

MINER YEARBOOK

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Ferrous scrap exported from the United States, 1943-47, by countries, in short tons

[U. S. Department of Commerce]

Country	1943	1944	1945	1946	1947
Argentina.....		87	4,204	4,630	8,414
Brazil.....		271	1,098	787	1,165
Canada.....	34,085	71,518	47,465	82,346	119,394
Chile.....	615	72	7,447	1,314	5,719
China.....			112	7,930	6,315
Colombia.....	155	1,819	955	22	587
Cuba.....	1		687	521	845
Denmark.....				55	2,080
Hong Kong.....				640	2,572
Mexico.....	18,167	17,500	27,471	48,104	33,978
Philippines, Republic of.....				240	420
Portugal.....			510	493	2,448
Sweden.....			50	50	1,077
Turkey.....	401		168	393	477
Union of South Africa.....			199	435	141
United Kingdom.....	115		4,432	425	1,721
Uruguay.....		220	877	505	4,585
Other countries.....	1,305	4,186			
Total: Short tons.....	54,894	95,682	95,734	149,106	104,021
Value.....	\$1,070,809	\$1,910,220	\$2,589,239	\$3,384,514	\$9,800,005

Lead¹

By RICHARD H. M.

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GENERAL SUMMA

EXTRAORDINARY consumer demand price to record-breaking levels, and a reconversion problems, such as burdened in 1946, together were chiefly responsible for mine output of recoverable lead, of 32 percent of refined lead, and of 30 percent in recoverable sources in 1947. The increased supply, however, by consumers for current needs and for civilian demand accumulated during the war, together with the production of primary, antimonial, and secondary at a record high of 1,172,000 short tons.

All previous peak records for recovery sources were shattered in 1947. Recovery that in the previous record year 1941 by 1946 output by 30 percent. For the second lead production surpassed the output of recoverable mines.

Refined lead stocks (physical inventory) declined 67 percent during 1947, and at the end of the year were 19 percent of the 1941 level.

The Office of Metals Reserve stock pile to 4,996 tons at the end of 1947—approximately the quantity available for allocation at the beginning of the year. Figure 1 shows trends in the domestic

¹ This report deals primarily with the smelting, refining, and casting of lead. For details of mining operations, see various State chapters of this volume.

Salient statistics of the lead industry in the United States, 1938-42 (average) and 1943-47, in short tons

	1938-42 (average)	1943	1944	1945	1946	1947
Production of refined primary lead:						
From domestic ores and base bullion	421,776	406,544	394,413	356,535	263,309	381,400
From foreign ores and base bullion	82,062	63,668	70,320	87,050	41,888	50,901
Total	503,838	470,212	464,733	443,585	305,197	432,301
Recovery of secondary lead	280,433	342,001	331,416	363,039	392,787	511,970
Imports ¹						
Lead in pigs, bars, and old	161,118	214,510	226,673	230,314	111,706	175,449
Lead in base bullion	30,476	4,583	58	8	125	1,500
Lead in ores and matte	69,798	69,915	93,570	70,695	41,407	50,752
Exports of refined pig lead ²	37,062	13,261	15,523	1,784	700	1,616
Estimated consumption of primary and secondary lead	817,600	1,113,000	1,118,631	1,051,602	956,476	1,172,000
Prices (cents per pound):						
New York:						
Average for year	5.45	6.50	6.50	6.50	8.11	14.67
Quotation at end of year	5.64	6.50	6.50	6.50	12.55	15.00
London average	3.98	4.49	4.49	4.99	8.63	15.27
Mine production of recoverable lead	439,752	453,313	416,393	390,831	335,475	391,221
World smelter production of lead	1,890,500	1,722,900	1,492,200	1,231,400	1,141,800	1,413,100

¹ Data include lead imported for immediate consumption plus material entering the country for storage under bond.

² Includes 11,258 tons of foreign lead reexported in 1913, less than 1 ton in 1914, 377 tons in 1915, 103 tons in 1916, and 102 tons in 1917, according to records of the U. S. Department of Commerce.

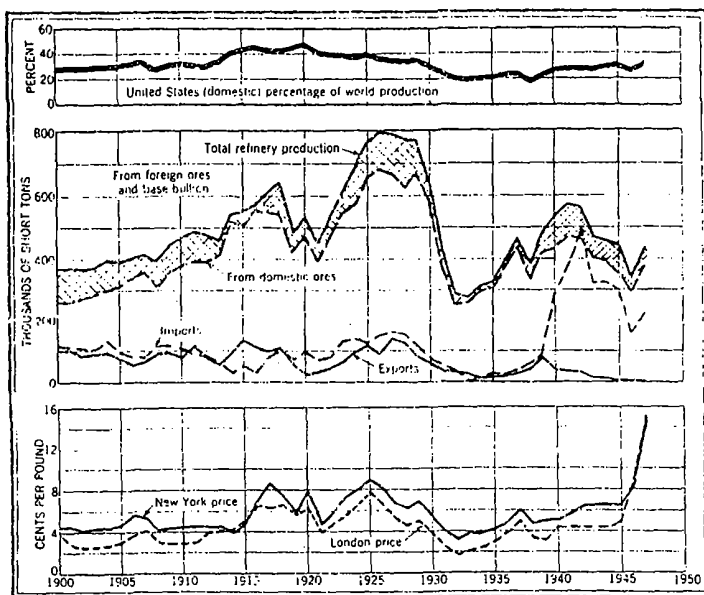


FIGURE 1.—Trends in the lead industry in the United States, 1900-1947. Imports include lead in ore, base bullion, pig lead, and scrap; exports include pigs, bars, and scrap lead exported in manufactures with benefit of draw-back. Data on lead exported in manufactures with benefit of draw-back not available for 1945-47.

RESERVE

The following information on reserves of reserves are discussed. Because of the information published in hearings before a Subcommittee on Public Lands, United States Senate, 1947 (pp. 257-258):

In the chapter on zinc a number of problems of reserves are discussed. Because of the information published in hearings before a Subcommittee on Public Lands, United States Senate, 1947 (pp. 257-258):

The existing technology for recovery of reserves is applicable that no significant reserves remain. The lead reserves available under normal economic conditions as reflected in the particularly zinc, in relation to production of the 20-year period, 1921-40; (2) additional under more favorable economic conditions, a better than normal; and (3) additional reserves under abnormal conditions similar to those of 1942 both lead and zinc were paid to operators of subordinate constituent in many base-metal ores, usually zinc, will have a large effect on the price of silver also will be a critical determining factor in lead-producing properties.

The [accompanying table] summarizes the million short tons of lead—measured, indicated, and inferred. The quantity of lead that could be mined or recovered is small, although it is realized that low-grade material available in Southeastern information is available for quantitative estimates of lead contained in the low-grade zinc ores region may never be recovered if this ore is available metal prices following the war.

The estimate does not include inferred reserves or in known districts the lead potentialities. Hence the estimate is a minimum that will factors to an unknown extent.

Estimated lead reserves of the United States metallic lead

	Measured and indicated ¹	Indicated ²
	Gross content in ground	Reserve content
A. Lead in deposits that could be mined under technologic conditions as in 1944:		
1. Under normal economic conditions	2,080,000	1,700,000
2. Additional, under somewhat more favorable economic conditions	400,000	300,000
3. Additional, under emergency prices	110,000	110,000
Total	2,600,000	2,200,000
B. Lead in deposits whose exploitation is dependent on future technologic advances		

¹ This includes estimates of measured and indicated reserves for which the tonnage figures are unavailable to us.

² Milling and smelting losses are considered to be rough.

³ Price equivalent to 6 cents per pound for both lead and zinc.

The Alaskan reserves, which as known at present amount to only 36,000 tons of metal, indicated and inferred, in all categories of ore, are not included in the table.

Without regard for price and productive capacity, the lead recoverable from measured and indicated ore by present technologic methods is equivalent to the domestic needs of this country for 4 years at an estimated minimum peacetime rate of 500,000 tons of primary metal per year. The additional inferred reserves in known districts should add another 9 years. At an annual wartime demand of about 750,000 tons, the total reserve is equivalent to only a 9-year supply. However because domestic lead-producing capacity is not rapidly adjustable to sudden increases in demand for the same reasons that make zinc production equally unadjustable, it would appear probable that, unless a huge stock pile is built up, heavy dependence will be placed on foreign sources in any future war period. The lead deposits of Mexico appear ample to supply a large share of such needs.

DOMESTIC PRODUCTION

Statistics on lead output may be prepared on a mine or on a smelter and refinery basis. The mine-production data compiled on the basis of lead content in ore and concentrates and adjusted to account for average losses in smelting are the most accurate measure of production from year to year. The pig-lead output, as reported by smelters and refiners, presents a more precise figure of actual lead recovery but generally differs from the mine figure owing to the overlap or lag between mine shipments and smelter receipts of ore and concentrates. These inequities, however, tend to balance over a period of years.

MINE PRODUCTION

The mine production of recoverable lead (including that made into pigments) from domestic mines in the United States and Alaska increased 15 percent in 1947; but, except for 1946, the output was the smallest since 1938. The domestic mine production of lead comes principally from three areas—Southeastern Missouri; the Tri-State area (Joplin region), embracing Southwestern Missouri, Southeastern Kansas, and Northeastern Oklahoma; and the Western States (principally Idaho, Utah, Arizona, Colorado, and Montana). Of the total produced in the United States in 1947, about 65 percent came from the output of 25 mines. Missouri again ranked first in the production of lead, and the Southeastern Missouri district continued to be the largest lead-producing area, supplying 34 percent of the total domestic output. The St. Joseph Lead Co. continued, as in the past, to produce the bulk of the output from its Bonne Terre, Desloge, Federal, and Leadwood groups of mines. Each mine is equipped with a mill; the four have a combined daily capacity of 21,400 tons of ore. The Tri-State area produced 6 percent of the total domestic output in 1947 compared with 7 percent in 1946. The Western States contributed 58 percent of the total domestic production and recorded a 34-percent gain in output over 1946. Idaho continued to be the largest producer of lead in the Western States and second largest in the United States. More than 92 per-

cent of the State total lead came from six properties in Idaho produced 56 percent of the total 85 percent came from Idaho. In 1947, lead mining in Utah had 19 percent greater than in 1946. Phelps Dodge Corp. at Bisbee continued to be the largest lead producer in 1947; about 89 percent of the total lead was recovered from zinc-lead ore. Arizona was the largest in any year covered from zinc-lead ore. Colorado was the largest lead-producing area in the State in 1947.

Mine production of recoverable lead in the United States and 1943-47, by State

State	1938-42 (average)
Western States and Alaska:	
Alaska.....	757
Arizona.....	13,014
California.....	2,282
Colorado.....	11,382
Idaho.....	101,303
Montana.....	18,045
Nevada.....	6,283
New Mexico.....	4,688
Oregon.....	31
South Dakota.....	18
Texas.....	228
Utah.....	70,102
Washington.....	3,802
Wyoming.....	1
Total.....	232,046
West Central States:	
Arkansas.....	16
Kansas.....	12,064
Missouri.....	163,163
Oklahoma.....	23,658
Total.....	199,700
States east of the Mississippi River:	
Illinois.....	1,342
Kentucky.....	233
New York.....	2,180
North Carolina.....	1
Tennessee.....	381
Virginia.....	3,239
Wisconsin.....	630
Total.....	8,006
Grand total.....	439,752

Mine production of recoverable lead in the United States, by districts that produced 1,000 tons or more during any year, 1943-47, in short tons

District	State	1943	1944	1945	1946	1947
Southeastern Missouri region	Missouri	179,012	169,622	173,005	175,706	170,516
Coeur d'Alene region	Idaho	80,813	76,813	63,410	75,516	73,090
West Mountain (Bingham)	Utah	35,437	31,169	22,723	12,313	26,161
Tri-State (Ogden region)	Kansas, Oklahoma, Missouri	34,722	28,079	23,535	23,373	34,330
Warren (Bisbee)	Arizona	16,022	11,660	8,016	8,373	10,852
Park City region	Utah	3,290	3,251	2,879	2,357	10,630
Summit Valley (Butte)	Montana	2,418	2,699	5,214	7,705	6,531
Coso (Darwin)	California	3,261	3,319	4,930	4,239	4,164
Butte	Idaho	3,140	4,161	5,216	4,740	4,033
Gold Butte (Leadville)	Colorado	4,320	4,762	5,016	4,411	4,396
Just Valley and Smelter (Tooele County)	Utah	3,705	3,293	3,137	3,490	3,829
Austerville	Virginia	1,700	4,235	4,222	4,381	3,803
Pioche	Nevada	2,012	4,036	2,087	3,187	3,187
Central	New Mexico	3,571	4,128	3,379	3,199	3,130
Merline	Washington	3,571	3,378	3,500	3,231	3,430
Tina (Spartan, Tappan, Twin Buttes)	Arizona	4,581	2,415	2,693	2,235	2,409
Upper San Miguel	Colorado	2,071	1,412	1,985	2,375	2,529
Big Bug	Arizona	1,145	1,214	1,281	1,155	2,323
Animas	Colorado	2,637	2,216	2,613	3,297	2,311
Leadville	Colorado	2,350	2,435	2,175	2,618	2,957
Imperial (Ogden)	Colorado	2,305	2,825	2,410	2,175	2,012
Imperial	Idaho	1,481	2,009	1,302	5,533	2,019
Kentucky-Southern Illinois	New Mexico	1,399	1,620	1,213	1,273	1,987
Warm Springs	Idaho	2,199	2,018	2,610	1,857	1,850
Upper Mississippi Valley	Illinois	3,635	3,333	2,317	1,619	1,829
St. Lawrence County	Iowa, Northern Illinois, Wisconsin	1,001	1,308	2,291	1,861	1,816
Tombah	New York	2,355	1,614	1,073	1,073	1,095
Hartshorn	Colorado	2,355	1,373	1,065	1,373	1,425
For Mile	Arizona	3,494	2,212	1,965	6,692	1,323
Silver Creek	Colorado	226	32	38	136	1,107
Rocky Mt.	Hiale	49	5	158	438	1,010
Rocky Mt.	Washington	1,701	1,414	1,722	6,800	9,214
Opik	Colorado	1,461	1,365	1,115	335	750
Walapai	Idaho	1,392	784	732	369	651
Beale	Arizona	1,580	1,128	630	463	303
Smelter (Lawis and Clark County)	Montana	2,389	1,361	223	463	60
Harker	California	1,613	(c)	56	(c)	89
Hester Springs	California	(c)	(c)	57	(c)	32

1 Revised figure.
2 Not listed in order of output.
3 Bureau of Mines not at liberty to publish figures.

Mine production of recoverable lead in the United States, 1941-47, by months, in short tons

Month	1941	1942	1943	1944	1945	1946	1947
January	2,117,627	44,182	37,205	39,626	31,830	22,475	31,515
February	2,117,627	42,916	37,082	37,982	31,507	22,412	30,251
March	2,117,627	45,305	40,032	39,272	33,220	30,298	32,735
April	2,117,627	41,318	39,180	37,733	33,602	28,108	33,302
May	2,117,627	43,301	37,806	36,352	35,316	25,555	33,361
June	2,117,627	42,238	36,733	35,731	31,941	25,030	32,826
July	2,117,627	41,238	36,733	35,731	30,717	25,030	32,826
August	2,117,627	39,872	36,733	35,731	30,717	25,030	32,826
September	2,117,627	37,764	36,733	35,731	30,717	25,030	32,826
October	2,117,627	38,191	36,733	35,731	30,717	25,030	32,826
November	2,117,627	37,065	36,733	35,731	30,717	25,030	32,826
December	2,117,627	39,268	36,733	35,731	30,717	25,030	32,826
Total	401,426	496,239	453,313	416,561	390,831	335,473	384,221

1 Monthly data for 1941-47 were based largely on smelter receipts, whereas those for 1945-47 represent actual mine output. All monthly figures are based on data reported to the Bureau of Mines by the mining industry. 2 Monthly average for first quarter; actual monthly figures not available.

