MINER
YEARB

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Lead[1]

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GENERAL SUMMARY

ACCENTUATED by the threat of possible lead shortages resulting from unpredictable work stoppages, an accelerated program of defense construction, and Government requirements for the strategic stock pile, consumer demand for lead remained high throughout 1948. As a result, the market quotation for lead advanced three times during the year to establish new record highs, and a sellers' market continued to prevail within the industry. With elimination of a 30,000-ton potential gain in domestic mine production in 1948 through work stoppages in certain mining areas which in turn limited domestic refinery output, there was increasing demand for lead from secondary and foreign sources. Recovery from secondary sources remained above 500,000 tons and surpassed domestic mine output for the third successive year. Total imports of lead were 52 percent greater in 1948 than in 1947 owing in part to the desire for American dollars abroad and to the suspension of lead import duties beginning July 1, 1948.

The total consumption of primary, antimonial, and secondary lead in the United States in 1948 was 1,115,995 tons. Lead stocks (physical inventory) at primary smelters and refineries rose 113 percent during 1948, and consumers' inventories at the end of the year were 30 percent greater than on January 1.

Government regulations requiring a license for the exportation of pig lead and lead semimanufactures remained operative throughout the year.

[1] This report deals primarily with the smelting, refining, and consuming phases of the industry. For details of mining operations, see various State chapters of this volume.

Salient statistics of the lead industry in the United States, 1944–48, in short tons

	1939–43 (average)	1944	1945
Production of refined primary lead:			
From domestic ores and base bullion	439,092	391,443	356,536
From foreign ores and base bullion	85,234	70,320	87,050
Total	524,926	464,763	443,586
Recovery of secondary lead	312,871	331,416	303,039
Imports:[1]			
Lead in pigs, bars, and old	209,373	226,073	230,313
Lead in base bullion	28,333	58	8
Lead in ores and matte	74,713	93,570	70,005
Exports of refined pig lead[2]	31,381	15,523	1,784
Estimated consumption of primary and secondary lead	931,000	1,118,643	1,051,602
Prices (cents per pound):			
New York:			
Average for period	5.80	6.50	6.50
Quotation at end of period	5.97	6.50	6.50
London average for period	(4)	4.49	4.99
Mine production of recoverable lead	456,470	416,801	390,831
World smelter production of lead[3]	1,840,000	1,424,000	1,233,000

[1] Data include lead imported for immediate consumption plus material under bond.
[2] Revised figures.
[3] Includes less than 1 ton of foreign lead reexported in 1944, 377 tons in 1947, and none in 1948, according to records of the U. S. Department of Co
[4] Figure not available.

DOMESTIC PRODUCTION

Statistics on lead output may be prepared on a refinery basis. The mine-production data comp lead content in ore and concentrates and adju average losses in smelting are the most pertinen tion from year to year. The pig-lead output, as and refiners, presents a more precise figure of act generally differs from the mine figure owing to t shipments and smelter consumption of ore and inequities, however, tend to balance over a perio

MINE PRODUCTION

Despite a continued high industrial demand time high-record market price, domestic mine o lead (including that made into pigments) in 194 2 percent over 1947. Work stoppages due t disputes curtailed lead outputs in certain areas a single factor to impede the obtaining of greater su mines in 1948. The work stoppage which shut Lead Co. mines, mills, and smelter in southeas weeks was estimated to have been responsible f tons of lead production. Work stoppages duri lead outputs in other areas, notably the Tri-Sta eastern Washington.

Of the total lead produced at United States mines in 1948, 63 percent came from the output of 25 properties. Missouri continued to rank first among the States in the production of lead, and the Southeastern Missouri district continued to be the largest lead-producing area, supplying 26 percent of the total domestic output. The St. Joseph Lead Co., as in the past, produced the bulk of the output from its Bonne Terre, Desloge, Federal, and Leadwood mine groups in St. Francois County and the Mine La Motte mine in Madison County. Each mine is equipped with a mill; the five have a combined daily capacity of about 24,000 tons. In the Tri-State district the production of lead concentrates, stimulated by the record high price, increased 11 percent over 1948 despite the loss of operating time caused by a labor strike in July and August. The Tri-State area produced 7 percent of the total domestic output in 1948 compared with 6 percent in 1947.

The combined Western States contributed 65 percent of the total domestic production and recorded a 14-percent gain over 1947. Idaho was again the largest producer of lead in the Western States and second only to Missouri in the United States. In 1948, 93 percent of the State total lead came from the Coeur d'Alene region. Six properties in Idaho produced 60 percent of the State total lead, and of the total more than 77 percent came from zinc-lead ore and old tailings. Lead production in Utah in 1948 responded strongly to the record high market price of lead, and the State output rose to the highest level since 1943. The United States & Lark property of the United States Smelting, Refining & Mining Co. in the West Mountain (Bingham) district remained first among the State lead producers. Of the State total lead in 1948, 88 percent was recovered from zinc-lead ore. Uninterrupted operation of lead and zinc-lead mines in Arizona in 1948 resulted in an output of 29,899 short tons of recoverable lead, the largest in the history of the State, and 5 percent greater than the previous record production in 1947. The Copper Queen mine of the Phelps Dodge Corp. at Bisbee continued to be the largest Arizona lead producer in 1948; about 90 percent of the State total lead was recovered from zinc-lead ore. In Colorado the value of lead recovered from ores in 1948 was higher than in any previous year and exceeded that of gold for the first time since 1891. In quantity the mine production of lead increased 34 percent over 1947 and was the largest since 1928. The leading producer in the State in 1948 was the American Smelting & Refining Co. Kokomo unit in Summit County. Zinc lead ore yielded 35 percent of the State total lead during the year. Lead production in Montana gained 14 percent over 1947 and was the largest yearly output since 1942. The four leading producers, which contributed 84 percent of the State total in 1948, were the Butte Hill mine and dumps, the Emma, Mike Horse, and Jack Waite mines. Of the Montana total output of lead in 1948, 89 percent was recovered from zinc-lead ore.

