, 66 percent was u
27 percent was used in welding-rod coa
into alloys, carbides, ceramics, fiberglass, a

TABLE 3.—Consumption of titanium concentrates in the United States, 1948–52 (average), 1953–55 total, and 1956–57, by products, in short tons

Product	Ilmenite [1]		Titanium slag		Rutile	
	Gross weight	Estimated TiO_2 content	Gross weight	Estimated TiO_2 content	Gross weight	Estimated TiO_2 content
1948–52 (average) [2]	630,068	328,972	[3] 24,236	[3] 16,746	13,432	12,881
1953	687,076	354,470	73,528	52,511	20,170	19,033
1954	679,903	353,146	100,825	71,102	20,663	19,431
1955	741,460	401,146	134,053	94,522	28,702	27,192
1956						
Pigments (mfg. TiO_2) [4]	854,874	458,814	160,228	113,538	29,809	28,407
Titanium metal	([5])	([5])	([6])	([6])	13,110	12,308
Welding-rod coatings	997	689	1,397	1,016	1,195	1,138
Alloys and carbide	9,294	4,579	([6])	([6])	[3] 381	[3] 357
Ceramics	27	17			1,100	1,065
Fiberglass					[3] 1,258	[3] 1,183
Miscellaneous [7]	10	10	800	594		
Total	865,211	464,009	162,434	115,148	[2] 46,853	[3] 44,463
1957						
Pigments (mfg. TiO_2) [4]	832,350	429,019	114,168	80,866	36,048	34,488
Titanium metal	([5])	([5])	([6])	([6])	14,490	13,054
Welding-rod coatings	1,051	614	1,460	1,066	604	578
Alloys and carbide	7,280	4,423	([6])	([6])	353	330
Ceramics	22	12			1,122	1,091
Fiberglass					776	729
Miscellaneous [7]	16	9	837	613		
Total	840,719	434,077	116,465	82,645	53,393	50,870

[1] Includes a mixed product containing rutile, leucoxene, and altered ilmenite used to make pigments and metal.
[2] Revised figures.
[3] 1952 only.
[4] "Pigments" include all manufactured titanium dioxide.
[5] Included with pigments to prevent disclosing individual company confidential data.
[6] Included in "Miscellaneous" to prevent disclosing individual company confidential data.
[7] Includes consumption for chemicals and experimental purposes.

TABLE 4.—Distribution of titanium-pigment shipments, by industries, 1948–52 (average) and 1953–57, percent of total

Industry	1948–52 (average)	1953	1954	1955	1956	1957
Distribution by gross weight:						
Paints, varnishes, and lacquers	73.9	67.1	64.3	65.3	65.3	64.9
Paper	6.2	9.7	10.1	10.1	10.3	10.9
Floor coverings (linoleum and felt base)	4.5	4.8	4.5	4.6	4.2	4.1
Rubber	2.8	3.4	3.1	3.4	3.4	3.6
Coated fabrics and textiles (oilcloth, shade cloth, artificial leather, etc.)	1.8	2.0	2.4	2.7	2.8	3.2
Printing ink	1.0	1.2	1.2	1.3	1.3	1.4
Other	9.8	11.8	14.4	12.6	12.7	11.9
Total	100.0	100.0	100.0	100.0	100.0	100.0
Distribution by titanium dioxide content:						
Paints, varnishes, and lacquers	66.4	58.8	65.4	58.4	58.3	57.7
Paper	9.1	14.1	14.1	13.6	13.6	14.2
Floor coverings (linoleum and felt base)	5.6	6.4	5.2	6.2	4.9	5.0
Rubber	3.6	4.5	4.0	4.4	4.4	4.6
Coated fabrics and textiles (oilcloth, shade cloth, artificial leather, etc.)	2.4	2.6	3.2	3.4	3.6	4.1
Printing ink	1.5	1.6	1.6	1.7	1.8	1.9
Other	11.4	13.0	10.5	13.4	13.4	12.5
Total	100.0	100.0	100.0	100.0	100.0	100.0