The 25 leading lead-producing mines in the United States in 1947, listed in the following table, yielded 65 percent of the total domestic lead output; the 5 leading mines produced 37 percent and the 10 leading mines nearly 50 percent.

Twenty-five leading lead-producing mines in the United States in 1947, in order of output

Rank	Mine	District	State	Operator	Type of ore
1	Federal	Southeastern Missouri	Missouri	St. Joseph Lead Co.	Lead.
2	Leadwood	do.	do.	do.	Do.
3	United States & Lark	West Mountain (Bingham)	Utah	U. S. Smelting, Refining, & Mining Co.	Zinc-lead.
4	Desloge	Southeastern Missouri	Missouri	St. Joseph Lead Co.	Lead.
5	Bunker Hill & Sullivan	Yreka	Idaho	Bunker Hill & Sullivan Mining & Concentrating Co.	Zinc-lead.
6	Copper Queen	Warren (Bisbee)	Arizona	Phelps Dodge Corp.	Do.
7	Bonne Terre	Southeastern Missouri	Missouri	St. Joseph Lead Co.	Lead.
8	Star	Hunter	Idaho	Sullivan Mining Co.	Zinc-lead.
9	Butte Mines	Summit Valley (Butte)	Montana	Anaconda Copper Mining Co.	Do.
10	Pago	Yreka	Idaho	Federal Mining & Smelting Co.	Do.
11	Mine La Motte	Southeastern Missouri	Missouri	St. Joseph Lead Co.	Lead.
12	Darwin group	Coso (Darwin)	California	Anaconda Copper Mining Co.	Do.
13	Madison	Southeastern Missouri	Missouri	St. Louis Smelting & Refining Co.	Lead-copper.
14	Chief, Gemini, etc.	Tintic	Utah	Chief Consolidated Mining Co.	Zinc-lead.
15	Morning	Idaho	Idaho	Federal Mining & Smelting Co.	Do.
16	Mammoth-Collins	Old Hat	Arizona	St. Anthony Mining & Development Co.	Do.
17	Sherman	Leland	Idaho	Day Mines, Inc.	Do.
18	Austinville	Austinville	Virginia	New Jersey Zinc Co.	Do.
19	Sidney	Yreka	Idaho	Sidney Mining Co.	Do.
20	Silver King	Park City	Utah	Silver King Coalition Mines Co.	Do.
21	Park Galena & Mayflower	do.	do.	New Park Mining Co.	Do.
22	Combined Metals group	Pioche	Nevada	Combined Metals Reduction Co., & R. E. West Mining Co.	Do.
23	Park Utah	Park City	Utah	Park Utah Consolidated Mining Co.	Do.
24	Resurrection	California (Leadville)	Colorado	Resurrection Mining Co.	Do.
25	San Xavier	Pima	Arizona	Eagle-Picher Mining & Smelting Co.	Do.

Detailed information on the production of mines and districts in the United States may be found in the chapters of this volume dealing with the mine production of gold, silver, copper, lead, and zinc in the various States.

SMELTER AND REFINERY PRODUCTION

Pig lead in the United States is derived from three main sources—domestic mine production, imports of foreign ore and base bullion, and secondary smelter output from scrap material—and is produced at primary plants that treat ore, base bullion, and small quantities of scrap and at secondary plants that process scrap exclusively. Of the eight primary smelters operating in the Western States, only two (Selby, Calif., and Bradley, Idaho) produced refined merchant lead. The other six plants produce only base bullion (containing approximately 98 percent lead plus gold, silver, and small quantities of impurities recovered from the ore smelted), which is shipped to refineries in the Middle Western and Eastern States for recovery of the gold and silver and purification of the lead to meet commercial requirements. Both primary and secondary smelting plants may make refined lead or antimonial lead. Because of the large quantity of hard lead—such as battery scrap—melted at secondary smelters, the output from this type of operation is essentially antimonial lead alloys. Statistics on the production of refined lead and alloys at secondary plants are given in the Secondary Lead section of this chapter. The 15 primary smelters and refineries in operation in the United States in 1947 consumed 448,703 short tons (lead content) of ore and concentrates, 14 percent of which was of foreign origin, compared with 353,197 tons in 1946, 12 percent of which was foreign.

ACTIVE LEAD SMELTERS AND REFINERIES

Primary lead smelters and refineries operating in the United States in 1947 were as follows:

California: Selby—Selby plant, American Smelting & Refining Co. (smelter and refinery).
 Colorado: Leadville—Arkansas Valley plant, American Smelting & Refining Co. (smelter).
 Idaho: Bradley—Bunker Hill Smelter, Bunker Hill & Sullivan Mining & Concentrating Co. (smelter and refinery).
 Illinois: Alton—Federal plant, American Smelting & Refining Co. (smelter and refinery).
 Indiana: East Chicago—U. S. S. Lead Refinery, Inc. (refinery).
 Kansas: Galena—Galena plant, Eagle-Picher Co. (smelter and refinery).
 Missouri: Herculaneum—Herculaneum plant, St. Joseph Lead Co. (smelter and refinery).
 Montana: East Helena—East Helena plant, American Smelting & Refining Co. (smelter).
 Nebraska: Omaha—Omaha plant, American Smelting & Refining Co. (refinery).
 New Jersey:
 Barber—Perth Amboy plant, American Smelting & Refining Co. (smelter and refinery).
 Carteret—United States Metals Refining Co. (refinery).
 Texas: El Paso—El Paso plant, American Smelting & Refining Co. (smelter).
 Utah:
 Midvale—Midvale plant, United States Smelting, Refining & Mining Co. (smelter).
 Murray—Murray plant, American Smelting & Refining Co. (smelter).
 Tooele—Tooele plant, International Smelting & Refining Co. (smelter).

LEAD

REFINED LEAD

Primary refineries in the United States in 1947 produced 441,010 short tons of refined lead, an increase of 32 percent over 1946 of 346,210 tons.

Of the 441,010 tons of primary lead produced in 1947, 86 percent was refined lead and 14 percent was base bullion supplied 86 percent domestic and 13 percent foreign. The quantity of refined lead produced from foreign base bullion has been small. The accompanying tables give the production of refined lead and by country of origin of the ore. Details of the production from domestic ores are given in the Mine Production chapter.

Refined lead produced at primary refineries in the United States, 1943-47, in short tons

Source	1943	1944
Refined lead:		
From domestic ores and base bullion	406,544	394,413
From foreign ores	62,936	70,225
From foreign base bullion	132	98
Total from primary sources	469,612	464,736
From scrap	1,863	11,368
Total refined lead	471,475	476,104
Average sales price per pound	\$0.004	\$0.004
Total calculated value of primary refined lead	\$60,110,000	\$59,400,000

* Excludes value of refined lead produced from scrap at primary refineries.

Refined primary lead produced in the United States, 1943-47, in short tons

Source	1943	1944
Domestic ore and base bullion	406,544	394,413
Foreign ore:		
Australia	16,180	22,210
Canada	4,537	7,461
Mexico	2,213	5,250
South America	9,610	13,434
Other Foreign	30,396	21,870
Total	62,936	70,225
Foreign base bullion:		
Mexico	80	58
South America	72	37
Total	132	95
Total foreign	63,068	70,322
Grand total	469,612	464,736

ANTIMONIAL LEAD

Antimonial lead production at primary refineries in 1947, 71 percent greater than in 1946, was 86,075 tons. The distribution of the lead, according to source

table. The quantity of antimony contained in antimonial lead produced in 1947 dropped to 5.7 percent owing to a greater demand for low-percentage alloys for use in manufacturing of such items as type metal, cable covering, sheet and pipe, and collapsible tubes and foil. Although antimonial lead is an important byproduct of the refining of base bullion, the quantity derived from this source is only a small part of the annual domestic output. The major production is recovered from the smelting of antimonial lead scrap at secondary smelters. Production data from lead-smelting plants treating scrap materials exclusively are summarized in the following section and discussed in detail in the Secondary Metals—Nonferrous chapter of this volume.

Antimonial lead produced at primary lead refineries in the United States, 1943-47

Year	Production (short tons)	Antimony content		Lead content by difference (short tons)			
		Short tons	Percent	From domestic ore	From foreign ore	From scrap	Total
1943.....	63,515	3,371	5.3	16,674	10,583	32,887	60,144
1944.....	57,902	4,670	8.1	13,280	5,477	34,475	53,232
1945.....	56,495	4,148	7.3	7,286	2,695	42,366	52,347
1946.....	50,480	3,285	6.5	11,196	2,149	33,850	47,195
1947.....	86,075	4,933	5.7	14,836	9,850	56,456	81,142

SECONDARY LEAD

Some scrap lead is treated at primary smelters and refineries, but the greater part is received at a large number of plants that treat secondary materials exclusively. Secondary lead is recovered in the form of refined lead, antimonial lead, and other alloys. Recovery at primary and other plants in 1943-47 is shown in the following table. Secondary lead recovery in 1947 exceeded the total domestic refined primary lead production by 16 percent and surpassed the domestic mine output of recoverable lead for the second successive year. Further details appear in the Secondary Metals—Nonferrous chapter of this volume.

Secondary lead recovered in the United States, 1943-47, in short tons

	1943	1944	1945	1946	1947
As refined metal:					
At primary plants.....	1,863	11,308	18,525	8,013	15,662
At other plants.....	56,459	43,678	42,598	53,601	95,843
Total.....	58,322	55,046	61,123	73,704	141,505
In antimonial lead:					
At primary plants.....	32,887	34,475	42,366	33,850	56,456
At other plants.....	144,040	146,343	151,713	159,834	209,479
Total.....	176,927	180,818	194,079	193,684	265,935
In other alloys.....	106,845	95,552	107,837	125,399	134,530
Grand total:					
Short tons.....	342,094	331,416	363,039	392,787	511,970
Value.....	\$43,788,000	\$42,421,248	\$46,468,992	\$65,988,216	\$146,423,420

LEAD PIGMENTS

The principal lead pigments are sublimed lead, leaded zinc oxide, and are manufactured for the most part. Some secondary as well as primary concentrates are converted directly. The production of lead pigments are given in the Zinc and Zinc Salts chapter of this volume.

CONSUMPTION

A survey of 575 plants in 1947 reported the consumption of refined lead in 660,657 short tons of refined lead, and some secondary as well as primary figure. Antimonial lead, unrefined, is excluded. Of the total consumed, 2 percent for lead and litharge; 14 percent for cable batteries; 12 percent for tetraethyl lead and litharge; 4 percent for pipe sheet lead; 3 percent for ammunition products and uses shown in the following table of primary, antimonial, and secondary, 1,172,000 tons compared with 956,400 tons in 1943.

Consumption of refined lead in the United States, 1943-47

	1943
Ammunition.....	64,023
Bearing metals.....	10,189
Brass and bronze.....	5,748
Cable covering.....	117,802
Calking lead.....	8,618
Casting metals.....	3,072
Collapsible tubes.....	11,428
Foil.....	5,816
Pipe, traps, and bends.....	19,724
Sheet lead.....	27,738
Solder.....	15,472
Storage batteries.....	68,231
Tetraethyl lead.....	812
Type metals.....	36,808
White lead.....	124,711
Red lead and litharge.....	65,322
Tetraethyl lead.....	8,173
Chemicals and insecticides.....	5,988
Annealing.....	814
Galvanizing.....	9,205
Lead plating.....	64,040
Weights and ballast.....	675,465
Other.....	
Total.....	675,465

STOCKS

Producers' Stocks.—Lead stock in the American Bureau of Metal Statistics table. Inventories of refined lead generally from a high of 48,826 tons at the end of the year.

Lead stocks at end of year at smelters and refineries in the United States, 1943-47,
in short tons,

[American Bureau of Metal Statistics]

	1943	1944	1945	1946	1947
Refined pig lead.....	28,821	15,602	1 37,584	1 40,870	13,634
Antimonial lead.....	4,260	3,934	1 7,283	1 6,717	7,604
Total.....	33,080	19,536	1 44,867	1 47,587	21,238
Lead in base bullion—					
At smelters and refineries.....	8,640	7,333	8,618	8,453	7,652
In transit to refineries.....	3,112	3,331	4,880	4,011	5,447
In process at refineries.....	16,020	14,473	15,097	16,042	10,328
Total.....	27,772	25,137	28,604	28,406	20,427
Lead in ore and matte and in process at smelters.....	68,678	80,461	80,462	111,836	77,100
Grand total.....	129,540	125,134	1 162,933	1 188,820	127,054

¹ Revised figure.

The Bureau of Mines annual survey of primary lead smelters and refiners indicated stocks of 40,963 tons (lead content) of refined lead at plants on January 1, 1947, and 13,633 tons on December 31, 1947. Primary antimonial lead stocks at these same plants increased from 5,935 short tons (lead content) at the beginning of 1947 to 7,009 tons at the end of the year. In terms of lead content, stocks of ore at the 15 operating smelters and refineries decreased 36 percent from 72,400 tons to 46,295 tons during the same period. The inventory of base bullion at refineries that receive base bullion as a raw material and at smelters that produce base bullion for shipment to refineries totaled 7,581 tons at the beginning of January and 7,767 tons at the end of December 1947. Stocks of "in-process" base bullion or work lead at five combination smelter-refinery plants are not included in reports to the Bureau of Mines. No direct comparison can be made between these data and the figures of the American Bureau of Metal Statistics. Figures reported to the Bureau of Mines represent physical inventory at the plants, irrespective of ownership, and do not include material in process or in transit.