Mine production of recoverable lead in the Unit 1944–48, by States, in s

State	1939–43 (average)	1944
Western States and Alaska:		
Alaska	599	44
Arizona	13,635	10,707
California	3,740	5,682
Colorado	13,097	17,698
Idaho	102,219	83,530
Montana	19,445	13,105
Nevada	6,305	6,605
New Mexico	4,842	7,265
Oregon	27	4
South Dakota	27	34
Texas	162	
Utah	70,022	52,510
Washington	4,010	6,825
Wyoming	1	
Total	237,737	209,018
West Central States:		
Arkansas	14	
Kansas	11,758	9,394
Missouri	175,740	174,683
Oklahoma	23,304	13,944
Total	210,816	198,021
States east of the Mississippi River:		
Illinois	1,716	1,971
Kentucky	261	170
New York	2,250	1,644
Tennessee	310	
Virginia	2,620	4,622
Wisconsin	751	1,416
Total	7,917	9,822
Grand total	456,470	416,861

Mine production of recoverable lead in the Un duced 1,000 tons or more during any ye

District	State
Southeastern Missouri region	Missouri
Coeur d'Alene region	Idaho
West Mountain (Bingham)	Utah
Tri-State (Joplin region)	Kansas, southwestern Missouri, Oklahoma.
Summit Valley (Butte)	Montana
Park City region	Utah
Warren (Bisbee)	Arizona
Coso (Darwin)	California
Tintic	Utah
Pioche	Nevada
Old Hat	Arizona
California (Leadville)	Colorado
Austinville	Virginia
Metaline	Washington
Rush Valley & Smelter (Tooele County).	Utah
Ten Mile	Colorado
Pima (Sierritas, Papago, Twin Buttes).	Arizona
Upper San Miguel	Colorado
Central	New Mexico
Kentucky-southern Illinois	Kentucky, southern Illinois
Magdalena	New Mexico
Big Bug	Arizona
Pioneer (Rico)	Colorado
Harshaw	Arizona
Heddleston	Montana
Animas	Colorado
Bayhorse	Idaho
Upper Mississippi Valley	Iowa, northern Illinois, Wisconsin.

Mine production of recoverable lead in the United States, by districts that produced 1,000 tons or more during any year, 1944–48, in short tons—Continued

District	State	1944	1945	1946	1947	1948
Tomichi	Colorado	373	366	333	1,458	1,788
Northport (Aladdin)	Washington	233	28	39	508	1,426
Bossburg	do	5	158	428	1,010	1,394
Warm Springs	Idaho	3,333	2,347	1,649	1,879	1,304
St. Lawrence County	New York	1,644	862	1,073	1,496	1,231
Aravaipa	Arizona	181	291	467	794	1,142
Red Cliff	Colorado	1,444	572	690	924	1,120
Eureka	do	46	59	300	630	1,107
Modoc	California	26	862	279	139	1,061
Alder Creek	Idaho	32	38	136	1,103	776
Eagle	Montana	1,128	590	469	393	600
Smelter (Lewis and Clark County)	do	1,364	222	463	60	396
Resting Springs [1]	California	[2]	[2]	[2]	[2]	[2]

[1] Not listed in order of output.
[2] Bureau of Mines not at liberty to publish figures.

Mine production of recoverable lead in the United States, 1947–48, by months, in short tons

Month	1947	1948	Month	1947	1948
January	31,545	33,246	August	31,281	23,685
February	30,251	32,517	September	31,124	27,279
March	32,735	35,999	October	33,682	35,687
April	33,302	35,200	November	31,550	36,986
May	33,361	33,370	December	32,622	38,542
June	32,826	34,543			
July	29,942	23,422	Total	384,221	390,476

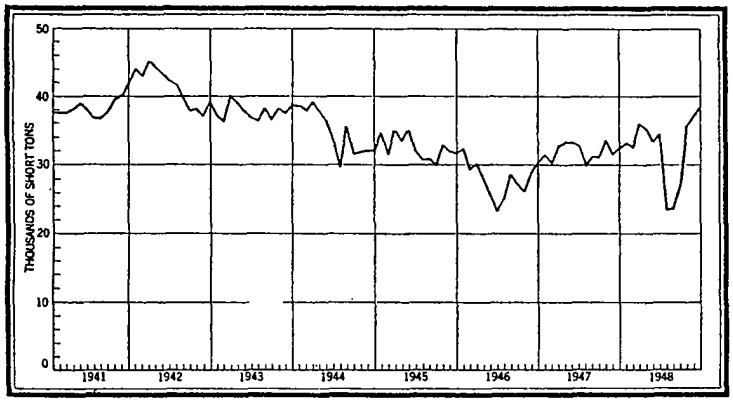

FIGURE 1.—Mine production of recoverable lead in the United States, 1941–48, by months.

The 25 leading lead-producing mines in the United States in 1948, listed in the following table, yielded 63 percent of the total domestic lead output; the 10 leading mines produced 45 percent, and the 4 leading mines 31 percent.

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.

Twenty-five leading lead-producing mines in the United States in 1948, in order of output

Rank	Mine	District	State	Operator	Type of ore
1	Federal	Southeastern Missouri	Missouri	St. Joseph Lead Co.	Lead.
2	United States and Lark	West Mountain (Bingham)	Utah	U. S. Smelting, Refining & Mining Co.	Zinc-lead.
3	Bunker Hill & Sullivan	Yreka	Idaho	Bunker Hill & Sullivan Mining & Concentrating Co.	Do.
4	Leadwood	Southeastern Missouri	Missouri	St. Joseph Lead Co.	Lead.
5	Copper Queen	Warren (Bisbee)	Arizona	Phelps Dodge Corp.	Zinc-lead.
6	Bonne Terre	Southeastern Missouri	Missouri	St. Joseph Lead Co.	Lead.
7	Butte Mines	Summit Valley (Butte)	Montana	Anaconda Copper Mining Co.	Zinc-lead.
8	Page	Yreka	Idaho	Federal Mining & Smelting Co.	Do.
9	Mine La Motte	Southeastern Missouri	Missouri	St. Joseph Lead Co.	Lead.
10	Star	Hunter	Idaho	Sullivan Mining Co.	Zinc-lead.
11	Darwin group	Coso	California	Anaconda Copper Mining Co.	Lead.
12	Madison	Southeastern Missouri	Missouri	St. Louis Smelting & Refining Co.	Lead-copper.
13	Mammoth-Collins	Old Hat	Arizona	St. Anthony Mining & Development Co.	Zinc-lead.
14	Chief, Gemini etc.	Tintic	Utah	Chief Consolidated Mining Co.	Do.
15	Combined Metals group	Pioche	Nevada	Combined Metals Reduction Co.	Do.
16	Silver King	Park City	Utah	Silver King Coalition Mines Co.	Do.
17	Sherman	Lelande	Idaho	Day Mines, Inc.	Lead.
18	Austinville	Wythe County	Virginia	New Jersey Zinc Co.	Zinc-lead.
19	Desloge	Southeastern Missouri	Missouri	St. Joseph Lead Co.	Lead.
20	Tamarack	Placer Center	Idaho	Day Mines, Inc.	Zinc-lead.
21	Kokomo unit	Ten-Mile	Colorado	American Smelting & Refining Co.	Do.