Metal.—The consumption of titaniu
ments as a gage, was 5,700 short tons
short tons reported in 1956. Most of
went into defense applications, partic
Titanium compressor rotors for jet engin
to be used [7] and other titanium aircraft
slat tracks,[9] gained wider acceptance by

Civilian applications of titanium me
1957 owing to increasing familiarity wi
and development of titanium alloys wi
heat-treating properties. Cast-titaniun
were tested for use in the chemical indu
an order for nearly 7 miles of titanium tu
in process equipment for treating cobal

Two experimental high-speed centrifu
an alloy of titanium containing 6 perc
vanadium. The machines can operate
less-steel machines for the same workin
owing to titanium's low density, which is
of steel.[11]

Titanium mill shapes were used in wo
num workracks in the chromic acid anc

Titanium was used by one firm facin
highly corrosive acid solution of ferri
titanium pump reportedly paid for itse
operation.[13]

STOCKS

Stocks of ilmenite, rutile, and titaniu
1957. The largest increase was noted in
120 percent over the 1956 total. Ilme
cent, and stocks of titanium slag increa
rate of consumption the stocks of ilmen
titanium dioxide content), represented

Year-end stocks of titanium sponge
totaled 2,800 short tons, a slight decrea
the beginning of the year. An addition
revolving-fund stockpile. Industry sto
supply at 1957 consumption rates.

Stocks of titanium scrap held by melt
tons at the beginning of the year to 3,6

[7] SAE Journal, Alloy Titanium in J-57 Turbojet Engine:
[9] American Metal Market, Sees Major Rise for Titanium B
p. 7.
[9] Materials and Methods, Titanium Used in Jet Slat Tru
May 1957, pp. 172-173.
[10] American Metal Market, T. M. C. Books Large Order fo
Sept. 4, 1957, pp. 1, 7.
[11] Chemical Engineering, You Can Capitalize on Ti's Stren
[12] Light Metal Age, Titanium Work Holders Speed Anod
1957, p. 37.
[13] American Metal Market, Titanium Aids Processing o
1958, p. 7.

TABLE 5.—Stocks of titanium concentrates in the United States at the end of the year, 1956–57, in short tons

Stocks	Ilmenite		Titanium slag		Rutile	
	Gross weight	Estimated TiO_2 content	Gross weight	Estimated TiO_2 content	Gross weight	Estimated TiO_2 content
1956						
Mine	64,553	29,736			26	24
Distributors	134	70			1,673	1,598
Consumers	534,940	[1] 281,395	112,047	79,367	25,048	23,875
Total stocks	599,627	[1] 311,210	112,047	79,367	26,746	25,497
1957						
Mine	38,758	18,062			83	78
Distributors	195	116			3,680	3,512
Consumers	695,794	301,475	180,314	127,620	55,205	52,590
Total stocks	734,747	379,653	180,314	127,620	58,968	56,189

[1] Revised figure.

PRICES

Concentrates.—Oversupply of rutile in 1957 was reflected in price reductions during the year. Nominal prices for rutile (94 percent TiO_2, f. o. b. Atlantic seaboard), as quoted by E&MJ Metal and Mineral Markets, decreased from $190 to $230 per short ton in January 1957 to $120 to $125 per short ton at the end of the year. Prices of ilmenite remained unchanged throughout the year at $26.25 to $30 per gross ton (59.5 percent TiO_2, f. o. b. Atlantic seaboard), according to E&MJ Metal and Mineral Markets.

Manufactured Titanium Dioxide.—On February 18, 1957, the prices of rutile and anatase grades of manufactured titanium dioxide were advanced $0.01 per pound. The following prices were quoted in the Oil, Paint and Drug Reporter throughout the remainder of the year:

	Per pound
Anatase, chalk-resistant, regular and ceramic, carlots, delivered	$0.25½
Less than carlots, delivered	.26½
Rutile, nonchalking, bags, carlots, delivered East	.27½
Less than carlots, delivered East	.28½
Titanium pigment, calcium-rutile base, bags, carlots, delivered	.09¼
Less than carlots, delivered	.09¾