Consumers' Stocks.—Approximately 575 consumer plants reported stocks of 48,816 tons of domestic and foreign refined lead on hand December 31, 1947—a 19-percent increase over the 41,144-ton inventory (revised figure) reported at the end of 1946.

Consumers' stocks of refined soft lead at the end of 1946 and 1947, by grades, in short tons

	Domestic and foreign					Foreign (all grades)
	Corroding	Chemical	Common	Other	Total	
Dec. 31, 1946 ¹	11,760	9,081	16,598	2,706	41,141	2,713
Dec. 31, 1947.....	25,524	6,151	13,778	3,363	48,816	3,793

¹ Revised figures

LEAD

Government Stocks.—Industry-owned supply of Government-owned lead stored out the United States for allocation to coming to reports of the Office of Metals Refined lead (mostly corroding grade) was 13,634 tons on December 31, 1947, compared with 45,493 tons on December 31, 1946.

PRICES

The two major markets for lead in the United States are New York and St. Louis; much of the lead produced in the United States is normally based upon quotations in these markets. Trading on the London Metal Exchange, which has had no direct influence on the London market, has had no direct influence on the differential between St. Louis and London, which remained at 0.15 cent per pound, an amount unchanged between the two points.

The market price for common lead, refined, was \$0.1255 per pound until January 7, 1947, which prevailed for a brief period in June. On January 7 the price advanced to \$0.13, and on January 14 advanced to \$0.14 occurred on February 1. March 3 domestic producers again advanced the price to \$0.15 per pound, at which level it remained the balance of the year.

The official London maximum price for Empire and foreign soft lead, fixed at \$0.125 per pound, was advanced to \$0.13 on January 1, 1947, was advanced to \$0.14 on January 14, 1947, and was unchanged the balance of the year. Quotations on the London Metal Exchange, discontinued at the outbreak of the war, were not resumed during 1947.

Average monthly and yearly quoted prices of refined soft lead, in cents per pound, London, 1945-47, in cents

	1945			1946	1947
	St. Louis	New York	London ¹		
January.....	6.35	6.50	4.49	6.35	6.50
February.....	6.35	6.50	4.49	6.35	6.50
March.....	6.35	6.50	4.49	6.35	6.50
April.....	6.35	6.50	4.49	6.35	6.50
May.....	6.35	6.50	5.13	6.35	6.50
June.....	6.35	6.50	5.39	6.35	6.50
July.....	6.35	6.50	5.39	6.35	6.50
August.....	6.35	6.50	5.39	6.35	6.50
September.....	6.35	6.50	5.39	6.35	6.50
October.....	6.35	6.50	5.39	6.35	6.50
November.....	6.35	6.50	5.39	6.35	6.50
December.....	6.35	6.50	5.39	6.35	6.50
Average.....	6.35	6.50	4.99	6.35	6.50

¹ St. Louis: Metal Statistics, 1948, p. 510. New York: Metal and Mineral Markets.

² Average price of foreign lead, converted to cents per pound, maximum price raised on June 11, 1945; Jan. 15, 1946; Apr. 8, 1947.

HISTORY OF THE PREMIUM PRICE PLAN

The Premium Price Plan, which involved a 5½-year period of unprecedented entry through legislation of Government into the economics of mining, originated in 1942. Although the necessity for increased domestic lead output to meet national defense needs was a matter of concern to Government and industry following the outbreak of war in Europe, the gravity of the domestic supply situation was not seriously considered until the Japanese attack on Pearl Harbor.

In an effort to expand domestic mine output of lead for the war program, the Office of Production Management jointly with the Office of Price Administration announced on January 13, 1942, the details of a plan whereby producers (miners) of lead (copper and zinc were also included in the plan) received through the Metals Reserve Company 9.25 cents a pound for lead produced in excess of quotas based upon 1941 output as against the regular ceiling price of 6.50 cents a pound, New York, established on the same date. This plan, originally scheduled for 2½ years' duration, became effective February 1, 1942. In the Tri-State district the miner was paid an extra \$39.60 a ton for 80-percent lead sulfide concentrates, this being declared the equivalent of 2.75 cents a pound premium. Later in 1942 the figure was adjusted to \$41.80. The Premium Price Plan was continued without further change in 1942.

Although the lead situation was relatively easy in 1942, the record of zinc output under the Premium Price Plan in that year indicated the need for materially higher prices if wartime production objectives were to be achieved. New premiums were approved by the Metals Reserve Company on December 23, 1942 in a revision of the plan whereby a second premium price level for lead above the existing subsidy of 2.75 cents was established. The additional premium on lead was justified only on the ground that it would serve to keep in operation mines whose output might later be needed on short notice and that it would be an additional incentive to zinc production in those mines producing both metals. The Quota Committee thus interpreted the additional premium for lead as an added zinc bonus and, in fact, granted it only to mines in which zinc occurred. In accordance with the revised plan the quotas were designated "A" quotas and "B" quotas. An "A" quota was defined as the ore tonnage for which a mine received the ceiling price of 6.50 cents. A mine with an "A" quota would thus receive the first premium price of 2.75 cents per pound for lead produced in excess of the "A" quota. Similarly, a "B" quota was the tonnage for which a mine received the first premium price, and all production in excess of the "B" quota received the second premium price of 2.75 cents. Thus it was possible to receive up to 12.00 cents a pound for mine production of lead. Under the revised plan, which became effective January 1, 1943, the period of premium prices was extended until July 31, 1945, and

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provision was made for increase or revocation 30 days' notice.

During the latter part of 1943, the situation was considered adequate by the War Production Administration, large Government stocks, rearmament, and labor supply. Accordingly, on October 1, 1943, a statement denying the premium price in effect at that date. Subsequently, a mine was assigned, the mine shipped metal (lead) or expenditures for development, reconstruction, or other work were made on or before October 27 to be eligible under the benefits of the quota plan.

The Premium Price Plan functioned well in 1944 and 1945. Before the date set for the end of the plan—July 31, 1945—Congress voted to extend the plan, S. 502, into Public Law 88 on June 14, 1946, to July 30, 1946.

A bill to extend the OPA and ceiling price plan and operation of the Premium Price Plan was vetoed by President Truman on June 30, 1946, without legislative approval for continuation of prices upon which to base subsidy payments. Reestablishment of the plan for retroactive premium payments to cover the period was in effect, and the Premium Price Plan was extended in 1947, under the same terms as in the previous plan. In the subsidy section of the bill extending the plan that "adjustments shall be made to the plan for development work and adequate allowance for depletion." The bill provided further that the plan were noncancelable unless necessary to the public interest of income to specific mines. With the extension of the ceilings on November 10, subsidies to mines under the Premium Price Plan were computed with reference to quotations as a base.

Continuation of the Premium Price Plan in 1947, was proposed in the Allen Bill (H. R. 10000), which was vetoed by President Truman. The bill provided for subsidy payments on domestic production of lead, zinc, and manganese at an amount of \$35,000,000.

A compilation of important data showing the operation of the Premium Price Plan, 1942-47, at the time of the payments made, is given in the accompanying tables.

Salient statistics on lead with regard to operation of Premium Price Plan, 1942-47¹

	1942 ²	1943	1944	1945	1946	1947 ³
TRI-STATE DISTRICT						
Total production of recoverable lead ⁴ short tons..	30,746	34,830	28,956	23,097	23,897	14,102
Ceiling production at 6.50 cents a pound short tons..	10,811	1,863	3,138	1,164	2,000	9,980
Percent of ceiling production to total production.....	35.10	5.35	10.84	5.04	8.37	70.83
Production under Premium Price Plan:						
"A" quota only (9.25 cents a pound) short tons..	19,700	26,259	10,404	13,009	⁵ 4,004	
"B" quota (12.00 cents a pound) do.....	235	6,514	5,633	8,159	⁶ 14,203	(*)
Total premium production.....do.....	19,935	32,773	26,127	21,168	21,887	4,113
Metals Reserve mine contracts.....do.....		104	691	765		
Total overcelling production.....do.....	19,935	32,907	25,818	21,933	21,887	4,113
Percentage of overcelling production to total:						
Production under Premium Price Plan:						
"A" quota only.....percent.....	64.07	75.30	67.32	56.32	⁵ 16.76	
"B" quota (also received "A").....do.....	.77	18.70	19.45	35.33	⁶ 59.46	(*)
Total premium production.....do.....	64.84	94.09	86.77	91.65	91.63	20.17
Metals Reserve mine contracts.....do.....		.56	2.39	3.31		
Total overcelling production.....do.....	64.84	94.65	89.16	94.96	91.63	20.17
Payments under Premium Price Plan: ⁷						
"A" premium.....dollars.....	1,096,435	1,802,407	1,381,983	1,104,240	⁸ 736,713	
"B" premium.....do.....	12,910	368,279	300,813	448,722	⁹ 1,171,068	(*)
Total premium production.....do.....	1,109,345	2,160,776	1,691,796	1,612,962	2,153,590	130,983
Metals Reserve mine contracts: ¹⁰.....do.....		10,127	66,394	68,034		
Total overcelling payments.....do.....	1,109,345	2,176,903	1,758,190	1,681,896	2,153,590	130,983
Average prices per pound of lead: ¹¹						
Average premium production.....cents.....	9.282	9.797	9.866	10.310	13.320	14.789
Metals Reserve mine contracts.....do.....		10.651	11.307	11.005		
Total overcelling production.....do.....	9.282	9.802	9.905	10.334	13.320	14.789
Total production.....do.....	8.304	9.625	9.636	10.141	12.908	14.892

See footnotes at end of table.

Salient statistics on lead with regard to 1942-47¹—Continued

	1942 ²	
OTHER DISTRICTS		
Total production of recoverable lead ⁴ short tons..	418,310	
Ceiling production at 6.50 cents a pound short tons..	358,447	
Percent of ceiling production to total production.....	86.10	
Production under Premium Price Plan:		
"A" quota only (9.25 cents a pound) short tons..	60,321	
"B" quota (12.00 cents a pound) do.....	1,542	
Total premium production.....do.....	57,863	
Metals Reserve mine contracts.....do.....		
Total overcelling production.....do.....	57,863	
Percentage of overcelling production to total:		
Production under Premium Price Plan:		
"A" quota only.....percent.....	13.53	
"B" quota (also received "A").....do.....	.37	
Total premium production.....do.....	13.90	
Metals Reserve mine contracts.....do.....		
Total overcelling production.....do.....	13.90	
Payments under Premium Price Plan: ⁷		
"A" premium.....dollars.....	3,182,450	
"B" premium.....do.....	84,789	
Total premium production.....do.....	3,267,239	
Metals Reserve mine contracts: ¹⁰.....do.....		
Total overcelling payments.....do.....	3,267,239	
Average prices per pound of lead: ¹¹		
Average premium production.....cents.....	9.323	
Metals Reserve mine contracts.....do.....		
Total overcelling production.....do.....	9.323	
Total production.....do.....	6.892	

See footnotes at end of table.

Salient statistics on lead with regard to operation of Premium Price Plan,
1942-47—Continued

	1942 ¹	1943	1944	1945	1946	1947 ²
TOTAL UNITED STATES						
Total production of recoverable lead ³ —short tons	447,056	444,000	410,016	390,831	332,477	189,770
Ceiling production at 6.50 cents a pound—short tons	369,258	295,864	203,757	147,955	71,327	125,400
Percent of ceiling production to total production	82.60	66.64	49.69	37.86	21.45	66.08
Production under Premium Price Plan:						
“A” quota only (9.25 cents a pound)—short tons	76,021	109,289	162,410	168,575	195,331	(*)
“B” quota (12.00 cents a pound)—do	1,777	38,660	43,140	73,536	147,279	(*)
Total premium production—do	77,798	147,942	205,550	242,111	261,150	61,364
Metals Reserve mine contracts—do		194	691	765		
Total overceiling production—do	77,798	148,136	206,250	242,876	261,150	61,364
Percentage of overceiling production to total production under Premium Price Plan:						
“A” quota only—percent	17.00	24.61	39.61	43.13	52.57	(*)
“B” quota (also received “A”)—do	.40	8.71	10.53	18.82	44.30	(*)
Total premium production—do	17.40	33.32	50.14	61.95	78.55	33.92
Metals Reserve mine contracts—do		.04	.17	.19		
Total overceiling production—do	17.40	33.36	50.31	62.14	78.55	33.92
Payments under Premium Price Plan: ⁴						
“A” premium—dollars	4,278,885	8,136,770	11,306,244	13,316,100	18,263,436	(*)
“B” premium—do	97,669	2,120,329	2,373,177	4,014,433	47,155,073	(*)
Total premium production—do	4,376,554	10,257,099	13,679,421	17,330,533	24,418,509	828,555
Metals Reserve mine contracts—do		10,127	66,394	68,934		
Total overceiling payments—do	4,376,554	10,267,226	13,745,815	17,429,467	24,487,483	828,555
Average prices per pound of lead: ⁵						
Average premium production—cents	9.313	9.969	9.827	10.085	11.626	14.969
Metals Reserve mine contracts—do		10.651	11.307	11.065		
Total overceiling production—do	9.313	9.970	9.832	10.088	11.626	14.969
Total production—do	6.960	7.658	8.176	8.730	10.934	14.578

¹ From published and unpublished reports of the Office of Price Administration and the Office of Premium Price Plan for Copper, Lead, and Zinc. Excludes exploration premiums totaling \$6,213,545 paid from July 1, 1946, through December 31, 1947, to encourage exploration and development of copper, lead, and zinc deposits; this total cannot be broken down by metals.

² Premium Price Plan effective Feb. 1, 1942; data refer to February-December, inclusive.

³ Premium Price Plan effective until June 30, 1947; data refer to January-June, inclusive.

⁴ Production of Tri-State lead from Office of Metals Reserve, Joplin, Mo.; all other from Bureau of Mines monthly reports. Data do not exactly check final annual totals for the United States except for 1945.

⁵ January-October. “A” and “B” quotas and premium payments for November and December are not separable by kinds and are shown with data footnoted 7.

⁶ “A” and “B” quotas and premium payments unavailable separately.

⁷ Total “A” and “B” quotas and premium payments for November and December; separation by kinds not available.

⁸ Data on premium payments and Metals Reserve mine-contract payments from Office of Metals Reserve.

⁹ All average prices shown include OPA ceiling price.

FOREIGN TRADE²

Tariff.—The import duty set by the Tariff Act bearing ores, fluo dust, and mattes (lead content) pound and on lead bullion, pigs, bars, scrap lead, type metal, babbitt metal, solder, and alloys not specified, for 2½ cents per pound. In accordance with the Agreement of January 30, 1943, these rates were fourths cent and 1½ cents per pound, respectively of the agreement permits the increase in the tariff.