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) produce 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 14 primary smelters and refineries in operation in the United States in 1948 consumed 432,543 short tons (lead content) of ore and concentrates, 16 percent of which was of foreign origin, compared with 448,703 tons in 1947, 14 percent of which was foreign.

ACTIVE LEAD SMELTERS AND REFINERIES

Primary lead smelters and refineries operating in the United States in 1948 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).
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).

REFINED LEAD

Primary refineries in the United States in 1948 produced 411,646 short tons of refined lead, a decline of 10 percent from the 1947 output of 456,672 tons.

Of the 406,694 tons of primary lead ores and base bullion supplied 83 percer ported base bullion 17 percent. In 194 domestic and 14 percent foreign. The quar from foreign base bullion, which has been n over one hundredfold in 1948. The followi of refined lead by sources and by country of the sources of lead from domestic ores duction section of this chapter.

Refined lead produced at primary refineries ir 1944–48, in short t

Source	1944	1945
Refined lead:		
From domestic ores and base bullion	394,443	350,
From foreign ores	70,225	86,
From foreign base bullion	95	
Total from primary sources	464,763	443,
From scrap	11,308	18,
Total refined lead	476,131	462,
Average sales price per pound	$0.004	$0.
Total calculated value of primary refined lead [1]	$69,490,000	$50,780,

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

Refined primary lead produced in the United Sta in short tons

Source	1944	19
Domestic ore and base bullion	394,443	35
Foreign ore:		
Australia	22,210	2
Canada	7,401	1
Europe		
Mexico	5,250	
South America	13,434	2
Other foreign	21,870	2
Total	70,225	8
Foreign base bullion:		
Australia		
Mexico	58	
South America	37	
Other foreign		
Total	95	
Total foreign	70,320	8
Grand total	464,763	44

ANTIMONIAL LE

Antimonial lead output at primary re highest level in history as production adv Distribution of the lead according to sou table. The average antimony content in 1948 remained unchanged from 1947 antimonial lead is an important byproc

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, 1944–48

Year	Production (short tons)	Antimony content		Lead content by difference (short tons)			
		Short tons	Percent	From domestic ore	From foreign ore	From scrap	Total
1944	57,902	4,670	8.1	13,280	5,477	34,475	53,232
1945	60,495	4,148	7.3	7,286	2,695	42,366	52,347
1946	50,480	3,285	6.5	11,106	2,149	33,850	47,105
1947	86,075	4,933	5.7	14,836	9,850	56,456	81,142
1948	100,764	5,760	5.7	29,561	15,918	49,525	95,004

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 1944–48 is shown in the following table. Secondary lead recovery in 1948 exceeded the total domestic refined primary lead production by 23 percent and surpassed the domestic mine output of recoverable lead for the third successive year. Further details appear in the Secondary Metals—Nonferrous chapter of this volume.

Secondary lead recovered in the United States, 1944–48, in short tons

	1944	1945	1946	1947	1948
As refined metal:					
At primary plants	11,368	18,525	8,013	15,662	4,052
At other plants	43,678	42,508	65,091	95,843	126,951
Total	55,046	61,123	73,704	111,505	131,003
In antimonial lead:					
At primary plants	34,475	42,366	33,850	56,456	49,525
At other plants	146,343	151,713	159,834	209,479	194,027
Total	180,818	194,079	193,684	265,935	243,552
In other alloys	95,552	107,837	125,309	134,530	124,616
Grand total:					
Short tons	331,416	363,039	392,787	511,970	500,071
Value	$42,421,248	$46,468,992	$65,088,216	$146,423,420	$179,025,418

LEAD PIGMENTS

The principal lead pigments are litharge, white lead, red lead, sublimed lead, leaded zinc oxide, and orange mineral. These products are manufactured for the most part from metal, but some ores and concentrates are converted directly to pigments. Details of the production of lead pigments are given in the Lead and Zinc Pigments and Zinc Salts chapter of this volume.

CONSUMPTION AND USE

Domestic lead consumption (including lead
rectly in the manufacture of lead pigments and sa
short tons in 1948. Of the total consumed, 6
fined soft lead, 280,952 tons antimonial lead, 5
white scrap, 52,719 tons percentage metals, 21,
scrap, 24,485 tons drosses and residues, and 1
ores used directly in the manufacture of lead
the year 77 percent of the total lead consumed w
facture of metal products. Production of the
consuming items—batteries, cable covering, an
used nearly 53 percent of all the lead consume
took 31 percent of the total, cable covering 15 pe
fluid 7 percent.

Consumption of lead in the United State

Metal products:	
Ammunition	
Bearing metals	
Brass and bronze	
Cable covering	
Calking lead	
Casting metals	
Collapsible tubes	
Foil	
Pipes, traps, and bends	
Sheet lead	
Solder	
Storage batteries (antimonial lead)	
Storage batteries (oxides)	
Terne metal	
Type metal	
Total metal products	
Pigments:	
White lead	
Red lead and litharge	
Pigment colors	
Other [1]	
Total pigments	
Chemicals:	
Tetraethyl lead	
Miscellaneous chemicals	
Total chemicals	
Miscellaneous uses:	
Annealing	
Galvanizing	
Lead plating	
Weights and ballast	
Total miscellaneous uses	
Other uses unclassified	
Grand total	

[1] Includes lead content of leaded zinc oxide production.

Consumption of lead in the United States in 1948, by months [1]

Month	Short tons	Month	Short tons
January	97,451	August	96,102
February	92,451	September	94,638
March	102,601	October	106,106
April	95,004	November	98,935
May	86,203	December	98,741
June	89,847		
July	75,720	Total	1,133,895

[1] Includes lead content of leaded zinc oxide production.