Metal.—In 1957 only one price change occurred for titanium-sponge metal and mill products. On June 3, 1957, sponge-metal producers lowered the price of Grade A–1 sponge 18 percent and Grade A–2 sponge 20 percent. Price of titanium mill products was reduced about 10 percent at the same time. Prices per pound quoted for titanium sponge and mill products in 1957 were as follows:

Titanium sponge, Grade A–1
Titanium sponge, Grade A–2
Sheet
Strip
Plate
Wire
Forging billets
Hot-rolled bars

[1] Maximum iron content of 0.20 percent, with a Brinel
[2] Maximum iron content of 0.45 percent, with a Brinel
[3] F. o. b. mill, commercially pure grades, in lots of 10,0

Ferrotitanium.—In 1957 the pri
quoted in E&MJ Metal and Minera
The price of high-carbon and mediun
on April 4, 1957. Nominal prices quo
Markets in 1957 were as follows:

Low-carbon: [1]
Titanium, 40 percent; carbon, 0.10 perce
Titanium, 25 percent; carbon, 0.10 perce
Medium-carbon: [2] Titanium, 17 to 21 perc
to 5 percent.
High-carbon: [2] Titanium, 15 to 19 percent;
8 percent.

[1] Price per pound in 1-ton lots or more, lump (½ inch,
United States.
[2] Price per net ton, carload lots, lump, packed; f. o. b. d

FOREIGN TR

Imports.—The 460,000 short tons c
for consumption in 1957 was a new
over 1956. Over 99 percent of imp
India. Material from Canada was r
an average of 70 percent TiO_2. Ilme
TiO_2 concentrate from sand deposits
of ilmenite from Malaya were less tha
Imports of rutile concentrate incre
new peak of 84,800 short tons, almost
Imports for consumption of titaniu
3,532 short tons, valued at $17 million
3,418 short tons (this includes the 77
the barter contract with Japan and lis
The United Kingdom supplied 67 ton

[4] Figures on imports and exports compiled by Mae B.
Activities, Bureau of Mines, from records of the U. S. De

TABLE 6.—Titanium concentrates [1] imported for consumption in the United States, 1948–52 (average) and 1953–57, by countries, in short tons

[Bureau of the Census]

Country of origin	1948–52 (average)	1953	1954	1955	1956	1957
ILMENITE						
North America: Canada	[2] 9,729	[2] 139,585	[2] 107,521	[2] 166,307	[2] 100,660	[2] 217,762
South America: Brazil	1,742					
Europe:						
France	(4)					
Norway	20,312					33
United Kingdom					40	
Total	20,312				40	33
Asia:						
Ceylon	(4)					
India	198,518	147,005	167,484	187,044	133,520	240,279
Malaya	678				28,864	2,279
Total	199,196	147,005	167,484	187,044	162,384	242,558
Africa: Egypt	144					
Oceania: Australia	42	54			197	
Grand total	231,165	280,644	275,005	353,351	359,281	460,353
Value	$1,847,506	$5,463,526	[3] $4,903,402	$7,031,060	[3] $9,107,835	$10,316,853
RUTILE						
North America: Mexico					50	
Europe:						
Norway	(4)					
Sweden					11	
Total	(4)				11	
Africa: French West						94
Oceania: Australia	9,140	16,098	14,905	19,526	48,845	84,743
Total as reported	9,140	16,098	14,905	19,526	48,906	84,837
Australia: In "zirconium ore" [5]	519	84	95			
Grand total	9,659	16,182	15,000	19,526	48,906	84,837
Value of "as reported"	$627,676	$1,791,494	$1,323,183	$1,984,431	$7,147,827	$11,843,295

[1] Classified as "ore" by Bureau of the Census
[2] Includes titanium slag.
[3] Chiefly all titanium slag averaging about 70 percent TiO_2.
[4] Less than 1 ton.
[5] Owing to changes in tabulating procedures by the Bureau of the Census, data known to be not comparable with other years.
[6] Rutile content of zirconium ore as reported to the Bureau of Mines by importers.