Total lead imported into the United States in ore, matte, base bullion, and reclaimed, 1943-47, by countries, in short tons

(U. S. Department of Commerce)

Country	1943	1944
Ore and matte:		
Africa	16,438	3,459
Argentina		
Australia	19,743	27,130
Bolivia	6,034	1,003
Canada	5,828	9,900
Chile		4,247
Mexico	2,931	3,603
Newfoundland and Labrador	15,473	32,273
Peru	3,428	11,285
Other countries	172	471
Total	69,945	93,570
Base bullion:		
Australia	3,816	
Korea		
Mexico	630	11
Peru	94	47
Other countries		
Total	4,533	58
Pigs and bars:		
Australia	8,084	560
Canada	18	8
Japan		
Korea		
Mexico	214,805	167,704
Peru	20,158	54,480
Yugoslavia		
Other countries		
Total	244,033	222,758
Reclaimed, scrap, etc.:		
Africa		
Australia		2,538
Canada	348	488
Canal Zone		
Chile		15
Italy		
Japan		
Malta, Gozo, and Cyprus		
Panama, Republic of	128	
Philippines, Republic of		
Other countries	1	74
Total	477	3,115
Grand total	310,938	310,701

¹ Data include lead imported for immediate consumption plus material entered for storage.

² Figures on imports and exports compiled by M. B. Price, of the Bureau of Economic Warfare, U. S. Department of Commerce.

ores, flue dust, and mattes to 1½ cents per pound (lead content), and lead bullion, pigs, bars, scrap lead, etc., to 1¼ cents per pound 30 days after the war emergency is officially terminated. As termination of the emergency was not declared in 1947, the lower rates applied throughout the year.

Imports.—Imports of lead increased sharply in 1947 but remained well below the high levels established during wartime. As in previous years, the greater part of the lead imported was in the form of pigs and bars, 54 percent of which came from Mexico, 37 percent from Canada, 7 percent from Australia, and 2 percent from Korea, Peru, Yugoslavia, British East Africa, and Union of South Africa. Imports of lead in base bullion increased over twelvefold in 1947. Of the 1,590 tons imported, 1,255 tons came from Mexico, 285 tons from Korea, and 50 tons from Peru. Receipts of lead in ore, concentrate, and matte—principally from Newfoundland, Peru, Australia, Bolivia, Union of South Africa, and Canada—increased 14 percent.

Lead imported for consumption in the United States, 1943-47, by classes ¹

[U. S. Department of Commerce]

Year	Lead in ores, flue dust, 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		
1943	83, 153	\$5, 590, 218	4, 511	\$557, 545	244, 633	\$20, 003, 382	25	\$20, 208	\$5, 219, 327, 132, 730	
1944	100, 846	6, 756, 389	73	7, 045	221, 376	22, 793, 430	40	39, 572	547, 20, 895, 575	
1945	76, 126	5, 768, 695	20	2, 242	227, 311	25, 280, 638	17	2, 778	32, 615, 31, 312, 708	
1946	28, 377	3, 056, 111	20	2, 302	100, 820	14, 205, 092	24	10, 251	21, 517, 17, 401, 086	
1947	44, 442	8, 561, 174	1, 768	422, 332	158, 705	38, 098, 443	67	42, 434	10, 453, 50, 086, 077	

¹ In addition to quantities shown (values included in total values), "reclaimed, scrap, etc." imported as follows—1943: 496 tons, \$56,158; 1944: 3,315 tons, \$208,712; 1945: 2,848 tons, \$235,840; 1946: 2,481 tons, \$104,913; 1947: 15,874 tons, \$3,041,241. Figures for 1943-47 include foreign lead received by the Government and held in stock piles.

Miscellaneous products, containing lead, imported for consumption in the United States, 1943-47

[U. S. Department of Commerce]

Year	Babbitt metal, solder, white metal, and other combinations containing lead			Type metal and antimonial lead		
	Gross weight (short tons)	Lead content (short tons)	Value	Gross weight (short tons)	Lead content (short tons)	Value
1943	236	69	\$330, 824	3, 703	3, 422	\$447, 019
1944	50	43	15, 368	7, 562	7, 174	954, 255
1945	143	73	101, 132	26, 110	24, 739	3, 241, 735
1946	157	72	211, 122	1, 740	1, 404	220, 645
1947	240	161	170, 247	2, 406	2, 219	753, 661

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Exports.—Total exports of pig lead in 1946 over 1946. Export restrictions imposed by the Act of 1940 remained in force throughout the year.

Lead exported from the United States

[U. S. Department of Commerce]

Year	Pigs and bars		Foreign lead exported in manufactures with benefit of draw-back (short tons)	Year
	Short tons	Value		
1943	2, 003	\$214, 433	15, 491	1946
1944	15, 523	2, 073, 145	20, 237	1947
1945	1, 407	202, 754	(1)	

¹ Data not available.

Pig lead exported from the United States, 1943-47

[U. S. Department of Commerce]

Destination	1943
Countries:	
Argentina	
Brazil	779
Canada	9
Canal Zone	
China	7
Colombia	
Cuba	51
Curaçao (N. W. I.)	26
Czechoslovakia	9
Hong Kong	
India	(1)
Madagascar	
Mexico	5
Netherlands	
Panama, Republic of	8
Philippines, Republic of	
Portugal	
Turkey	
U. S. S. R.	14
United Kingdom	1, 017
Uruguay	
Venezuela	8
Other countries	70
Total	2, 003
Continents:	
North America	80
South America	893
Europe	1, 031
Asia	6
Africa and Oceania	3

¹ In addition, 11,258 tons of foreign lead were reexported in 1946 and 103 tons in 1947.

² Less than 1 ton.

WORLD PRODUCTION

World production of lead in recent years, insofar as data are available, is shown in the following table.

World production of lead, 1940-47, in metric tons ¹

[Compiled by B. B. Mitchell]

Country	1940	1941	1942	1943	1944	1945	1946	1947
Argentina	12,861	18,021	20,790	23,800	19,100	21,150	16,190	20,000
Australia	256,129	239,052	255,409	192,322	157,026	159,353	139,665	161,093
Austria	8,202	8,879	8,787	12,013	10,123	1,272	4,178	3,567
Belgium	30,890	8,880	16,210	7,960	7,690	7,310	23,762	40,520
Burma	80,709	74,456	17,130					
Canada	199,662	206,862	220,722	203,691	129,347	147,990	150,390	146,963
China	1,210	1,403	1,160	1,179	153	850	14	771
Czechoslovakia	(3)	(3)	(3)	(3)	(3)	615	2,800	4,700
France	25,577	23,220	12,462	12,428	1,923	2,765	31,650	31,621
Germany	167,100	163,900	140,100	157,300	139,900	(3)	* 23,920	* 21,356
Greece	1,250	800	2,300	1,150	690	700	600	1,000
Guatemala	(9)	95	119	114	130	115	131	110
Hungary	110	4,610	4,810	6,370	* 3,230	* 10	10	60
Indochina, French	8	3	2	16	51			(5)
Italy	36,900	36,900	28,090	* 12,372		820	11,010	17,143
Japan	10 27,748	10 30,585	10 26,919	10 32,511	10 38,048	10 12,568	4,965	8,747
Korea	7,630	10,000	11,000	18,467	21,200	12,518	0 0	0 250
Mexico	191,080	151,167	192,980	212,452	178,270	201,078	137,712	217,827
Northern Rhodesia	253	378	1,118	1,265	1,017	1,718	8,371	15,891
Norway	123	39				52	(3)	(3)
Peru	31,131	32,871	37,915	43,171	38,006	40,001	36,178	32,810
Poland	16,593	16,718	16,311	15,506	15,835	* 7,000	10,515	12,761
Romania	49	258	154	187	261	3,363	3,225	3,316
South-West Africa	690							64
Spain	45,901	46,865	41,140	36,760	30,978	31,922	32,316	31,381
Sweden			230	2,193	10,553	12,501	11,223	11,000
Tunisia	26,620	15,679	8,210	1,867	5,335	7,023	7,850	12,590
U. S. S. R.	75,000	30,000	100,000	125,700	100,000	40,000	47,500	59,900
United Kingdom	10,304	10,262	5,437	4,877	3,353	2,911	2,738	2,282
United States (refined) ¹²	468,675	494,126	497,908	425,903	421,538	402,304	306,717	400,018
Yugoslavia	32,949	(3)	(3)	(3)	(3)	(3)	(3)	(3)
Total (estimate)	1,756,400	1,701,300	1,684,300	1,563,000	1,314,600	1,117,100	1,035,900	1,281,300

¹ By countries where smelted but not necessarily refined. Data derived in part from Monthly Bulletin of the United Nations, The Mineral Industry of the British Empire and Foreign Countries Statistical Summary, and from the Yearbook of the American Bureau of Metal Statistics.

² Approximate production.

³ Included with Germany.

⁴ Exclusive of secondary material. Includes Upper Silesia and Sudetenland through 1944.

⁵ Data not yet available; estimate by author of chapter included in total.

⁶ Includes scrap.

⁷ British zone only. Includes antimonial lead.

⁸ January to June, inclusive.

⁹ Data represent Trianon Hungary subsequent to October 1944.

¹⁰ Preliminary data.

¹¹ South Korea only.

¹² Figures cover lead refined from domestic and foreign ores; refined lead produced from foreign base bullion not included.

Lead and Zinc Pigments and Zinc Salts

By HELENA M. MEYER AND ALET

GENERAL SUMMARY

ON THE whole, the pigments covered in increasing quantities in 1947, made available still left consumers. Continuing high demand for pigments essential crude materials, among which have been preeminent for a number of years, remained unsatisfied and some being met by Labor-management relations, in pigment-making as in industries supplying crude materials, improved in 1947; and such improvements among those to show marked gains. The automobiles and trucks gained more than of new construction rose 41 percent, an increased 26 percent. Consumption of considerably more zinc oxide than the year doubled in quantity in 1947, whereas the 27 percent, the over-all total rising 8 percent, varnish, and lacquer materials sold in a new peak of \$1,000,000,000; the high level prices, however, was a noteworthy factor.

Lead-pigment prices established new margins in 1947, exceeding even the peak after price controls on them were removed in 1946, and the general inflationary trend in the United States and abroad were responsible for price gains. Quoted prices for zinc were the highest for many years and for than ever before.

Shipments of zinc pigments on the whole of lead pigments but fared better than in earlier years. The total weight and value were higher than ever before. Lead pigments established new high records in 1947, far exceeding earlier peak tonnages for 1928-29.

As has been pointed out in previous reports of this series, for several recent years supplies of zinc have been more plentiful, though far from abundant, than of lead. Lead supplies rose sharply in 1947 but continued to fall short of total requirements. Domestic production rose in response to the greatly improved labor-management relationship and to the aforementioned highest price on record. Production from scrap was higher than ever before, and imports gained substantially. Not only was more lead made available as indicated, but, in helping to handle demand, producers' stocks were cut to less than half, and Government inventories were reduced to a very small tonnage.

Total supplies of zinc in relation to requirements in 1947 were again more abundant than of lead, as evidenced by the sharp advance in deliveries for Government account (probably almost entirely for stock piling). Production and imports were more than adequate for current demand, but the large gain in shipments to the Government came chiefly from producers' inventories.

Salient statistics of the lead and zinc pigments industry of the United States, 1942-47

	1942	1943	1944	1945	1946	1947
Production (sales) ¹ of principal pigments:						
White lead (dry and in oil).....short tons.....	83,639	76,167	85,726	51,170	166,501	68,787
Litharge.....do.....	91,513	113,001	138,203	138,798	133,799	167,050
Red lead.....do.....	48,369	53,378	53,972	47,381	32,526	36,064
Zinc oxide.....do.....	99,677	143,402	140,675	127,955	157,851	190,771
Leaded zinc oxide.....do.....	48,128	43,828	61,305	62,598	67,971	81,450
Lithopone.....do.....	137,320	135,723	142,905	136,161	147,001	165,024
Value of products:						
All lead pigments.....	\$39,353,000	\$41,807,000	\$40,691,000	\$39,045,000	\$43,595,000	\$30,199,000
All zinc pigments.....	30,785,000	36,260,000	39,288,000	36,614,000	44,195,000	63,891,000
Total.....	70,178,000	78,157,000	85,889,000	75,689,000	87,790,000	154,090,000
Value per ton received by producers:						
White lead (dry).....	160	163	163	159	2207	308
Litharge.....	150	152	146	148	175	313
Red lead.....	171	171	164	168	196	333
Zinc oxide.....	138	137	139	138	144	186
Leaded zinc oxide.....	129	132	132	132	113	204
Lithopone.....	79	79	78	78	81	105
Foreign trade:						
Lead pigments:						
Value of exports.....	957,000	1,439,000	1,387,000	1,427,000	851,000	1,011,000
Value of imports.....	4,000	3,000	6,000	8,000	13,000	150,000
Zinc pigments:						
Value of exports.....	2,741,000	2,737,000	2,017,000	2,279,000	2,911,000	6,551,000
Value of imports.....	8,000	5,000	1,500	(9)	9,000	31,000
Export balance.....	3,686,000	4,168,000	3,396,500	3,698,000	3,740,000	7,411,000

¹ Reported as shipments, 1945-47.

² Data for basic lead sulfate in 1946 included under white lead; Bureau of Mines not at liberty to show separately.

³ Excludes value of basic lead sulfate; Bureau of Mines not at liberty to publish.

⁴ Less than \$500.

On their own merits and because of inadequate supplies of lead and zinc pigments, shipments of the titanium group established new records in each of the years 1944-47. The 1947 peak, as well as the others, would have been higher except for plant-capacity limitations.

Total plant capacity has been expanded several years and will be extended further. In zinc classes, titanium pigments shipments have been high for several years.

Features of the distribution of lead and zinc pigments in 1947 are given in the following distribution. Noteworthy gains in 1946 in the use of the report and a further conspicuous advance in shipments to ceramic manufacturers rose 39 percent, both new peaks; ceramics became an important use of litharge. White-lead shipments advanced in 1947, but did not represent a new peak, whereas red-lead shipments for this purpose continued the 1946 trend. Shipments of leaded zinc oxide and white lead to paint makers advanced. Zinc oxide to a new peak by a substantial margin. Storage batteries gained 47 percent, or 40 percent record for 1945, and red lead rose 9 percent. Litharge, on the other hand, continued the falling 49 percent from 1946, and this use showed an important drop—28 percent.

zinc sulfate for this purpose were the second highest use of zinc sulfate in manufacturing rayon, exceeding the previous high record for 1946.

According to figures released by the Department of Commerce, manufacturers of paints and varnishes in 1946 used the following pigments in (thousands of pounds): 2,989 (3,370) short tons of white lead, 2,087 (2,147) tons of the "in oil" varnish (sulfide), 3,416 (3,153) tons of titanium dioxide, 4,923 (2,900) tons of extended titanium pigments, 4,923 (2,900) tons of free, 700 (1,327) tons of zinc oxide (lead white), 567 (722) tons of other white pigments; 567 (722) tons of mineral, and 413 (364) tons of litharge.