Lead consumption in the United States in 1948, by class of products and type of material, in short tons

	Soft and antimonial lead	Scrap, percentage metal, drosses, etc.	Total
Metal products	715,183	153,049	868,232
Pigments	124,203	195	[1] 124,488
Chemicals	94,080		94,080
Miscellaneous	16,170	521	16,691
Unclassified	11,733	762	12,495
Total	961,468	154,527	[1] 1,115,986

[1] Excludes 17,000 tons of lead contained in leaded zinc oxide.

STOCKS

Producers' Stocks.—Lead stocks, as reported by the American Bureau of Metal Statistics, are shown in the following table. Stocks of refined and antimonial lead include metal held by all primary refiners and by some of the refiners of secondary material who produce soft lead. According to monthly reports released by the American Bureau of Metal Statistics, stocks of refined lead and antimonial lead declined in the first quarter of the year to a low of 14,837 tons at the end of March. Inventories gained sharply to 19,453 tons during April and continued to advance through May and June. Stocks on

Lead stocks at end of year at smelters and refineries in the United States, 1944–48, in short tons

[American Bureau of Metal Statistics]

	1944	1945	1946	1947	1948
Refined pig lead	15,602	37,584	40,870	13,634	29,050
Antimonial lead	3,934	7,283	6,717	7,694	9,594
Total	19,536	44,867	47,587	21,328	38,644
Lead in base bullion—					
At smelters and refineries	7,333	8,618	8,453	7,652	9,697
In transit to refineries	3,331	4,880	4,011	5,447	4,101
In process at refineries	14,473	15,007	16,042	16,328	17,939
Total	25,137	28,504	29,406	29,427	31,737
Lead in ore and matte and in process at smelters	80,461	89,462	111,836	77,199	76,373
Grand total	125,134	162,933	188,829	127,054	146,754

July 1 totaled 23,246 tons, declined slight
dropped sharply in August to 18,971 tons
the remainder of the year the inventories
peak 1948 level of 38,644 tons—a net gain of

The Bureau of Mines annual survey of
refiners indicated stocks of 13,634 tons (le
at plants on January 1, 1948, and 29,048 t
Primary antimonial lead stocks at these s
7,009 short tons (lead content) at the b
tons at the end of the year. In terms of
at the 14 operating smelters and refiner
from 46,313 tons to 44,038 tons during the
tory of base bullion at refineries that rec
material and at smelters that produce ba
refineries totaled 4,912 tons at the beginn
tons at the end of December 1948. Stock
or work lead at five combination smelt
included in reports to the Bureau of Min
can be made between these data and th
Bureau of Metal Statistics. Figures repor
represent physical inventory at the plants,
and do not include material in process or i

Consumers' Stocks.—Consumers' stocks
during 1948. Inventories of refined lead
creased 20 percent and 57 percent, resp
prevailing at the first of the year. Total
1, 1948, were 91,344 tons, dropped to 80,8
showed a general upward trend thereafter
on December 31, the highest point of the y

Reconstruction Finance Corporation Sto
(mostly corroding grade) of 4,996 short t
January 1, 1948, were transferred during
Department, Bureau of Federal Supply.

Consumers' stocks of lead at the end of 1947 and
short tons

Date	Refined soft lead	Antimonial lead	Unmelted white scrap	Percenta metals
Dec. 31, 1947	51,610	22,402	3,514	6,2
Dec. 31, 1948	62,077	35,088	4,828	7,0

PRICES

The two major markets for lead in th
York and St. Louis; much of the lead pro
at prices normally based upon quotations
suspension of trading on the London Met
1939, the London market has had no dire
quotations, and the differential between
prices has remained 0.2 cent a pound, an
freight charges between the two points.

The market price for common lead, N

$0.15 per pound until April 5, when the price advanced to $0.175. Continued heavy demands for lead from consumers and sales of foreign metal at premiums reportedly as high as 5 cents a pound resulted in a further advance on July 28 to $0.195 per pound. An additional increase on November 1 raised the quotation to an all-time record of $0.215 per pound at which level it remained the balance of the year.

The official London maximum price of £90 per long ton, duty paid, for Empire and foreign soft lead, fixed by the British Ministry of Supply March 31, 1947, was advanced to £112 on October 1, 1948, but remained unchanged the remainder of the year. Quotations of the London Metal Exchange, discontinued at the outbreak of the war in September 1939, were not resumed during 1948.

Average monthly and yearly quoted prices of lead at St. Louis, New York, and London, 1946–48, in cents per pound [1]

Month	1946			1947			1948		
	St. Louis	New York	London [2]	St. Louis	New York	London [2]	St. Louis	New York	London [2]
January	6.35	6.50	6.28	12.76	12.93	12.58	14.82	15.00	16.17
February	6.35	6.50	7.01	13.01	13.18	12.58	14.82	15.00	16.17
March	6.35	6.50	7.01	14.77	14.96	12.58	14.82	15.00	16.17
April	6.35	6.50	7.84	14.82	15.00	16.17	17.04	17.21	16.17
May	6.35	6.50	8.09	14.82	15.00	16.17	17.32	17.50	16.17
June	8.03	8.18	8.09	14.82	15.00	16.17	17.32	17.50	16.17
July	9.10	9.25	9.88	14.82	15.00	16.17	17.63	17.81	16.17
August	8.10	8.25	9.88	14.82	15.00	16.17	19.32	19.50	16.17
September	8.10	8.25	9.88	14.82	15.00	16.17	19.32	19.50	16.17
October	8.10	8.25	9.88	14.82	15.00	16.17	19.32	19.50	20.12
November	10.29	10.44	9.88	14.82	15.00	16.17	21.32	21.50	20.12
December	12.02	12.19	9.88	14.82	15.00	16.17	21.32	21.50	20.12
Average	7.96	8.11	8.63	14.50	14.67	15.27	17.87	18.04	17.16

[1] St. Louis: Metal Statistics, 1949, p. 409. New York: Metal Statistics, 1949, p. 493. London: E&MJ Metal and Mineral Markets.
[2] Average price of foreign lead, converted to cents per pound with the pound sterling at $4.02½. Official maximum price raised on June 11, 1945; Jan. 15, 1946; Apr. 8, 1946; July 1, 1946; Jan. 1, 1947; Mar. 31, 1947; and October 1, 1948.