Exports.—In 1957 the United States exported 53,000 short tons of titanium dioxide and pigments, a decline of 18 percent below 1956. Canada, as in the past, the destination for most of the titanium-pigment exports, received 22,800 short tons in 1957. Other countries that received 1,000 tons or more were as follows: Argentina, 1,300; Australia, 1,600; Belgium and Luxembourg, 1,300; Colombia, 1,400; Cuba, 1,600; France, 4,100; Italy, 1,800; Mexico, 3,300; Netherlands, 3,900; Philippines, 2,100; and Venezuela, 1,600.

Of the 2,000 short tons of titanium concentrates shipped in 1957, 1,300 tons went to Canada. The remainder was exported as follows: Argentina, 11 tons; Chile, 3 tons; Hong Kong, 11 tons; Mexico, 25 tons; Philippines, 42 tons; United Kingdom, 56 tons; and West Germany, 112 tons.

Exports of titanium sponge and scrap increased considerably over 1956 but were still less than 100 tons. Canada and West Germany

received about 25 tons each, the Unit
and the remainder went to Sweden,
land, and Portugal. Exports of titar
to 779 short tons in 1957, a 25-percen
received 774 tons, mostly as ingots.
3 tons of mill shapes and about 1 ton of
products went to France, Sweden, Net
bourg, West Germany, Japan, and Ital

Canada received 266 short tons of
ported in 1957. Italy received 90 tons
Brazil, Sweden, Turkey, Thailand, and

TABLE 7.—Exports of titanium products from
and 1953–57, by

[Bureau of the Ce

Year	Ore and concentrates		Metal and alloys in crude form and scrap [1]		Primary n. e
	Short tons	Value	Short tons	Value	Short tons
1948–52 (average)	1,015	$112,435	(2)	(2)	(4)
1953	1,368	109,878	2	$11,858	31
1954	603	85,896	48	1,107,682	171
1955	1,143	103,752	10	36,363	35
1956	1,838	312,285	14	59,092	559
1957	2,019	276,472	71	77,629	779

[1] Beginning Jan. 1, 1955, classified as sponge and scrap.
[2] Beginning Jan. 1, 1955, classified as intermediate mill sh
[3] Not separately classified before 1952. 1952: 762 tons ($3
commercially pure titanium metal.
[4] Not separately classified before 1952. 1952: 3 tons ($38,9

WORLD REV

Declining United States requiremen
titanium metal resulted in an oversup
increased 30 percent over 1956 to a n
World ilmenite production continued
peak of 1.9 million short tons. The Un
ing producer of ilmenite, supplying 39 p
the leading producer of rutile, supplied
tailment of tin production in Malaya
ilmenite concentrate available for ship

The United States was the leading m
metal; its output was 17,200 short to
production of 3,400 short tons. An
Kingdom was 1,700 short tons.

Australia.—The estimated 147,000 s
produced in Australia was a 36-percen
from sand deposits in Queensland and
companies, Crescent Rutile N. L. at
South Wales, and Silver Valley Uraniu
South Wales, began production in 1957

TABLE 8.—World production of titanium concentrates (ilmenite and rutile), by countries, 1948–52 (average) and 1953–57, in short tons [1]

[Compiled by Pearl J. Thompson and Veronica B. Mitchell]

Country	1948–52 (average)	1953	1954	1955	1956	1957
ILMENITE						
Australia (sales) [2]	[3] 504		526	600	4,787	[4] 49,600
Brazil	1,885					
Canada [5]	14,375	151,170	124,502	164,260	220,885	269,406
Egypt	1,063	2,787	2,900	2,664	4,547	[4] 4,400
Finland		3,465	55,765	93,668	113,444	116,568
Gambia (exports)			1,216			
India	268,630	241,091	209,375	280,867	376,321	331,521
Japan [6]	[7] 661	3,199	2,638	5,097	9,634	9,055
Malaya (exports)	27,639	20,758	50,114	60,360	136,837	102,742
Norway	114,157	141,220	164,448	173,981	209,990	231,693
Portugal	384	746	553	866	679	335
Senegal	4,706	6,358	13,779	30,424	21,716	[4] 40,200
Spain	709	1,582	1,397	7,388	5,962	8,929
Thailand					385	[4] 385
Union of South Africa		10		1,917	1,855	3,118
United States [8]	464,760	513,696	547,711	583,044	684,956	757,180
World total ilmenite (estimate) [1]	890,500	1,095,100	1,234,900	1,405,100	1,792,000	1,925,100
RUTILE						
Australia	26,794	42,604	50,018	66,767	107,886	[4] 146,600
Brazil	4		140	174	338	[4] 330
French Cameroon	310	58		110	168	[4] 60
French Equatorial Africa	[9] 2					
India	70	117	117	160	606	530
Norway	24	3		10	26	28
Senegal	[10] 17				650	[4] 116
United States	7,247	6,625	7,411	8,513	11,997	10,702
World total rutile (estimate) [1]	34,500	49,600	57,700	75,700	121,700	158,400