Tariff Action.—At the United Nations Conference on Employment held at Geneva in 1947, the United States proposed that in 1948, was taken on lead and zinc compounds.

Litharge—bound at 2½ cents a pound. Zinc oxide—bound at 2½ cents. Orange mineral—reduced from 2½ to 25 percent ad valorem.

White lead—bound at 2½ cents.

Red lead—reduced from 2½ to 1½ cents.

Lead suboxide—bound at 3 cents, with provision that ad valorem could not be less than 15 percent nor more than 30 percent.

Lead compounds n.s.p.f.—bound at 20 percent ad valorem.

PRODUCTION

The value of lead and zinc pigments in 1947, exclusive of that for basic lead sulfate, which cannot be shown, was \$154,090,000, a 76-percent increase over 1946, which included the comparatively small lead sulfate value. In 1945 basic lead sulfate accounted for less than 1 percent of the total value of lead and zinc pigments. Lead and zinc pigments represented 59 and 41 percent of the total value in 1947, compared with 55 and 45 percent, respectively, in 1939.

For many years, figures on sales were used in this series of reports as a better guide to activity in the pigments industry than production. Beginning with 1945, the base was changed to shipments to conform with data compiled on Bureau of Mines lead and zinc schedules. Available information for 1945 (the year of change) indicated that there was little difference between sales and shipments in that year. In reporting tonnages of pigments, an attempt is made to avoid all duplication. One of the chief problems is that finished pigments frequently are blended to make another product. Basic lead sulfate and zinc oxide, for example, are blended to make leaded zinc oxide, and in this instance the pigment weights appear in the total for the last-named class only. Pigments consumed by producing companies to make products beyond those covered by this report—that is, paints, storage batteries, and other articles—are considered as shipments.

LEAD PIGMENTS

Shipments of lead pigments gained 17 percent in 1947 over 1946, and because of new peak pigment prices the value of shipments more than doubled. Basic lead sulfate, which represented less than 2 percent of the quantity and value in 1945, is included in 1946 but not in 1947, so the actual increases in 1947 were slightly greater than indicated. Data for basic lead sulfate may not be published. All other lead pigments contributed to the foregoing gains, litharge shipments rising 25 percent over 1946 and establishing a new peak by a substantial margin over the previous record in 1945. White lead in oil increased 21 percent, but shipments of this product were low compared with most earlier years. Supplies of pig lead continued in-

Lead pigments shipped by domestic manufacturers in the United States, 1946-47

Pigment	1946			1947		
	Short tons	Value (at plant, exclusive of container)		Short tons	Value (at plant, exclusive of container)	
		Total	Average		Total	Average
Basic lead sulfate or sublimed lead	(1)	(1)	(1)	(1)	(1)	(1)
Red lead	32,525	\$46,394,095	\$196	36,961	\$12,022,585	\$333
Orange mineral	123	(2)	(2)			
Litharge	133,799	23,440,389	175	167,050	\$2,315,911	313
White lead:						
Dry	41,892	17,401,217	179	39,075	12,696,551	309
In oil	24,609	6,235,030	255	29,712	13,794,387	461

¹ Basic lead sulfate included with white lead (dry) in 1946; Bureau of Mines not at liberty to publish.

² Bureau of Mines not at liberty to publish.

³ Value of orange mineral included with red lead in 1946; Bureau of Mines not at liberty to publish.

⁴ Weight of white lead only but value of paste.

LEAD AND ZINC PIGMENTS AND

adequate for all needs, a factor that impeded and made it impossible for manufacture. Average values per ton for the lead pigment rose 70 to 82 percent over those for 1946. 1947 were substantially above the previous 1946.

Lead pigments sold¹ by domestic manufacturers in short tons

Year	White lead		Basic lead or sublimed
	Dry	In oil	White
1943	39,525	36,642	4,752
1944	46,460	39,260	5,233
1945	27,382	21,788	2,235
1946	41,892	21,609	(2)
1947	39,075	29,712	(2)

¹ Reported as shipped, 1946-47.

² Basic lead sulfate included with white lead (dry) in 1946; Bureau of Mines not at liberty to publish.

³ Bureau of Mines not at liberty to publish.

ZINC PIGMENTS AND

Shipments of zinc pigments in 1947 rose in value of shipments gained 45 percent, records. The foregoing gains are small group; but zinc pigments made a better showing, nonetheless, in relation to earlier years. Shipments were 18 percent above the previous type virtually duplicated the peak rate. Shipments were larger than in years other. The relatively more abundant supply of white lead was responsible in part for the increase in average values for zinc pigments, 29 to 30 percent. The top of the range was made by leaded zinc oxide content of this class.

Zinc pigments and salts shipped by domestic manufacturers in the United States, 1946-47

Pigment or salt	1946	
	Short tons	Value (at plant, exclusive of container)
		Total
Zinc oxide	157,851	\$22,650,450
Leaded zinc oxide	67,971	9,694,097
Lithopone	147,001	11,840,596
Zinc chloride, 50% B	57,316	3,133,891
Zinc sulfate	24,931	2,102,706

¹ Zinc oxide containing 5 percent or more lead is classed as leaded zinc oxide. Zinc oxide include a small quantity containing less than 5 percent lead.

Shipments of zinc chloride totaled 65,521 tons (50° B.), 14 percent above 1946, and may have established a new record; the larger tonnage for 1920 is a production figure, and complete data for 1935-41 are not available. Zinc sulfate shipments fell 14 percent below the all-time record for 1946 but were second only to the tonnage for that year.

Zinc pigments and salts sold¹ by domestic manufacturers in the United States, 1943-47, in short tons

Year	Zinc oxide	Leaded zinc oxide ²	Lithopone	Zinc chloride (50° B.)	Zinc sulfate
1943.....	143,402	43,828	135,723	53,797	15,649
1944.....	140,675	61,395	142,905	57,545	17,156
1945.....	127,955	62,598	136,161	56,230	20,854
1946.....	157,851	67,971	147,001	57,316	21,931
1947.....	160,771	81,459	165,024	65,521	21,547

¹ Reported as shipped, 1945-47.

² Includes a small quantity containing less than 5 percent lead.

CONSUMPTION BY INDUSTRIES

WHITE LEAD

Shipments of white lead (dry and in oil) in 1947 continued the uptrend begun in 1946 from the very low levels of 1945. White lead (in oil) in 1947 was 21 percent above 1946, itself 3 percent higher than 1945. Trade reports indicated that the increased quantities of both varieties of white lead available in 1947 failed to fill the demand. Reports show that 89 percent of total white-lead shipments in 1947 was for the manufacture of paint, but this percentage would doubtless be increased if a more complete breakdown of the "Other" classification were possible. A postwar development has been the increased use of several pigments for the manufacture of ceramics, a trend for white lead that was continued in 1947.

Production of white lead (dry) amounted to 39,337 tons and of white lead in oil to 32,677 tons in 1947.

Distribution of white lead (dry and in oil) sales¹ 1943-47, by industries, in short tons

Industry	1943	1944	1945	1946 ²	1947
Paint.....	66,441	79,948	46,448	60,943	61,265
Ceramics.....	1,411	946	839	1,367	1,665
Other.....	8,282	4,832	3,913	4,191	5,857
	76,134	85,726	51,100	66,501	68,787

¹ Reported as shipments, 1945-47.

² Data for basic lead sulfate in 1946 included with white lead; Bureau of Mines not at liberty to show separately.

The manufacture of white lead in Germany was discussed in a recent report.¹

¹ Causer, H. and Frith, J. S., Manufacture of White Lead: British Intelligence Objectives Subcommittee Final Rept. 1521, item 22, 14 pp.

BASIC LEAD SULFATE

The Bureau of Mines is not at liberty to lead sulfate for 1946-47. Shipments in 1946 on "white lead" (dry), but 1947 data are Basic lead sulfate is used almost entirely quantities are used as an intermediate prod leaded zinc oxide. Such quantities have a series under leaded zinc oxide rather than b

Distribution of basic lead sulfate sales,¹ 1943-47,

Industry	1943	1944
Paints.....	4,802	5,490
Rubber.....	131	26
Storage batteries.....	3	56
Other.....	661	
	5,597	6,332

¹ Reported as shipments, 1945-47.

² Data for basic lead sulfate in 1946 included with white lead; separately.

³ Bureau of Mines not at liberty to publish.

RED LEAD

Shipments of red lead in 1947 gained 11 percent lower than in every year from 1939 to 1945 and This condition was due not to lack of demand but because not enough pig lead was available pigments and other items to meet all need tinned to use the largest quantities of red over 1946, whereas paints - the second most rose 22 percent. The use of red lead for c other pigments, had been trending upward 20 percent in 1947.

Production of red lead amounted to 36,000 tons with 29,874 tons in 1946.

Distribution of red-lead sales,¹ 1943-47, by

Industry	1943	1944
Storage batteries.....	26,616	30,200
Paints.....	22,271	18,000
Ceramics.....	622	800
Other.....	3,869	4,800
	53,378	53,900

¹ Reported as shipments, 1945-47.

ORANGE MINERAL

No shipments nor production of orange 1947, compared with 123 tons shipped and

Distribution of orange mineral sales,¹ 1942-47,² by industries, in short tons

Industry	1942	1943	1944	1945	1946
Ink manufacture.....	93	49	56	63	79
Color pigments.....	7	8	265	151	18
Other.....	28	22	23	16	27
	128	79	284	230	123

¹ Reported as shipments, 1945 and 1946.
² No shipments reported for 1947.

LITHARGE

The use of litharge in storage batteries rose to a new peak by a substantial margin in 1947, causing total shipments of litharge also to establish a new high record. Litharge shipments in 1947 were 25 percent higher than in 1946 and 20 percent above the previous record for 1945. Storage-battery use of litharge rose 47 percent above 1946 and 40 percent above the previous peak in 1945. This use accounted for 67 percent of the total shipments of litharge. In addition to the litharge used to make batteries, the storage-battery manufacturers themselves produce from pig lead a black or suboxide of lead which they use as a substitute for litharge. The quantity produced in 1947—69,000 tons—was higher than ever before, exceeding 1946 by 50 percent and the previous record tonnages for 1944 and 1941 by 13 percent. Black oxide figures are not included in the Bureau of Mines totals for litharge.

The sharp postwar advance in use of litharge in ceramics placed this industry second in importance as a consumer of litharge in 1947; the tonnage shipped for that purpose rose 39 percent and slightly exceeded the previous record for 1941. Chrome pigments took 15 percent less litharge than in 1946 and likewise less than in 1945 and the peak of 13,927 tons in 1941. The oil-refining industry received 15 percent more than in 1946, or the largest tonnage since 1937; the tonnages for 1929 and 1930, the earliest data available, were considerably higher than that for 1947. Use of litharge in insecticides fell 49 percent in 1947, a continuation of the sharp downward movement since 1944. The advance of 29 percent in shipments to varnish makers carried this use back to the level of 1936, above all intervening years.

Litharge production totaled 174,341 tons in 1947 compared with 133,266 tons in 1946.

Distribution of litharge sales,¹ 1943-47, by industries, in short tons

Industry	1943	1944	1945	1946	1947
Storage batteries.....	54,984	72,342	79,981	75,536	111,810
Ceramics.....	9,866	12,381	11,511	13,156	18,360
Chrome pigments.....	9,351	8,233	11,391	10,877	9,228
Oil refining.....	5,227	5,608	6,419	6,682	7,684
Insecticides.....	20,336	25,957	18,061	14,239	7,285
Varnish.....	3,453	2,988	2,752	3,362	4,258
Rubber.....	4,362	5,423	1,861	2,131	2,205
Floor coverings.....	98	117	115	106	141
Other.....	5,574	7,554	6,701	7,440	6,012
	113,991	138,263	136,798	133,790	167,059

¹ Reported as shipments, 1945-47.

ZINC OXIDE

Continuing large demand for zinc oxide (pigments of this pigment gaining 2 percent over peak rate established in 1928-29. Rubber for 51 percent of the total but took 2 percent. Paints, the second-largest use, took 6 percent of coated fabrics and textiles 9 percent less. U.S. has been gaining since 1942 and in 1947 was 1946, the previous record year. Thus ceramic importance as a consumer of zinc oxide likewise increased substantially in 1947, but this use separately is not available.

Production of lead-free oxide amounted with 142,567 tons in 1946. Of the total for by the American process from ores and produced by the French process from metal and scrap processes, compared with 74, 20, and 6 percent.

Distribution of zinc oxide sales,¹ 1943-47, by industries

Industry	1943	1944
Rubber.....	67,808	50,500
Paints.....	29,852	24,000
Ceramics.....	3,203	3,000
Coated fabrics and textiles.....	6,633	9,500
Floor coverings.....	21,801	27,600
Chemical warfare.....	14,015	15,200
Other.....	143,402	140,000

¹ Reported as shipments, 1945-47.
² Includes 3,363 tons for rayon.
³ Includes 7,302 tons for rayon.

According to a recent note,² Durham Chemical Co., Montreal, is planning to convert to the production of zinc oxide and other chemicals a plant, recently purchased by the Canadian Government, at Cap de la Madeleine, Quebec. The plant was formed by Harrisons & Crosfield, Ltd., Birtley, Co. upon-Tyne Zinc Oxide, Ltd., Birtley, Co.

Another report³ stated that a new corporation (Aust.), Ltd., would manufacture zinc oxide and other chemicals. It was to acquire the Masco Chemical Co., South Wales and to build plants and laboratories.

The December 5, 1947, issue of Rzeczpospolita reported on Polish exports of zinc white:

The domestic production of zinc white is increasing. The plants have already reached their prewar production. Feniks foundry at Bedzin has been doubled and the Marta foundry at Olawa and the Polish Zinc Works at Tarnobrzeg produce 12,000 metric tons of zinc white annually. (Tarnobrzeg) Poland has an adequate supply of zinc white and will increase exports of that product. Exports in 1947 were 1,000 tons.

¹ Oil, Paint and Drug Reporter, vol. 152, No. 10, Sept. 8, 1947.
² Chemical Engineering, vol. 54, No. 10, October 1947, p. 206.

tons, but this year they will increase to 9,000 metric tons. The number of foreign buyers of Polish zinc white has also increased. Poland now exports this article to: USSR, Sweden, Great Britain, Denmark, Finland, Switzerland, Holland, Norway, and Palestine.

LEADED ZINC OXIDE

The use of leaded zinc oxide has continued at high levels for several years. Shipments of this pigment were at a new all-time peak in 1947 by a wide margin, exceeding the 1946 total by 20 percent and the previous high in 1941 by 18 percent. Of total shipments, 96 percent in 1947 was reported used for paint, but a better break-down of the "Other" class doubtless would increase this percentage. Figures for basic lead sulfate used in blending to make leaded zinc oxide are included in tonnages for the latter pigment.