FOREIGN TRADE [2]

Tariff.—The import duty set by the Tariff Act of 1930 on lead-bearing ores, flue dust, and mattes (lead content) was 1½ cents per pound, and on lead bullion, pigs, bars, scrap lead, antimonial lead, type metal, babbitt metal, solder, and alloys not specifically provided for, 2⅛ cents per pound. In accordance with the Mexican Trade Agreement of January 30, 1943, these rates were reduced to ¾ cent and 1 1/16 cents per pound, respectively. A provision of the agreement permits the increase in the tariff on lead-bearing ores, flue dust, and mattes to 1½ cents per pound (lead content) and lead bullion, pigs, bars, scrap lead, etc., to 1 7/16 cents per pound 30 days after the war emergency is officially terminated. The import duty of 1 1/16 cents per pound on pig lead and ¾ cent a pound on lead in ores and concentrates was suspended in June 1948 until June 30, 1949, by act of Congress.

Imports.—Imports of lead increased sharply in 1948 but remained well below the peak level established in 1942. As in previous years,

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

the greater part of the lead imported was in
40 percent of which came from Mexico, 22
percent from Australia, 9 percent each fr
percent from 20 other countries. Import
increased almost fivefold in 1948 to reach t
Nearly 90 percent of the bullion originate
of lead in ore, concentrate, and matte—
Union of South Africa, Australia, Peru, Ne
increased 26 percent.

Total lead imported into the United States in ore, and reclaimed, by countries, in sho

[U. S. Department of Comm

Country	1944
Ore and matte:	
Africa	3,469
Argentina	
Australia	27,130
Bolivia	1,093
Canada	9,909
Chile	4,247
Mexico	3,603
Newfoundland and Labrador	32,273
Peru	11,295
Other countries	471
Total ore and matte	93,570
Base bullion:	
Korea	
Mexico	11
Peru	47
Other countries	
Total base bullion	58
Pigs and bars:	
Africa	
Australia	560
Belgium-Luxembourg	
Burma	
Canada	8
Italy	
Japan	
Korea	
Mexico	167,704
Netherlands	
Peru	54,486
Spain	
Yugoslavia	
Other countries	
Total pigs and bars	222,758
Reclaimed, scrap, etc.:	
Africa	
Australia	2,738
Belgium-Luxembourg	
Canada	488
Canal Zone	
Chile	15
Italy	
Japan	
Malta, Gozo, and Cyprus	
Mexico	
Netherlands	
Panama, Republic of	
Philippines, Republic of	
Yugoslavia	
Other countries	74
Total reclaimed, scrap, etc	3,315
Grand total	319,701

[1] Data include lead imported for immediate consumption plus
[2] Revised figure.

Lead imported for consumption in the United States, 1944–48, 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		
1944	100,846	$6,756,269	73	$7,015	223,379	$22,703,430	40	$39,672	$547	$29,895,575
1945	70,126	5,758,605	20	2,242	227,311	25,280,638	17	2,778	32,516	31,312,708
1946	28,377	3,056,111	20	2,302	100,820	14,205,992	24	10,251	21,517	17,491,080
1947	[2] 44,419	[2] 8,558,643	[2] 1,758	[2] 416,643	158,705	38,008,443	67	42,434	10,453	[2] 50,108,767
1948	33,932	8,350,507	10,922	3,230,135	244,998	81,061,605	181	100,519	36,554	101,069,746

[1] In addition to quantities shown (value included in total values), "reclaimed, scrap, etc." imported as follows—1944: 3,316 tons, $298,712; 1945: 2,848 tons, $235,840; 1946: 2,481 tons, $194,013; 1947: Revised figures. 15,063 tons, $3,072,161; 1948: 28,801 tons, $8,282,520. Figures for 1944–48 include lead received by the Government and held in stock piles.

[2] Revised figure.

Miscellaneous products, containing lead, imported for consumption in the United States, 1944–48

[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
1944	50	43	$15,368	7,562	7,174	$954,255
1945	143	73	101,132	20,110	24,730	3,241,735
1946	157	72	211,122	1,740	1,494	220,645
1947	240	161	170,247	2,406	2,219	753,604
1948	257	184	213,614	14,346	12,707	5,162,168

Exports.—Total exports of pig lead (excluding reexports of foreign refined lead) declined from 1,514 tons in 1947 to 399 tons in 1948. Export restrictions imposed under the Export Control Act of 1940 remained in force throughout 1948.

Lead exported from the United States, 1944–48

[U. S. Department of Commerce]

Year	Pigs and bars		Foreign lead exported in manufactures with benefit of draw-back (short tons)	Year	Pigs and bars		Foreign lead exported in manufactures with benefit of draw-back (short tons)
	Short tons	Value			Short tons	Value	
1944	15,523	$2,073,145	20,237	1947	1,514	$383,132	(1)
1945	1,407	202,754	14,846	1948	399	159,421	(1)
1946	597	106,457	(1)				

[1] Data not available.

Pig lead exported from the United States, by dest

[U. S. Department of Comm

Destination	1944
Countries:	
Argentina	
Brazil	450
Canada	5
Canal Zone	
Chile	23
China	1
Colombia	34
Cuba	18
Czechoslovakia	
Hong Kong	
India	
Madagascar	
Mexico	8
Netherlands	
Netherlands Antilles	9
Panama, Republic of	18
Philippines, Republic of	
Portugal	542
Saudi Arabia	
Turkey	
U. S. S. R.	14,314
Uruguay	7
Venezuela	17
Other countries	77
Total	15,523
Continents:	
North America	80
South America	541
Europe	14,867
Asia	30
Africa and Oceania	5

[1] In addition less than 1 ton of foreign lead was reexported in tons in 1947, none in 1948.

[2] Less than 1 ton.