[1] This table incorporates a number of revisions of data published in previous Titanium chapters. Data do not add to totals shown owing to rounding where estimated figures are included in the detail.
[2] Owing to high chromium content in the ore, sales are shown.
[3] Average for 1950–52 only; previous years are not available on sales basis.
[4] Estimate.
[5] Beginning 1950, includes Ti slag containing approximately 70 percent TiO_2.
[6] Represents titanium slag.
[7] Average for 1 year only, as 1952 was the first year of commercial production.
[8] Includes a mixed product containing ilmenite, leucoxene, and rutile for 1949–57.
[9] Average for 1950–52.
[10] Average for 1951–52.

TABLE 9.—Exports of rutile concentrate from Australia, 1953–57, by countries of destination, in short tons [1]

[Compiled by Corra A. Barry]

Country	1953	1954	1955	1956	1957 [2]
Belgium	521	1,519	2,700	4,797	(3)
France	2,106	3,852	3,486	4,599	(3)
Germany, West	2,144	4,397	4,573	4,042	(3)
Italy	1,981	2,289	2,154	3,433	(3)
Japan	450	1,370	2,118	2,335	(3)
Netherlands	3,504	5,100	8,687	9,008	(3)
Sweden	2,824	1,742	3,003	3,591	(3)
United Kingdom	9,701	11,078	13,702	13,993	10,214
United States	15,020	16,148	23,798	51,754	62,599
Other countries	2,148	2,162	2,539	2,161	33,887
Total	40,405	49,747	66,849	100,673	106,700

[1] Compiled from Customs Returns of Australia.
[2] January through September only.
[3] Data not separately recorded.

Ilmenite mining activity in Australi
was reported that many companies h
Australia's beaches, where sand is rich
The combined estimated annual c
N. L., Capel, and Cable, Ltd., Bunb
ilmenite concentrate.[15] Westralian Oil,
a plant with a capacity of 100,000 to
year in the Capel and Yoganup distric
Canada.—The Quebec Iron & Titani
tinued to increase its output of titaniu
of 258,900 short tons in 1957. The co
and began production from a new furn
the total number of furnaces to 6; 2 mo
by the end of 1958.[17]

TABLE 10.—Quebec Iron & Titanium Corp
short ton

Item	1953
Ore crushed	158,218
Ore smelted	(1)
Titanium slag produced	141,883
Titanium slag shipped	145,402
Estimated TiO_2 content of slag produced	99,318
Value of slag produced	$4,206,490
Desulfurized iron produced	100,875
Desulfurized iron shipped	94,687

[1] Data not available.

A total of 10,500 short tons of ilmenit
in 1957 from the St. Urbain area, Qu
Iron Co., Ltd., and Continental Iron
use as heavy aggregate for concrete i
United States and for manufacturing
short tons valued at $37,100 was shi
uses.[18]
The first titanium-pigment plant in C
nium Pigments, subsidiary of National
was officially opened at Varennes, Q
Plant capacity was rated at 18,000 ton
a year. Titanium dioxide slag, crushe
about 70 percent titanium dioxide, w
Iron & Titanium Corp. smelter about
River from Varennes.[19]
Ceylon.—It was reported that the C
to develop the ilmenite sands at Pulmo
were reportedly obtained by the Gove
plant and lend technologic assistance.[20]
Finland.—Further details on the tita
maki, owned and operated by the Gov