Leaded zinc oxide production totaled 78,799 tons in 1947 compared with 71,016 in 1946. The totals comprise grades as follows (1946 for comparison in parentheses): 68,413 (61,251) tons of 35 percent lead and under and 10,386 (9,765) tons of over 35 percent lead.

Distribution of leaded zinc oxide sales,¹ 1943-47, by industries, in short tons

Industry	1943	1944	1945	1946	1947
Paints.....	42,303	62,223	58,852	61,816	77,994
Rubber.....	42	119	200	166	131
Other.....	1,483	2,053	3,546	2,989	3,334
	43,828	64,395	62,598	64,971	81,459

¹ Reported as shipments, 1945-47.

LITHOPONE

The lithopone statistics in this report are given on the basis of ordinary lithopone sold as such plus the ordinary lithopone content of the high-strength product. This method of publication is used to conceal the operations of one company that always dominates the output of the high-strength product and has been the only producer in some years. In 1947 one company, operating two plants, produced high-strength lithopone, whereas two companies, operating three plants, produced in 1946. Shipments of lithopone increased 12 percent in 1947, were the largest since 1941, and were smaller only than in that year and in the 3 years 1927-29. Sales to manufacturers of paints increased 9 percent, and all other broad classifications gained. Rubber manufacturers took 92 percent more than in 1946 but accounted for only 2 percent of the total. Separation of the lithopone shipped for floor coverings and textiles shows that 8,421 tons were for coated fabrics and textiles and 9,048 for floor coverings, compared with 7,626 and 7,541 tons, respectively, in 1946. The use of lithopone by paper manufacturers, which had been rising before 1945 and continued at about the 1945 rate in 1946, moved upward again in 1947; it amounted to 4,069 tons compared with 3,011 tons in 1946 and 6,488 tons in 1944. Shipments reported for use in ink manufacture

LEAD AND ZINC PIGMENTS

are trending downward; the tonnages were 830 in 1946, and 720 in 1947. A tonnage is regularly shown by one manufacturer sold for paint, but the tonnages given here. Exports are included mainly under "Other" classifies part of its exports according to

Plant capacity for the manufacture of total 157,000 tons in 1947.

Production of lithopone amounted to compared with 148,926 tons in 1946.

Distribution of lithopone sales,¹ 1943-47,

Industry	1943	1944
Paints, varnishes, and lacquers.....	103,869	103,869
Floor coverings and textiles.....	15,999	15,999
Rubber.....	1,078	1,078
Other.....	14,786	14,786
	135,732	135,732

¹ Reported as shipments, 1945-47.

² Includes a quantity, not separable, used for printing ink.

Consumption of ordinary lithopone in lithopone has trended downward almost 19,400 tons, was used in 1937. There 1947, owing chiefly to the discontinuance by one of the large manufacturers. The following table are included in the total the preceding table.

Titanated lithopone produced in the United States in its manufacture, 1943-47

Year	Titanated lithopone produced	Ordinary lithopone used	
1943.....	9,800	8,400	1946.....
1944.....	9,800	8,300	1947.....
1945.....	9,200	7,800	

The lithopone industry in Germany report.⁴

ZINC SULFIDE

In 1947, as in several earlier years, zinc sulfide; the Bureau of Mines is not for this pigment.

A report⁵ on luminescent pigments in

⁴ Hill, B. P., and others, Barium Compounds and Lithopone Objectives Subcommittee Final Report, 1140, Item 22, 34 pp.

⁵ Hillier, G. E., and Clay, H. P., Luminescent Pigments, Riedel de Haen A. G., British Intelligence Objectives Sub-

ZINC CHLORIDE

Shipments of zinc chloride, in terms of 50° B. solution, totaled 65,521 tons in 1947, a gain of 14 percent over 1946. The total for 1947 may be a new all-time peak, although data for 1935-41 are incomplete, because the only annual total known to have been higher—that for 1920—represented production rather than shipments. The figures shown here include the zinc chloride equivalent of zinc ammonium and chromated zinc chloride produced. Complete figures covering distribution of zinc chloride shipments by uses are not available.

Production amounted to 67,475 tons in 1947 and 57,088 in 1946.

ZINC SULFATE

Increased shipments of zinc sulfate in 1947 for use in the manufacture of rayon (8 percent more than in 1946) contrasted with smaller shipments for agricultural purposes (28 percent below 1946), together with less consequential changes for other uses, resulted in an over-all drop of 14 percent in zinc sulfate shipments in 1947. Shipments in 1947, nonetheless, were second only to those for 1946. The gain in rayon manufacture, coincident with the drop in agriculture, caused the former use to resume first place, relinquished in 1946, in consumption of zinc sulfate. Rayon shipments established a new all-time record in 1947, and those for agriculture were second only to the peak established in 1946. Chemicals, electrogalvanizing, paints, and textile dyeing and printing all dropped in 1947, whereas flotation reagents and glue made gains. A more complete break-down of the chemicals classification probably would add to some of the other classifications.

In 1947, 23,423 tons of zinc sulfate were produced, compared with 25,004 tons in 1946.

Distribution of zinc sulfate sales,¹ 1943-47, by industries, in short tons

Industry	1943		1944		1945		1946		1947	
	Gross weight	Dry basis	Gross weight	Dry basis	Gross weight	Dry basis	Gross weight	Dry basis	Gross weight	Dry basis
Rayon	4,537	5,954	6,729	5,303	7,634	5,883	8,210	6,173		
Agriculture	3,329	4,974	6,655	5,492	19,816	8,178	7,827	6,125		
Chemicals	1,642	1,459	2,617	1,749	2,251	1,438	2,120	1,439		
Flotation reagent	1,282	1,131	1,272	935	1,691	643	1,112	717		
Glue	635	264	26	186	511	335	324	141		
Electroplating	187	278	255	163	488	315	254	146		
Paints and varnish processing	2,439	1,330	589	539	174	151	61	51		
Textile dyeing and printing	213		574	474	552	491	60	39		
Other	1,385	1,757	1,993	1,342	1,418	935	1,309	564		
	15,649	17,159	20,994	15,811	21,931	18,427	21,517	15,597		

¹ Reported as shipments, 1945-47.

RAW MATERIALS USED IN MANUFACTURE OF LEAD AND ZINC PIGMENTS AND ZINC SALTS

Figures covering the raw materials used in making pigments and salts were not available when the report of this series for 1946 was prepared. Data for 1946 are given below, and those for 1947 will appear in the next annual issue of this volume.

LEAD AND ZINC PIGMENTS AND SALTS

Lead pigments and zinc pigments and salts are a variety of materials, including ore, refined materials as scrap. In 1946, roughly 90 percent of the lead pigments was derived from pig lead and the remainder from lead in ore used to make leaded zinc oxide from foreign sources. The proportion for zinc pigments is 10 percent from ore and concentrates, 10 percent from secondary materials; about 15 percent from foreign.

The following tables give the source of raw materials for each pigment and salt. Pig lead is either directly or indirectly, in the manufacture of red lead, and orange mineral and is used in the manufacture of basic lead sulfate. The lead content of lead in basic lead sulfate, which in turn was made from pig lead in the table. Zinc oxide is made from a considerable slab zinc is used. Ore is either zinc oxide, leaded zinc oxide, lithopone, and basic lead sulfate. A substantial proportion (60 percent in 1946) and most of that made in the United States are derived from a number of years before the United States War, there had been a large increase in the zinc used in the manufacture of zinc oxide. Of both metal and scrap caused the proportion by the French process, which uses only metal in 1942 and to continue comparatively small fact that the percentage from metal and scrap continued upward in 1944, 1945, and 1946. Zinc oxide from metal and scrap accounted for 41 percent in relation to total production: 41 percent in 1942, 19 percent in 1943, 22 percent in 1944, and 19 percent in 1946.

Lead content of lead and zinc pigments produced in 1946-46, by sources, in short tons

Pigment	1945				Total lead in pigments
	Lead in pigments produced from--				
	Ore		Pig lead	Secondary material	
	Domestic	Foreign			
White lead			39,742		39,742
Red lead			43,685		43,685
Litharge			131,116		131,116
Orange mineral			196		196
Basic lead sulfate	2,807		327		3,134
Leaded zinc oxide	14,436	1,453	529	1	16,419
	17,243	1,453	215,805	1	234,502

¹ Bureau of Mines not at liberty to publish.

² Excludes lead in basic lead sulfate; Bureau of Mines not at liberty to publish.

Zinc content of zinc pigments and salts produced by domestic manufacturers, 1945-46, by sources, in short tons

Pigment or salt	1945					1946				
	Zinc in pigments and salts produced from—				Total zinc in pigments and salts	Zinc in pigments and salts produced from—				Total zinc in pigments and salts
	Ore		Slab zinc	Secondary material ¹		Ore		Slab zinc	Secondary material ¹	
	Domestic	Foreign				Domestic	Foreign			
Zinc oxide.....	65,505	18,240	15,462	12,161	111,368	68,113	15,709	17,091	12,050	113,063
Leaded zinc oxide.....	25,395	4,197	.....	706	30,293	31,845	3,010	278	.....	35,133
Lithopone.....	11,474	2,998	.....	12,207	26,679	11,370	110	26	17,582	20,088
Total pigments ²	102,374	25,435	15,462	25,074	168,345	111,328	18,819	18,295	29,632	178,174
Zinc chloride.....	.....	22	.....	12,472	12,494	.....	.....	.....	12,559	12,559
Zinc sulfate.....	2,383	808	34	3,289	6,514	3,673	75	.....	3,837	7,585

¹ These figures are higher than those shown in the report on Secondary Metals—Nonferrous because they include zinc recovered from byproduct sludges, residues, etc., not classified as purchased scrap material.

² Excludes zinc sulfide, data for which Bureau of Mines not at liberty to publish.

PRICES

Total and average values received by producers for lead and zinc pigments and zinc salts are given in the tables in the first part of this report. Average values for lead pigments in 1947 were the highest ever recorded, and those for zinc pigments and salts were the highest in many years.

Quoted prices for lead pigments were at all-time peaks at the beginning of the year and all price changes during the year were upward, the quotations following the movement of prices for pig lead. Such changes as took place in zinc price quotations in 1947 were likewise upward, so that for both classes the lower parts of the ranges for 1947, shown in the accompanying table, were for the first of the year and the higher parts for the last of the year.

Range of quotations on lead pigments and zinc pigments and salts at New York (or delivered in the East), 1944-47, in cents per pound

(Oil, Paint and Drug Reporter)

Product	1944	1945	1946	1947
Basic lead sulfate, or sublimed lead, less than carlots, barrels.....	7.50-7.75	7.50-7.75	7.50-13.50	13.25-15.75
White lead, or basic lead carbonate, dry, carlots, barrels.....	8.25	8.25	8.25-13.75	13.75-16.00
Litharge, commercial, powdered, barrels.....	8.00-9.00	8.00-9.00	8.00-14.75	13.75-17.60
Red lead, dry, 95 percent or less, less than carlots, barrels.....	9.50-10.00	9.50-10.00	9.50-16.00	15.75-18.60
Orange mineral, American, small lots, barrels.....	12.00-12.50	12.00-12.50	12.00-18.25	17.75-21.00
Zinc oxide:				
American process, lead free, bags, carlots.....	7.25	7.25	7.25-9.00	9.00-10.00
American process, 5 to 35 percent lead, barrels, carlots.....	7.25-7.38	7.25-7.38	7.25-10.75	9.25-12.00
French process, red seal, bags, carlots.....	8.50	8.50	8.50-10.25	10.25-11.25
French process, green seal, bags, carlots.....	9.00	9.00	9.00-10.75	10.75-11.75
French process, white seal, barrels, carlots.....	9.75	9.75	9.75-12.00	11.50-12.50
Lithopone, ordinary, small lots, bags.....	4.50	4.50	4.50-5.25	5.25-6.25
Zinc sulfide, less than carlots, bags, barrels.....	8.50-8.75	8.50-8.75	8.50-10.00	10.00-11.00
Zinc chloride, works:				
Solution, tanks.....	2.50	2.50	2.50	2.50-3.00
Fused, drums.....	5.00-6.50	5.00-6.50	5.00-6.50	5.00-7.40
Zinc sulfate, crystals, barrels.....	3.65-4.60	3.65-4.40	3.65-4.40	3.65-5.00

FOREIGN TRADE

Imports of lead and zinc pigments are in domestic shipments of the various items. total value in 1947, chiefly because receipts because the average values gained. The total exported likewise gained in 1947, but not as increased. The total value of zinc pigments doubled in 1947, and the grand total of lead salts exported likewise doubled in that year. are much larger than the lead group, zinc amounting to 10 times or more than litharge.

Value of foreign trade of the United States in lead and zinc pigments and salts, 1946-47¹

{U. S. Department of Commerce}

	Imports
Lead pigments:	
White lead.....	\$33,800
Red lead.....	3,800
Litharge.....	4,500
Other lead pigments.....	4,300
	13,000
Zinc pigments:	
Zinc oxide.....	8,400
Lithopone.....	300
Zinc sulfide.....	8,800
	17,500
Lead and zinc salts:	
Lead arsenate.....	400
Zinc chloride.....	17,200
Zinc sulfate.....	17,700
	35,300
Grand total.....	48,300

¹ Changes for table in Minerals Yearbook, 1946, p. 706, are as follows: Imports \$38,000; lead pigments import total \$7,783, export \$1,427; zinc pigments import total \$4,716,725.

² Data not available.

Lead pigments and salts imported for consumption

{U. S. Department of Commerce}

Year	Short tons		
	Basic carbonate white lead	Red lead	Litharge
1943.....	.....	.....	4
1944.....	(1)	.....	.....
1945.....	1	.....	.....
1946.....	1	54	.....
1947.....	1	22	.....

¹ Less than 1 ton.

² Includes also lead pigments, n. s. p. l., as follows—1946: \$97,000 and 1947: \$20,700 (120,000 pounds).

³ Figures on imports and exports compiled by M. B. Price, of U. S. Department of Commerce.

Lead pigments and salts exported from the United States, 1943-47

[U. S. Department of Commerce]

Year	Short tons						Total value
	White lead	Red lead	Litharge	Orange mineral	Sublimed lead	Lead arsenate	
1943.....	4,692	1,535	1,610	7	71	1,527	\$1,814,612
1944.....	3,052	2,117	2,301	13	82	2,133	1,888,120
1945.....	4,079	1,922	2,612	3	53	3,170	2,162,648
1946.....	910	1,355	2,180	(¹)	(¹)	1,398	1,184,372
1947.....	863	787	1,212	(¹)	(¹)	1,652	1,632,143

¹ Data not available.