WORLD REVIE

Lead is produced in many countries Mexico, Australia, and Canada—have quarters of the world output in recent ye accompanying table, which shows worl 1942–48, insofar as statistics are available

World smelter production of lead, by countries w tons [1]

[Compiled by B. B. Mit

Country	1942	1943	1944
Argentina	20,760	23,800	19,100
Australia	255,409	192,322	157,026
Austria	8,787	12,043	10,123
Belgium [2]	16,240	7,960	7,690
Burma	17,130		
Canada	220,722	203,091	129,347
China	1,169	1,179	153
Czechoslovakia	(3)	(3)	(3)
France	12,402	12,428	1,923
Germany [4]	140,100	157,200	[5] 139,900
Greece	2,300	1,150	600
Guatemala	119	114	136
Hungary	4,810	6,370	[5] [6] 3,230
India			
Indochina, French	2	16	51
Italy	28,998	17,715	2,229

See footnotes at end of table.

World smelter production of lead, by countries where smelted, 1942–48, in metric tons [1]—Continued

Country	1942	1943	1944	1945	1946	1947	1948
Japan	[10] 26,910	[10] 32,511	[10] 38,048	[10] 12,568	4,065	8,747	10,600
Korea:							
Northern	11,000	18,467	21,200	2,548	[8] 2,000	[8] 2,000	(9)
Southern						250	
Mexico	192,980	212,452	178,270	201,078	137,742	217,827	187,067
Northern Rhodesia	1,118	1,265	1,047	1,748	8,371	15,801	13,229
Norway				52	36	48	(9)
Peru	37,915	43,171	38,906	40,001	36,478	32,810	34,297
Poland	16,311	15,506	15,833	[8] 7,000	10,915	12,761	16,874
Rumania	154	187	261	3,363	3,225	3,316	(9)
South-West Africa						64	82
Spain	41,149	36,760	30,978	31,922	32,346	34,382	20,926
Sweden	230	2,193	10,553	12,501	11,223	9,229	5,192
Tunisia	8,210	1,867	5,335	7,023	7,880	9,840	17,960
U. S. S. R.[4]	80,000	50,000	45,000	40,000	48,000	63,000	75,000
United Kingdom [4]	5,487	4,064	3,556	2,743	2,540	2,852	2,312
United States (refined) [11]	497,908	425,903	421,538	402,304	306,717	400,018	363,092
Total (estimate) [12]	1,605,000	1,402,000	1,202,000	1,119,000	1,034,000	1,283,000	1,288,000

[1] Data derived in part from Monthly Bulletin of the United Nations, The Mineral Industry of the British Commonwealth and Foreign Countries Statistical Summary, and the Yearbook of the American Bureau of Metal Statistics.
[2] Includes scrap.
[3] Included with Germany.
[4] Exclusive of secondary material. Includes Upper Silesia and Sudetenland through 1944.
[5] Approximate production.
[6] Data not yet available, estimate by author of chapter included in total.
[7] Bizonal area.
[8] January to June, inclusive.
[9] Data represent Trianon Hungary subsequent to October 1944.
[10] Preliminary data.
[11] Figures cover lead refined from domestic and foreign ores; refined lead produced from foreign base bullion not included.
[12] Includes estimate for Yugoslavia by author.

Argentina.—The chief lead-producing district in Argentina is the Aguilar, where the Compania Minera Aguilar, S. A., a subsidiary of the St. Joseph Lead Co., operates the Aguilar group of mines. Over 80 percent of the annual Argentine mine output of lead is produced at this property. Output in 1948 was at a rate approximately 40 percent under the installed mill capacity owing to extremely poor transportation facilities, which interrupted incoming shipments of machinery, Diesel oil, and mine timber, as well as shipments of concentrates to the smelter. The production of lead concentrates in 1948 totaled 24,068 metric tons compared with 25,834 tons in 1947. On December 31, 1948, 1,744 tons of lead concentrates and 84,496 tons of zinc concentrates were stock-piled at the mine awaiting shipment.

Australia.—Shortages of labor and material continued to hamper mining operations in Australia in 1948. Steel was in particularly short supply; as a result, deliveries of mining and milling machinery were being delayed 18 months to 2 years.

Lead and zinc production was emphasized during the year at the Mount Isa mines in northwest Queensland, the copper section of the mine being idle until the new copper milling and smelting plant is completed. Production of lead-zinc ore totaled 571,706 tons; ore reserves in the lead-zinc lodes were estimated at 9,608,400 tons assaying 6.4 ounces of silver per ton, 8.7 percent lead, and 7.3 percent zinc. During 1948 the Zinc Corp., Ltd., treated 454,717 tons of ore compared with 408,648 tons in 1947. At the New Broken Hill Consolidated property, adjoining the Zinc Corp. on the south and managed

by that company, ore output was increased to 103,567 tons in 1948, the grade of ore b ton, lead 9 percent, and zinc 12.6 percent.

The Lake George Mining Corp., Ltd., at (Wales, produced 12,644 tons of lead conce June 30, 1948. Ore reserves on that date w tons assaying 1.17 dwt. gold and 1.46 oun percent lead, 11.85 percent zinc, and 0.65 p put of Electrolytic Zinc Co. of Australasia ir assaying 2.0 dwt. gold and 7.05 ounces of s zinc, 6.2 percent lead, and 0.48 percent cop

A shortage of skilled miners and reduced by North Broken Hill, Ltd., as the principa duction in 1948. The grade of ore mined years, but recoveries of lead, silver, and z obtained. At Broken Hill South, Ltd., pro June 30, 1948, totaled 236,950 tons of ore as per ton, 13 percent lead, and 12 percent zir of lead concentrates containing 74.8 percen

Burma.—Rehabilitation of the Burma C which was severely damaged by Japanese c continued in 1948. The mine was unwatere level—668 feet below the 6th level—and op an effort to gain access to the 12th level. the electric pump on that level will be pu prewar method of controlling mine water w Additional electric power provided by thr installed in May 1948 enabled resumption operations. Production of refined lead beg continued until early September, when it w shortage of essential mining supplies cause over the Burma Railway due to insurge production were resumed early in October refined lead was produced before opera September.

Chile.—Exceptionally high grade lead-z curring at the Compania Minera Aysen n Lago Buenos Aires in Aysen Territory of so exploration has developed enough ore reser mill with the financial aid of the Chilean Mi lurgical tests conducted in the laboratorie duced high-grade lead and zinc flotation c separation and recoveries. Until Chilean ciently to permit economical transportatio centrates will be shipped from Puerto Des the Atlantic coast.