[15] Mine and Quarry Engineering, Western Australia Ilm
[16] Industrial and Mining Standard, Tailings From the W
[17] Konnecott Copper Corporation, Forty-Third Annual
[18] Janes, T. H., Titanium in Canada, 1957: Canadian De
[19] Janes, T. H., Titanium in Canada—1957: Canadian M
[20] Chemical Age (London), Ceylon Ilmenite Project: Vol

lished during 1957.[21] Through improved ore-dressing techniques, the Otanmaki Company was able to produce tonnages of ilmenite in excess of designed capacity. The mill began producing in 1954 after the processes involved had been extensively studied at the Mineral Dressing Laboratory of the State Institute for Technical Research in Helsinki.

Japan.—The output of titanium slag used for making titanium metal decreased slightly in 1957 from 9,600 short tons in 1956 to 9,000 tons. Output of the 4 major producers was as follows: Hokuetsu Electric Chemical Industrial Co., 2,716 short tons; Morioka Electric Chemical Co., 1,743 short tons; Nisso Steel Manufacturing Co., 2,622 short tons; and Osaka Titanium Co., Ltd., 1,916 short tons. The Tokyo Iron & Steel Co. produced 57 short tons in March and September.

The Nisso Steel Manufacturing Co. announced in July that production of titanium slag in its plant was halted because Osaka Titanium Co., its chief customer, was not accepting any more titanium slag or other titanium raw materials.[22]

The titanium-sponge-metal industry increased output, but production rates at the end of 1957 were somewhat below capacity. Output during the year was 3,393 short tons—22.6 percent above the 1956 production.

TABLE 11.—Titanium-sponge production in Japan, 1952–57, in short tons

Company	1952	1953	1954	1955	1956	1957
Osaka Titanium Co., Ltd	9	66	338	639	1,146	1,604
Toho Titanium Industry Co., Ltd		5	263	608	1,439	1,559
Nippon Soda Co., Ltd		6	37	115	183	170
Nippon Electric Metallurgical Co., Ltd		(1)	28	9		
Mitsui Mining & Smelting Co., Ltd		(1)	7	7		
Total	9	77	673	1,378	2,768	3,393

[1] Less than 1 ton.

Exports of titanium sponge in 1957 totaled 2,734 short tons, of which 2,689 short tons went to the United States and 45 tons to countries in Europe.

Production of titanium dioxide continued upward to 33,700 short tons, 33 percent over 1956. In July the Ishihara Industrial Co., Ltd., the leading titanium dioxide producer in Japan, completed an expansion program, which doubled its capacity from 1,000 tons to

TABLE 12.—Titanium dioxide production, exports, and stocks in Japan, 1953–57, in short tons

Year	Production	Exports	Stocks	Year	Production	Exports	Stocks
53	6,703	530	502	1956	25,269	10,208	1,174
54	13,820	5,218	882	1957	30,811	16,590	2,400
55	19,068	8,677	538				

[21] Mining World, How Otanmaki Floats Ilmenite From Finland's Titaniferous Magnetite: Vol. 19, No. 4, April 1957, pp. 49–55.
[22] Metal Bulletin (London), Japanese Slag Output Stops: No. 4212, July 19, 1957, p. 25.

2,000 tons monthly.[23] The plant is at Yo
southern Honshu and is designed to proc

Malaya.—Ilmenite exports from Ma
percent compared with 1956. Ilmenite
of tin dredging. Curtailment of tin ope
pected to reduce the quantity of ilmenite

**TABLE 13.—Exports of ilmenite from Malaya, 19
in short tons [1]**

[Compiled by Corra A.

Country	1953
Australia	
Belgium	3,607
France (including Corsica)	2,670
Germany, West	
Italy (including Sardinia)	
Japan	10,527
Netherlands	1,456
United Kingdom	11,592
United States	
Other countries	
Total	29,768

[1] Compiled from Customs Returns of Malaya.