Zinc pigments and salts imported for consumption in the United States, 1943-47

[U. S. Department of Commerce]

Year	Short tons						Total value
	Zinc oxide		Lithopone	Zinc sulfide	Zinc chloride	Zinc sulfate	
	Dry	In oil					
1943.....	10	11				546	\$34,033
1944.....	(1)	5		(1)		542	30,220
1945.....	(1)		(1)	(1)		421	16,806
1946.....	41		(1)	(1)	2	415	26,528
1947.....	117	1	(1)			295	47,482

¹ Less than one ton.

Zinc pigments and salts exported from the United States, 1943-47

[U. S. Department of Commerce]

Year	Short tons		Total value ¹	Year	Short tons		Total value ¹
	Zinc oxide	Lithopone			Zinc oxide	Lithopone	
1943.....	6,019	17,320	\$2,898,253	1946.....	10,055	9,651	\$2,011,467
1944.....	5,511	11,551	2,194,203	1947.....	19,082	13,652	6,554,250
1945.....	7,162	11,576	2,554,177				

¹ Includes also—1943: Zinc sulfide, \$29,521 (78,387 pounds); zinc chloride, \$57,300 (751,861 pounds); zinc sulfate, \$81,750 (1,830,508 pounds); other zinc salts and compounds, \$22,087 (139,940 pounds); 1944: Zinc sulfide, \$7,195 (40,223 pounds); zinc chloride, \$47,133 (711,953 pounds); zinc sulfate, \$83,596 (2,029,801 pounds); other zinc salts and compounds, \$40,587 (167,474 pounds); 1945: Zinc sulfide, \$25,309 (173,475 pounds); zinc chloride, \$83,590 (1,490,755 pounds); zinc sulfate, \$62,119 (1,213,820 pounds); other zinc salts and compounds, \$119,747 (750,108 pounds). Beginning January 1, 1940, none of the foregoing classes separately recorded.

Lime¹

By G. W. JOSEPHSON AND M.

GENERAL SUMMARY

DURING 1947 the high demand in refractory uses, coupled with the record boom, expanded the sales of lime to 419 short tons. This output was 13 percent above the historical record set in 1943 but sales, 74 percent were in the form of quicklime. In harmony with the general trend toward concentration of production value per short ton for quicklime increased in 1947; hydrated advanced from \$9.15 to \$10.00. The number of active plants declined from 31 in 1925-29 an average of 419 plants produced in the United States.

Salient statistics of the open-market lime industry (average), 1935-39 (average), and 1947

	1925-29 (average)	1935-39 (average)
Active plants.....	419	31
Sold by producers:		
By types:		
Quicklime..... short tons.....	2,871,236	2,488,200
Hydrated..... do.....	1,585,631	1,204,120
Total lime:		
Short tons.....	4,456,867	3,692,399
Value ¹	\$38,648,498	\$20,892,111
Per ton.....	\$8.65	\$7.25
By uses:		
Agricultural..... short tons.....	318,224	350,530
Building..... do.....	2,096,744	870,330
Chemical and industrial..... do.....	1,623,885	1,929,940
Refractory (dead-burned dolomite)..... short tons.....	418,014	541,580
Imported for consumption:		
Short tons.....	18,683	14,100
Value.....	\$344,887	\$240,900
Exported:		
Short tons.....	15,752	16,900
Value.....	\$221,177	\$123,160

¹ Selling value, f. o. b. plant, excluding cost of containers.² Revised figure.³ Figures in this chapter pertain to open-market lime and exclude other lime.

and foil and tubes (3,318 tons), up respectively 22 and 56 percent, accompanied by declines of 15 percent in solder to 5,621 tons, and 4 percent in alloys to 13,535 tons. Economy of tin used for tin plate in the United States compared with British practice is strikingly evident. In 1947 United States shipments of tin plate (and terno-plate) were six times as great as the British but tin consumption therefor was only three and one-half times as great. Government and consumer stocks of tin in metal and in concentrates dropped from nearly 20,400 tons at the beginning to 15,600 tons at the year end.

The British Government in April approved the planned £50,000,000 modernization of the South Wales tin plate and sheet-steel industry. The cold-reduction strip mill is to be erected near Llanelli. It is to have an annual capacity of 7,000,000 base boxes. The hot-strip mill, now under construction near Port Talbot, can roll 72-inch sheared strip, the widest in England. The weekly output is gaged at 22,400 tons. The project is being undertaken by private capital notwithstanding the Labor Government's announced intent to force through nationalization of the iron and steel industry even to the extent of curtailing the already limited powers of the House of Lords that has, at least for the time, blocked the requisite legislative action.

Titanium

By HELENA M. MEYER

GENERAL SUMMARY

PIGMENT manufacturers used record quantities in 1947, as in 1946 and 1945, in producing more than ever before, or at the new high rates of expansion of plant capacity in 1947. As for expanding capacity output was inadequate, but to handle record-breaking demand. Further expansion was in progress when the year closed. Inadequate plant construction and equipment impeded titanium pigments plant capacity.

Domestic production and shipments of titanium pigments at higher rates than ever before. Record domestic production with recent increasing activity in the investment sources for the mineral, point to the growing dependence of consumers of foreign sources of supply, a trend that during World War II, when dislocation of sources of supply, flow of ore from accustomed Indian and Norwegian sources also established a new peak in 1947. As a result of the supply of crude material, coupled with the limited plant capacity, stocks rose to a new peak and at the year end for almost 1 year's requirements at the 1947 level.

Although the manufacture of titanium pigments from ilmenite used, research by the Bureau of Mines indicates possibilities for use of titanium metal in the field indicates that this use probably will be limited to quantities of ilmenite when costs of production are low.

Rutile production continued to break records, 10 percent above the previous peak in 1946, but less than the 1946 record. For the second year, domestic output was more than adequate for domestic requirements and into stocks. Receipts of rutile from abroad and statistically were entirely in excess of requirements. As a result of the foregoing, industry stocks rose to a new peak at the end of the year were sufficient for almost 1 year's rate of consumption.

The Supreme Court, in a decision rendered in 1947, affirmed the decree of the lower court in the civil suit brought by the

certain factors in the titanium pigments industry. In summarizing the matter the National Lead Co. stated:¹

On June 23, 1947, there was affirmed by the Supreme Court of the United States the decree of the lower court in the civil suit by the Government against the Company and others involving charges of violation of the anti-trust laws. In brief, the decree directs the cancellation of certain agreements which provided, among other things, for territorial arrangements and for the exchange of titanium-pigment patent rights, domestic and foreign; it also directs the sale of the Company's stock interests in certain partly owned foreign companies engaged in the titanium pigment business or, in the alternative, the purchase by the company of the interests of the other stockholders in these companies; it further directs the granting of non-exclusive licenses under United States patents in the titanium pigment field on a uniform, reasonable royalty basis. The Company is at the present time proceeding to carry out the provisions of the decree. The disposal of its stock interest in British Titan Products Company, Limited, * * * and the acquisition of the outstanding minority interest in Canadian Titanium Pigments Limited, * * * are steps taken in this connection.

Prices for ilmenite changed little in 1947 following a \$9 to \$10 drop in 1946. They were quoted nominally at \$19-\$20 a long ton for ilmenite containing 57-60 percent TiO_2 , f. o. b. Atlantic seaboard, according to grade and impurities, when the year ended as when it began, having declined to a low point of \$17-\$19 in midyear. Rutile prices continued to be quoted nominally at 8-10 cents a pound, guaranteed minimum 94 percent concentrate.

DOMESTIC PRODUCTION

Ilmenite output rose 19 percent in 1947 to a new peak rate, surpassing the previous peak in 1945 by 9 percent, and shipments in 1947 likewise were the highest on record. Rutile production also established a new high, rising 15 percent above the previous peak in 1946, but shipments fell 31 percent below the peak established in 1946. Shipments of ilmenite concentrates in 1947 ranged from 44 to 60 percent TiO_2 and of rutile from 93 to 94 percent TiO_2 .

Production and mine shipments of titanium concentrates from domestic ores in the United States, 1943-47, in short tons

Year	Ilmenite				Rutile			
	Production	Shipments			Production	Shipments		
		Gross weight	TiO_2 content	Value		Gross weight	TiO_2 content	Value
1943.....	203,551	211,715	94,283	\$3,738,970	3,987	3,941	3,639	\$610,870
1944.....	278,610	280,791	128,095	7,371,279	6,922	6,770	6,312	1,088,112
1945.....	308,516	308,513	141,852	7,359,170	7,179	6,837	6,414	899,020
1946.....	282,447	282,708	130,624	4,878,917	7,453	7,514	7,046	996,989
1947.....	336,533	336,061	157,328	5,029,490	8,562	5,157	4,813	533,548

Florida.—In December 1947, E. I. du Pont de Nemours & Co., Inc., signed a long-term lease for State-owned ilmenite-bearing property near Starke, Fla., to provide a large domestic source of supply of the ore. Large-scale mining operations are expected to get under way promptly. The grade of the sand analyzes about 4 to 4.5 percent

heavy mineral. Composition of the heavy mineral is approximately: ilmenite 45 percent, staurolite 10 percent and other components in minor quantities. The content is so low as to be almost negligible. The mineral is a suction dredge and pumped to Humphreys spring for concentration. The spiral concentrate will be dried in static machines. The conductors will be split and the conductors will be further treated to concentrate. The recently investigated and described,² is about 32 miles to the east coast of north Florida. Drilling extended along U. S. Highway 90 a few miles east of Macduffy, about 32 miles to a section about 3 miles north of Macduffy.

Production of ilmenite in Florida in 1947 came from the Mining Co. of Florida, near Jacksonville, and from the company and the Riz Mineral Co., near Vero Beach. The latter was inactive most of the year.

New York.—Production of titanium-bearing mineral in Essex County, by the National Lead Co. was greater than in 1946. An outstanding reason for the record performance was as a whole.

North Carolina.—The Yadkin Valley Ilmenite Co., produced 27,349 short tons of ilmenite (93 percent TiO_2) at Finley, Caldwell County. This was the highest production above that in 1946.

Virginia.—Ilmenite and rutile continued to be produced at Roseland, Nelson County, by the American Rutile Co. of the Metal & Thermit Corp. The Calco Chemical Co. and the Cyanamid Co. likewise continued to produce rutile at River, Nelson County.

CONSUMPTION AND USE

Consumption of ilmenite established a new high in 1947, the fifth successive year, enabled to rise 19 percent above the previous year, because of further expansion of pigment-plant capacity. Plant-capacity expansion had been sufficient to handle additional tonnages of ilmenite would have been required for manufacture of titanium pigments again used 99 percent consumed. Rutile consumption rose 8 percent above the previous year. Rod coatings again took by far the largest quantity, total, in that year.

Titanium Pigments.—New peak records for consumption of titanium pigments were established in 1947, the fifth successive year. The expanded capacity operation to supply all requirements for this product by the National Lead Co. for titanium pigments, although rising demand, has been accentuated in recent years because of competitive lead- and zinc-paint pigments. Production from a leading manufacturer, the use of titanium pigments in 1947 was as follows: 75 percent was

¹ Annual Report for 1947, pp. 18 and 19.

² Spencer, Robt. V., "Titanium Minerals in Trall Ridge, Fla.," Bureau of Mines Bulletin 4208, 1946, 21 pp.

Consumption of ilmenite and rutile in the United States, 1943-45 (total) and 1946-47, by products, in short tons

Product	Ilmenite		Rutile	
	Gross weight	Estimated TiO ₂ content	Gross weight	Estimated TiO ₂ content
1943.....	302,822	142,808	17,634	16,451
1944.....	350,941	175,475	14,813	13,837
1945.....	381,178	187,680	9,791	9,144
1946				
Pigments (manufactured titanium dioxide) ¹	399,042	200,352		
Welding-rod coatings ¹	105	57	5,990	5,600
Alloys and carbide.....	4,085	2,025	1,035	966
Ceramics.....			75	72
Miscellaneous ²	451	220	34	32
Total 1946.....	404,283	202,663	7,134	6,670
1947				
Pigments (manufactured titanium dioxide) ¹	473,154	248,231		
Welding-rod coatings ¹	144	74	6,425	5,907
Alloys and carbide.....	5,972	2,431	1,131	1,050
Ceramics.....			102	95
Miscellaneous ²	254	123	34	31
Total 1947.....	479,524	250,859	7,692	7,083

¹ "Pigments" include all manufactured titanium dioxide, consumption of which in welding-rod coatings was 938 tons in 1946 and 1,257 tons in 1947.

² Consists of ilmenite used as a steel flux and rutile used in lamp-electrode coatings and as a steel deoxidizer.

lacquer, 8 percent for paper, 6 percent for rubber, 2 percent each for floor coverings and welding rods, and 7 percent for other uses.

Welding-Rod Coatings.—Production of titanium-coated welding rods was 153,000 short tons in 1947, a gain of 15 percent over 1946 and the first increase since 1943. In 1946, 133,000 short tons were coated and in 1943, 481,000 tons. Of the rods in 1947, 54 percent were coated with natural rutile, 33 percent with manufactured titanium dioxide (extracted from ilmenite), 7 percent with both varieties of dioxide, and 6 percent with ilmenite.

Titanium Alloys and Other Uses.—New acid-resistant, highly opaque sheet-metal cover-coat enamels made from relatively high percentages of titanium dioxide have come to the fore³ because of their many advantages in covering power and acid resistance. A steel has been developed⁴ to withstand very high temperature of enameling furnaces so that a special tough porcelain enamel can be applied to the metal. The single porcelain enamel finish on the titanium steel has production advantages over the two-coat finish.

Synthetic rutile gems have been developed at the titanium division

³ Steel Enameling Industry Limited by Raw Material Shortages: Vol. 122, No. 1, Jan. 5, 1948, p. 239.
⁴ The Iron Age, Titanium Iron for Vitreous Enameling (Advertisement): Vol. 158, No. 24, Dec. 12, 1946, p. 149.
 Daily Metal Reporter, Westinghouse Offers Range With Titanium Steel Tap: Vol. 48, No. 61, Apr. 2, 1948, p. 9.

TITANIUM

of the National Lead Co. research laboratories:

Pure rutile crystals may have other uses in adhesives have not yet been investigated due to the position. The atomic structure of the mineral and its electrical, optical and sonic properties.

STOCKS

Ilmenite and rutile industry stocks in short tons respectively, during 1947.

Stocks of titanium concentrates in the United States, in short tons

Stocks	1946			
	Ilmenite		Rutile	
	Gross weight	Estimated TiO ₂ content	Gross weight	Estimated TiO ₂ content
Mine.....	1,309	613	533	500
Distributors ¹	3,919	2,155	8,488	7,977
Consumers.....	375,988	195,541	1,806	1,521
Government ²			3,891	3,655
Total stocks.....	381,226	198,309	14,808	13,653

¹ Includes ilmenite and rutile content of mixed zirconium-titanium concentrates.