French Morocco.—Mine output of lead in in 1948 and surpassed the prewar product ducing centers were Zellidja, Aouli, Toui Cedra. The Société Nord Africaine du Société des Mines de Zellidja (51 percent), N percent), and St. Joseph Lead Co. (16 perce

conducted exploration of mineral lands formerly held by the Zellidja Co. in both Morocco and Algeria, adjacent to the main Zellidja property.

Greece.—Rehabilitation of the Laurium lead-zinc mine 35 miles south of Athens was in progress during the latter part of 1948 by the Mediterranean Mines, Ltd. The company plans to erect a 200-ton flotation mill to treat an indicated sulfide-ore reserve of 260,000 tons carrying 5 to 8 percent lead and an estimated 2,500,000 tons of tailings and slimes assaying 2.5 to 4.5 percent lead.

Greenland.—In the summer of 1948 a Danish Government geological survey party headed by Dr. Lange Koch discovered a lead deposit on the east coast of Greenland at Mesters Vig in the area around King Oscar Fjord and Davy Sound (73° 15′ N. Lat., 24° W. Long.). The deposit included 3 quartz veins 5 to 10 meters wide and 8 kilometers long extending from the coast to a mountain pass at an elevation of 600 meters. Ore samples taken from the outcrops assayed 80 percent lead and some samples contained as high as 300 grams of silver per ton. No zinc, bismuth, or other minerals were found which might complicate the recovery of the lead. On the basis of data obtained from exploration conducted in 1948 the area is thought to contain an estimated one million tons of lead. More detailed development and exploration are planned for the summer season of 1949.

Peru.—Lead production from Peru comes from a large number of mines, the most productive being the Cerro de Pasco, Casapalca, Huaron, Volcan, Atacocha, Cercapuquio, and Colquijirca mines. Lead output in 1948 at Cerro de Pasco was greater than in the previous year, due partly to the fact that throughout 1948 the Paragsha mill at Cerro de Pasco was used exclusively for lead-zinc ores, making possible expansion of mining operations in the Cerro de Pasco lead-zinc ore body. Production was halted at the Casapalca mine on April 19, 1948, by a fire which began in the underground hoist room of the Aguas Calientes shaft, killing 52 mine employees.

During the year the Compania Minero Atacocha began erecting the first of three 330-ton units of a new 1,000-ton flotation mill. The new plant is expected to be operating by the middle of 1950.

The Peruvian Government took action during 1948 to aid in expanding mineral production and early in the year made the first substantial reduction in tax load granted by any Latin American country by lowering the export tax.

South-West Africa.—The Tsumeb mine is the only important source of lead in South-West Africa. During 1948 shipments of lead-copper ores and concentrates totaled 74,837 short tons, containing 29,428 tons of lead and 7,483 tons of copper. Development included unwatering the mine to the twentieth level (1,900 feet below the surface), where mine workings of the former German owners were found to be in good condition. Diamond drilling below the twentieth level disclosed new and substantial ore tonnages. To provide additional productive capacity from the lower levels of the mine and to permit handling 1,800 to 2,000 tons of ore per day, the company plans to sink a new shaft at an estimated cost of $2,000,000. The new 1,200-ton-per-day selective flotation mill began producing in March 1948.

Tanganyika.—There were many conflicti
to the importance of the lead deposit at
indicated proved ore reserves of 25 million
cent lead, in addition to copper, silver, go
cobalt. Other more conservative reports
proved tonnage averaging 6.5 percent lead.
plant construction at the property proceed
of Uruwira Minerals, Ltd., with technical
Corp., Ltd. Late in the year the Union Cor
pation in the development for the stated
disclosed did not indicate an ore body of enc
the expensive development that would be ne
could be exploited.

Turkey.—Metallurgical tests on ore fr
owned by the Turkish Government agenc
during 1948. The property in the Taurus M
of Nigde, 257 kilometers from the Mediterr
has a known ore reserve of 250,000 tons c
5 percent zinc, and some gold and silver.

A flotation plant, power plant, and repa
during 1948 at the Keban mine in the Prov
meters from Iskenderon. The concentrator
tons of ore annually. Proved ore reserves t
ing 10 percent lead. It is planned to build
to treat concentrates from both the Keban

Lead and Zinc Pigments and Zinc Salts

By HELENA M. MEYER and ALETHEA W. MITCHELL

GENERAL SUMMARY

SMALLER quantities of all of the lead and zinc pigments covered by this report were shipped in 1948 than in 1947, declines ranging from a low of 6 percent for zinc oxide to a high of 33 percent for white lead (dry and in oil). Again, as in several immediately preceding years, the quantities shipped were not a true measure of demand. Large pigment users, such as the automobile, construction, storage battery, and rubber industries, operated at or above the high levels of 1947, so that requirements for pigments were unabated in 1948. The manufacture of passenger automobiles and trucks, for example, rose 9 percent following the sharp advance in 1947; new private and public construction was 26 percent larger in value, and the value of paint, varnish, and lacquer materials rose slightly over the previous all-time peak in 1947. Gains in unit values, of course, played an important part in raising total values for construction and paint. Consumption of natural rubber increased 11 percent, whereas that of the synthetic type dropped 20 percent, causing an over-all decrease. Natural rubber, however, requires considerably more zinc oxide than the synthetic type.

Shortages of crude materials used for pigment manufacture, notably pig lead, continued to be a limiting factor in the pigments picture. The inadequate supplies of pig lead in recent years and the inflationary trend of prices in general caused the price of pig lead to reach new peaks in 1947 and again in 1948. Lead-pigment prices responded by establishing new tops of their own in both years. These high prices played a part, no doubt, in reducing demand for some of the pigments covered by this report. The price for slab zinc gained markedly but did not exceed records set in World War I. Zinc-pigment prices in 1947 and 1948 were the highest in many years and in some instances may have reached new all-time heights.

Shipments of white lead (dry) dropped 32 percent and were the smallest since 1934. Those of the "in oil" variety fell 34 percent and were smaller even than the 1945 total, itself below all previous totals since considerably before the beginning of the present century. Red-lead shipments declined 15 percent and were the lowest since 1938. The total for litharge was 7 percent below the record performance in 1947 but second only to shipments in that year.