Union of South Africa.—The Anglo A
Africa) announced that Umgababa M
company, would begin to produce titan
trates by mid-1958 from a mine at Umg
This mine was formerly operated on a s
Corp. of South Africa. Umgababa Mi
additional facilities to raise capacity to
year and to recover zircon and rutile at
tons per year, respectively.[24] Part of th
be utilized by a titanium dioxide-pigm
planned by the British Titan Products
Explosives & Chemical Industries, Ltd.

United Kingdom.—Imperial Chemical
Wilton, Yorkshire, continued to be the
titanium-sponge metal in the United K
annual capacity in 1957 of the Wilton
short tons. The company melting and
compressed titanium granules produce
titanium tetrachloride into pellets or ba
the metal was to be melted in a furnac
nonconsumable electrodes. Construction
rolling plant at Waunarlwydd, near S
expected to be completed by mid-1958.
Witton were expected to cease as the W

[23] Mining World, Asia: Vol. 19, No. 8, July 1957, p. 100.
[24] American Metal Market, Umgababa Will Start Ilmenite
1957, pp. 1, 7.

pleted.[25] A 2,000-ton double-melting vacuum furnace, equipped with fully automatic, electronically controlled electrode feeder gears, and operated remotely, was being built in Hanau, West Germany, for the I. C. I. melting plant at Witton.[26]

TECHNOLOGY

One of the most significant advances in titanium-metal technology in recent years was reported by the Federal Bureau of Mines in 1957.[27] A laboratory process was developed for preparing high-purity titanium from scrap and offgrade sponge. By electrorefining the metal in a fused-salt bath, titanium containing relatively large amounts of iron, nitrogen, and oxygen and having a Brinell hardness of 314 was refined to a metal with a Brinell hardness of 78.

An arc-melting technique was reported [28] for preparing 25- to 30-pound ingots of uncontaminated titanium, binary titanium-aluminum alloys, and various ternary additions to the titanium-aluminum base. Extensive chemical and mechanical tests showed a high degree of uniformity in the ingots prepared and confirmed reports by other investigators of the high impact-strength potential of certain titanium-aluminum alloys.

A constitution diagram for the system titanium-germanium up to 30 percent germanium was proposed.[29] Metallographic, X-ray, and resistivity studies indicated a eutectic composition of 19 percent germanium at 1,360° C. and a peritectic reaction at 905° C. with 4 percent germanium. Formation of a single compound, Ti_5Ge_3 was reported in the part of the system studied.

Corrosion rates of titanium and a variety of titanium alloys with manganese, chromium, iron, vanadium, and zirconium were studied in mineral acids, nitric acid, and chloride solutions by L. B. Golden and others.[30] Comparative tests were conducted on samples from arc-melted ingots and ingots prepared by powder-metallurgy techniques.

Thermodynamic values at 298.15° and 1,600° K. for several titanium-oxygen interstitial compounds were determined in a cooperative undertaking between the Federal Bureau of Mines and the Office of Naval Research.[31] Theoretical considerations were reported and calculated partial molal free energy-composition isotherms for 800° and 1,600° C. are presented for the composition range 0 to 2 weight-percent oxygen.

Submarginal deposits of titanium minerals were investigated and a method proposed for separating columbium and iron from these ores by a fractional distillation process following chlorination.[32]

[25] Metal Bulletin (London). Titanium Progress At Waunarlwydd: No. 4195, May 17, 1957, p. 23.
[26] Metallurgia, Titanium-Melting-Plant Order: Vol. 55, No. 331, May 1957, p. 247.
[27] Nettle, J. R., Baker, D. H., Jr., and Wartman, F. S., Electrorefining Titanium Metal: Bureau of Mines Rept. of Investigations 5315, 1957, 43 pp.
[28] Huber, R. W., and Lane, I. R., Jr., Consumable-Electrode Arc Melting of Titanium and Its Alloys: Bureau of Mines Rept. of Investigations 5311, 1957, 36 pp.
[29] Peterson, V. C., and Huber, R. W., The Titanium-Germanium System From 0 to 30 Percent Germanium: Bureau of Mines Rept. of Investigations 5365, 1957, 20 pp.
[30] Golden, L. B., Ackerman, W. L., and Schlain, D., The Relative Corrosion Resistance of Titanium and Some of Its Alloys: Bureau of Mines Rept. of Investigations 5209, 1957, 25 pp.
[31] Mah, A. D., and others, Thermodynamic Properties of Titanium-Oxygen Solutions and Compounds: Bureau of Mines Rept. of Investigations 5316, 1957, 33 pp.
[32] Nieberlein, V. A., Low-Temperature Chlorination of Columbium-Bearing Titanium Minerals: Bureau of Mines Rept. of Investigations 5349, 1957, 15 pp.