² A large quantity previously counted as stocks was written off.

³ Excludes stocks in Government strategic stock pile.

PRICES

Ilmenite, 57-60 percent TiO₂, was quoted by Mineral Markets nominally at \$19-\$20 per ton on the seaboard, according to grade and impurities, at the end of the year, but slumped to a low of \$15 in late spring. Rutile, 94 percent TiO₂, quoted nominally at 8-10 cents a pound through ferrotitanium, ton lots, at \$1.23 per pound for 45-percent grade and \$1.35 for 20- to 40-percent carbontitanium, 15-20 percent Ti, at \$1.50 per pound for 10- to 15-percent carbon and \$157.50 for 3- to 5-percent metal, 96-98 percent, continued to be quoted until May when the quotation was advanced to \$160. It remained until reduced in September, when it level it continued through the remainder of the year. Titanium dioxide (anatase), chalk-resistant, in bags, carlots, delivered—quoted in October at 15½ and 15½ to 17½ cents a pound, respectively, of the year—was raised 1 cent a pound in November and 1 cent at the end of December.

⁴ Science News Letter, New Synthetic Gems Made: Vol. 62, No. 15, April 1948, p. 15.

FOREIGN TRADE ¹

Imports.—Receipts of ilmenite from abroad in 1947 were larger than ever before, being 24 percent above 1946 and 5 percent higher than the previous record established in 1939, before the war had cut off normal trade movements. India was by far the largest source, furnishing 87 percent of total entries in establishing new record quantities in 1947. Norwegian ilmenite came into the country again in larger quantities following the resumption of shipments to the United States in 1945. Imports of rutile, much of it in the form of mixed zircon-rutile-ilmenite concentrates from Australia, more than doubled

Titanium concentrates ¹ imported for consumption in the United States, 1943-47, by countries, in short tons

[U. S. Department of Commerce]

Country of origin	1943	1944	1945	1946	1947
ILMENITE					
Australia ²	390	79	1,763	.....	³ 1,650
Brazil.....	.....	5,511	10,504	2	1
Canada.....	65,437	32,580	6,087	1,250	7,122
Ceylon.....	.....	4,648	.....	.....	.....
India.....	8,960	62,066	179,603	218,623	262,503
Norway.....	.....	.....	6,405	21,077	30,026
Total as reported.....	74,787	104,884	208,836	240,952	301,311
Australia: In "zirconium ore" ⁴	3,306	4,064	⁵ 1,236	1,388	.....
Grand total.....	78,093	108,948	210,072	242,340	301,311
Value of "As reported".....	\$380,161	\$596,034	\$1,217,339	\$1,440,112	\$1,791,020
RUTILE					
Australia ²	2,802	1,806	3,070	4,377	7,400
Brazil.....	4,920	1,609	234	31	.....
Cameroon (French) ⁶	1,095	.....	.....	.....	3
India.....	818	134	.....	.....	113
Total as reported.....	9,635	3,699	3,304	4,408	7,576
Australia: In "zirconium ore" ⁴	4,703	6,320	7,298	1,456	.....
In "ilmenite".....	.....	.....	.....	.....	⁵ 5,061
Grand total.....	14,338	10,019	10,602	5,864	12,637
Value of "As reported".....	\$823,624	\$272,283	\$98,170	\$213,795	\$468,810

¹ Classified as "ore" by the U. S. Department of Commerce.

² Most of the imports of titanium from Australia in 1943-47 were in mixed zircon-rutile-ilmenite concentrates. Totals of mixed concentrates are derived by addition of the U. S. Department of Commerce figures for imports of ilmenite, rutile, and "zirconium ore" from Australia. These totals are apportioned by the Bureau of Mines (on the basis of surveys of importers) into the three component minerals. The excess quantities of ilmenite and rutile over the quantities reported by the U. S. Department of Commerce in those specific categories are entered as "In 'zirconium ore'."

³ Most of the ilmenite, rutile, and zircon from Australia in 1947 was imported in the form of zircon-rutile or zircon-rutile-ilmenite mixed concentrates. These concentrates (including separated concentrates of a single mineral) totaled 36,074 short tons, of which 1,650 were ilmenite, 12,521 rutile, and 21,903 zircon. For statistical convenience, it can be assumed that 5,061 tons of the material reported by the Department of Commerce as ilmenite was actually rutile; the value of this 5,061 tons of rutile, however, is inseparable from the value of ilmenite as reported.

⁴ Includes 309 tons not recovered from mixed concentrates.

⁵ Includes quantities reported by the U. S. Department of Commerce as originating in French Equatorial Africa, from which no rutile production has been recorded.

⁶ Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the U. S. Department of Commerce.

in 1947 and were the largest since 1919, an important foreign source of rutile in 1947 for consumption totaled 45 short tons in the United Kingdom.

Exports.—Of the concentrates exported, 30 percent to Canada, 30 percent to the Union of South Africa, and 10 percent to France. Of the pigments, 63 percent to Belgium-Luxembourg; Norway, 10 percent; and 27 percent to the United States out of the 44 remaining destinations totaled 10 percent. South America as a whole received 10 percent, including Belgium-Luxembourg 5 percent. Total titanium products exported about \$5,500,000.

Exports of titanium products from the United States

[U. S. Department of Commerce]

Year	Concentrates		Ferro-alloys ¹	
	Short tons	Value	Short tons	Value
1943.....	576	\$103,947	760	\$117,727
1944.....	291	\$1,828	703	127
1945.....	000	121,051	744	122
1946.....	1,385	200,866	650	63
1947.....	1,266	192,703	600	80

¹ Includes metal and nonferrous alloys, 1943-44.
² Beginning Jan. 1, 1946, not separately classified.

TECHNOLOGY

Bureau of Mines' pilot-plant product was discussed in the report of this series. The method used, a modification of the Kroll process, involved the production of pure titanium tetrachloride. About 100 pounds of titanium tetrachloride have been subjected to a distillation process developed by the Bureau of Mines, recently issued, gives detailed information.

German research in connection with the production of magnesium oxide-lined batch rotary kiln in the presence of sodium hydroxide flux is discussed in this chapter. German methods of production are referred to.

An article ⁸ recently published states that present time titanium can be produced

⁷ Stoddard, C. Kerby, and Pletz, Emil, Pilot-Plant Distillation of Titanium Tetrachloride; Bureau of Mines Rept. of Investigations 4153, 1947.
⁸ Gee, E. A., and Waggaman, W. H., Metallic Titanium: Resistant Materials and Methods, vol. 27, No. 1, January 1948.

pound, and estimates of large-scale production have been as low as 50 cents a pound. The article says:

Even at the higher prices, the unusual and valuable properties of titanium are such as to amply justify its use for purposes that cannot be adequately fulfilled by other metals. The technology of titanium, however, is only in its infancy, and continued improvement of the preparation and fabrication processes will eventually bring about lower costs.

WORLD REVIEW

Available data on world production of ilmenite and rutile in recent years are shown in the accompanying table. Brief notes on certain important producing and consuming countries follow.

World production of titanium concentrates (ilmenite and rutile), 1940-47, by countries, in metric tons

[Compiled by B. B. Mitchell]

Country	1940	1941	1942	1943	1944	1945	1946	1947
ILMENITE								
Australia:								
New South Wales.....	1,538	3,521	3,651	3,815	3,500			
Queensland.....		258	937	1,902	3,697	6,671	5,804	6,449
Tasmania.....								
Brazil (exports).....	12	4,471			3,250	5,000		(¹)
Canada.....	4,114	11,477	9,100	62,992	30,820	12,834	1,275	1,134
Egypt.....	465	2	2,691		9		146	(¹)
India.....	267,376	331,111	49,977	38,396	102,412	174,848	187,803	(¹)
Malayan Union.....	2,596	44					(¹)	(¹)
Norway.....	61,700	61,086	60,713	66,191	63,975	28,312	(¹)	(¹)
Portugal.....	899	708		121		301	633	(¹)
Senegal.....	7,082	1,000	4,840	730		3,200	4,310	(¹)
Spain.....		71	85	178	548	216	128	136
United States.....	18,750	21,135	70,042	184,057	252,749	279,890	256,290	305,206
Total ilmenite.....	354,532	234,974	200,036	358,982	461,050	511,271	500,000	(¹)
RUTILE								
Australia:								
New South Wales.....	1,641	3,549	4,496	4,828	4,597			
Queensland.....		267	1,007	1,655	4,246	9,900	8,283	13,408
South Australia.....	2	(¹)						
Brazil (exports).....	499	2,369	4,615	4,557	1,564	160	28	45
Cameroon, French.....	400	1,800	2,400	2,735	3,320	1,440	1,260	800
India.....	934	1,891	2,295	2,396	1,672	620	262	(¹)
Norway.....	150	172	77	116	85	76	(¹)	(¹)
United States.....	2,020	2,819	2,402	3,017	6,279	6,513	6,701	7,707
Total rutile.....	6,252	12,887	17,292	19,904	21,763	18,709	16,700	(¹)

¹ Data not available. In 1946, estimates by author of chapter included in world total.

² Includes 26 tons of garnet-ilmenite.

³ Exports.

⁴ January to September, inclusive.

⁵ Approximately 20 percent of ilmenite concentrates is zircon.

⁶ Less than 1 ton.

Ceylon.—Investigation was said ⁹ to be in progress for the possibility of installing a factory for the manufacture of titanium metal from ilmenite to be produced from reports on the east coast.

Finland.—Finnish press reports in 1947 stated that about 20,000,000 tons of ore, containing 67 percent titanium, were discovered to be in deposits in the Lapland region.

Germany.—The report of this series for 1946, based on data made available recently on titanium concentrates, report ¹⁰ is abstracted as follows:

Research is described on the smelting of ilmenite in a rotary kiln in the presence of both carbon and a sodium compound. The ore is a high carbon content iron and a sodium compound. The titanium dioxide with a TiO₂/Na₂O mol ratio of 1:1 is reduced with sulfuric acid and subsequently processed to titanium metal. Research had not progressed far enough to evaluate the economics of the process, or to establish definitely the refractory lining.

Three methods employed by German firms for the production of titanium metal were described ¹¹ in 1946.

India.—Descriptions of the discovery of titanium metal in Travancore, and of the methods of its production, were recently published. ¹² The report mentioned in the report of this series for 1946, stated that construction in Travancore, is expected ¹³ to cost about \$1,250,000, and to have a capacity of 100 tons a day. British interests, headed by British Overseas Airways Corporation, were said to have agreed to assist in setting up the plant.

Malaya.—Resumption of the exportation of titanium metal mining, was expected ¹⁴ in 1947. Exports of long (11,276 metric) tons in 1939.

Mexico.—A large deposit of ilmenite was discovered recently west of Victoria, capital of the State of Baja California. The Instituto de Geologia de la Universidad Nacional (Geological Institute of the National University) of Mexico was reported ¹⁵ recently to have discovered large deposits of rutile near the village of Pluma Hidalgo, near the village of Pluma Hidalgo.

⁹ Metal Industry (London), vol. 71, No. 12, Sept. 19, 1947.

¹⁰ Kramer, Edw. N., and others, The Smelting of Ilmenite.

(U. S.) FIAT Final Rept. 1061, Mar. 5, 1947, 53 pp. (Publishing Office, FIAT, Turin, Italy).

¹¹ Titanium, Three German Methods of Production: Metals from B. I. O. S. report, pp. 303-304.

¹² Viswanathan, P., Beach Minerals of Travancore: Science, 1946, pp. 22-29.

¹³ Indian Monazite Exports Restricted by Government: India, No. 25, June 19, 1947, p. 3.

¹⁴ Bureau of Mines, Mineral Trade Notes: Vol. 25, No. 4, 1946, p. 1.

¹⁵ Bureau of Mines, Mineral Trade Notes: Spec. Suppl. 18, 1946, p. 1.

¹⁶ Bureau of Mines, Mineral Trade Notes: Vol. 25, No. 1, Jan. 1947, p. 1.

New Zealand.—Titanium mineral resources on the West Coast of Wanganui are said ¹⁷ to have been examined and reported on for E. I. du Pont de Nemours & Co., Inc. Some 22,000,000 tons of titaniferous magnetite ore are estimated ¹⁸ to be present.

Norway.—Second only to India in the output of ilmenite before World War II, Norway's production was subsequently surpassed by the United States. Expansion of capacity for output at the mine of the National Lead Co. at Fredrikstad was announced late in 1947, the second since the end of the war.

United Kingdom.—The 1947 annual report of the National Lead Co. indicated the disposal of stock interest in British Titan Products Co., Ltd., early in 1948 in conformance with the United States Supreme Court ruling mentioned in the opening section of this report.

¹⁷ South African Min. & Engr. Journal, vol. 58, pt. I, No. 2831, May 17, 1947, p. 371.

¹⁸ Chemical Age (London), vol. 56, No. 1447, Apr. 5, 1947, p. 422.

Tungsten

By HUBERT W. DAVIS

GENERAL SUMMARY

LACK of offerings of tungsten concentrates of the first half of 1947, increased world demand, and higher prices were features of the tungsten market. To ease the shortage that existed in the United States, the tool-steel industry made an unsuccessful appeal to the tungsten in the Government strategic stockpile. Owing largely to a shortage of supplies, European and South American tungsten, and increased domestic production of imported tungsten concentrates advanced to a new ton unit of WO_3 , duty paid, by mid-July; and the price of delivered, reached \$32 a unit. After an improvement in position and buyer resistance, the price of both tungsten concentrates dropped to \$30 a unit by the end of the year.

Salient statistics of tungsten ores and concentrates in the United States in pounds of tungsten

Year	Production	Shipments from mines	Imports for consumption	Consumption
1943.....	11,472,985	11,388,295	19,445,017	19,313,000
1944.....	9,784,647	9,788,637	18,396,277	19,195,000
1945.....	5,388,639	5,200,818	4,773,861	14,146,000
1946.....	4,671,042	4,942,282	6,869,438	6,458,000
1947.....	3,026,470	2,944,622	6,018,008	7,812,000

Despite much higher prices and substantial increases in production in 1947, domestic production and shipments of tungsten concentrates (60 percent WO_3 basis) declined for the fourth successive year. Production in short tons, respectively, in 1947, decreases of 31 percent from 1946. Nevada again was the premier tungsten producer, followed by North Carolina—where output was double that of 1946, from fourth to second place.

Imports of tungsten ores and concentrates into the United States were 6,323 short tons (60 percent WO_3 basis), a decline of 12 percent from 1946. China (21 percent), and Bolivia (14 percent), supplied 5 percent each. However, important quantities were also consumed in Congo and Siam.

Consumption of tungsten concentrates in the United States was about 8,200 short tons (60 percent WO_3 basis) in 1947.