A comprehensive study of the titaniu
to semifinished product was published.[33]
geologic occurrence, prospecting, minin
titanium minerals as well as descriptions
manufacturing titanium metal, pigment
other miscellaneous products containing

A field method using simple, inexp
evaluation of heavy-mineral-bearing sa
found application in expediting the wor
sand deposits.[34]

Gamma rays from radioactive cobalt
research laboratory to determine the lev
arc melting furnace.[35] According to this
melting was maintained automatically
through the furnace walls and the ingot

Comparative physical-property data
metals and a table of mediums in which
corrosion resistance were made availab
production engineers interested in using

Chemical and physical data for a nu
alloys were reported.[37]

A literature survey was conducted [38]
cation, and mechanical and corrosion pr

Development of the iodide process o
conium was reviewed.[39]

Sodium reduction of titanium tetrachl

A laboratory process using ilmenite as
a potassium chlorotitanate product, whi
posed at 300° to 500° C. to titanium
chloride, was reported in 1957.[41] Produ
chloride is claimed.

Mellgren and Opie studied equilibriu
valent titanium in a fused sodium chlo
at various temperatures and concentratio

A method was patented for direct re
by aluminum metal, followed by a lea
metal to remove excess aluminum.[43]

[33] Miller, J. A., Titanium, A Materials Survey: Bureau of M
[34] Clemmons, B. H., Stacy, R. H., and Browning, J. S., Heav
of Sands by Prospectors and Plant Operators: Bureau of Mines
[35] American Metal Market, Titanium Furnace Is Controlle
Apr. 19, 1957, pp. 1, 7.
[37] Industrial and Engineering Chemistry, Part I, Titanium:
[38] Inglis, N. P., Titanium Research and Development: Met
185–188, 194.
[39] Bomberger, H. B., Titanium: Ind. Eng. Chem. pt. II, vol.
[41] Shelton, R. A. J., The Development of the Iodide Process of
lurgia, vol. 55, No. 331, May 1957, pp. 225–231.
[43] Milton, John, Sodium Process Extracts Titanium in Comm
May 1957, pp 120–122.
[41] Chemical Engineering Progress, New Process for Titanium
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High-Melting-Point Metals and Their Alloys: U. S. Patent 2,8

In another patented method for producing titanium, titanium-bearing material is reacted with calcium chloride and an alkali metal such as sodium.[44]

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Tungs

By R. W. Holliday [1] a

THE TUNGSTEN-MINING indu
in December 1956 when the Go
concentrate from domestic produc
and prices declined.

From a domestic output of 2,896,0
in 1949, production had increased e
pounds in 1955 and nearly as much i
tion during the same period increas
pounds to an estimated 77,520,000 po
in 1956. Much of the increase, bot
United States Government stockpil
sumption was relatively stable, ave
years 1949–56. Virtually all Governm
at above-market prices.

Therefore, after suspension of Gov
sources, the available supply greatly
United States were capable of prod
required by industry; by the end of
producers and consumers; additiona
for import; and large Government st
market, were available for emergenc

TABLE 1.—Salient statistics of tungsten or
1948–52 (average) and 1953–57, in thou

	1948–52 (average)
Mine production	4,808
Mine shipments	4,855
General imports [1]	9,995
Consumption	8,060
Stocks:	
Producers	410
Consumers and dealers	4,297
Total	4,707

[1] Includes Alaska.
[2] Ore and concentrate received in the United States;
the remainder entered bonded warehouses or Governme

[1] Commodity specialist.
[2] Statistical clerk.