Salient statistics of the lead and zinc pigments
1943–48

	1943	1944	1945
Production (sales) [1] of principal pigments:			
White lead (dry and in oil)—short tons	76,167	85,726	51,17
Litharge—do	113,091	138,203	138,79
Red lead—do	53,378	53,972	47,38
Zinc oxide—do	143,402	140,675	127,09
Leaded zinc oxide—do	43,828	64,395	62,50
Lithopone—do	135,723	142,905	136,10
Value of products:			
All lead pigments	$41,897,000	$46,601,000	$39,045,00
All zinc pigments	36,260,000	39,288,000	36,644,00
Total	78,157,000	85,889,000	75,689,00
Value per ton received by producers:			
White lead (dry)	163	163	15
Litharge	152	146	14
Red lead	171	164	16
Zinc oxide	137	139	13
Leaded zinc oxide	132	132	13
Lithopone	79	78	[4]
Foreign trade:			
Lead pigments:			
Value of exports	1,439,000	1,387,000	1,427,00
Value of imports	3,000	6,000	8,00
Zinc pigments:			
Value of exports	2,737,000	2,017,000	2,279,00
Value of imports	5,000	1,500	(4)
Export balance	4,168,000	3,396,500	3,698,00

[1] Reported as shipments, 1946–48.
[2] Data for basic lead sulfate in 1946 included under white lead; separately.
[3] Excludes value of basic lead sulfate; Bureau of Mines not at lib
[4] Less than $500.

Zinc oxide shipments were 6 percent und
than in only five other preceding years,
inclusive. Shipments of leaded zinc oxide
were smaller only than the previous peaks i
relatively the same as the 1946 tonnag
dropped 15 percent and were the smallest s

Zinc chloride evidently established a ne
though there are a few gaps in the statist
zinc sulfate approximated those for 1947 a
peak for 1946.

Titanium pigments were shipped in gr
before in 1948, continuing the establishm
fifth successive year. Even greater height
in recent years had production capacity
expanded again in 1948 to close to 10 p
record high tonnages made available, how
demand, and further plant extensions were

High lights in the distribution of pigment
report are outlined in the following discus
to make noteworthy gains as a consumer
largest outlet for litharge, ceramics took r
ever before, rising 9 percent over previou

Zinc oxide was shipped for ceramic manufacture in new high record quantities for the third successive year, and red lead was shipped at a record high rate, except for 1941. The use of white lead by ceramic makers, on the other hand, has been gaining for several years but dropped, at least temporarily, in 1948. All pigments were shipped in smaller quantities for paint manufacture than in 1947; shipments of white lead for this purpose doubtless were the smallest since many years before the present century began. Shipments of red lead for paint manufacture, however, were 6 percent above the prewar (1935–39) average rate. Those of zinc oxide were relatively unchanged from that average, of leaded zinc oxide were 72 percent higher, and of lithopone were 11 percent lower than the prewar period. White-lead shipments for paint fell to considerably below half of the prewar average rate. Storage-battery manufacture took less litharge and red lead in 1948 as compared with 1947 but used more litharge than in any other year, or almost three times the prewar average quantity; red lead amounted to 27 percent less than the prewar average. The insecticidal use of litharge has been hardest hit of this pigment's uses, falling 17 percent from 1947, amounting to only 23 percent of the all-time high record in 1944, and falling 60 percent below the prewar average. Consumption of zinc sulfate for agricultural purposes likewise made a poor showing in 1948, falling 31 percent (dry basis) from 1947 and amounting to only about half of its peak tonnage in 1946. The manufacture of rubber took greater quantities of the pigments covered by this report in 1948 than in 1947 and also showed to advantage in relation to earlier years. Zinc oxide was used for rubber at a record rate except for 1941 and 1946, lithopone was the highest since 1937, and litharge the largest since 1944, being 53 percent above the prewar level. A new high record was established in 1948 by shipments of zinc sulfate for rayon manufacture. This use has climbed continuously since 1942.

Batteries.—There has been publicity [1] recently in connection with the nickel-cadmium battery, new to the United States but long-known in Europe. Arguments both in favor of and against the battery were contained in the literature.

Paints.—A lead-free exterior house paint, with a titanium base, was introduced [2] in 1948. Late in 1947 a new basic silicate white-lead pigment, which was said to contain 45 percent lead by weight as compared to 80 percent in basic carbonate white lead, was announced.[3] The characteristic of basic silicate white lead, it was said, results from pigment particles having a central core of silica so that whereas the pigment has the characteristics of lead compounds, less lead is required. Prospects for the development of improved finishes (paints, varnish, etc.) were outlined [4] briefly.

[1] Willibnganz, Eugene, Is There a Lifetime Battery: Pres. at convention of Association of American Battery Manufacturers, Inc., Chicago, Ill., Nov. 11–13, 1948.
The Nickel Cadmium Battery, a progress report: Consumers Reports, vol. 14, No. 5, May 1949, pp. 220–222 and 233–234.
Manchester, Harland, Nickel-Cadmium Battery Lasts as Long as the Car: Popular Science, vol. 153, No. 2, August 1948, pp. 113–118.
[2] Oil, Paint & Drug Reporter, vol. 154, No. 7, Aug. 16, 1948, p. 82.
[3] Oil, Paint & Drug Reporter, vol. 152, No. 20, Nov. 17, 1947, p. 82.
[4] Chemical Engineering, Improved Finishes, vol 54, No. 10, October 1947, p. 242.

PRODUCTION

The value of lead and zinc pigments in
basic lead sulfate, which cannot be sho
increase of 2 percent despite the 13-percent
total tonnage of the lead and zinc pigments
values in 1948, of course, made the fo
Lead pigments and zinc pigments comp
respectively, of the total value in 1948,
percent, respectively, in 1947.

For many years, figures on sales were us
as a better guide to activity in the pigments
Beginning with 1945, the base was change
with data compiled on Bureau of Mines
Available information for 1945 (the year
there was little difference between sales a
In reporting tonnages of pigments, an att
duplication. One of the chief problems
frequently are blended to make another pi
and zinc oxide, for example, are blended to
in this instance the pigment weights ap
last-named class only. Pigments consume
to make products beyond those covered by
storage batteries, and other articles—are co

LEAD PIGMENTS

Lead pigments shipments dropped 15 per
to higher average values, rose 1 percent i
with 1947. (Shipments of basic lead sulf
Mines is not at liberty to publish, are exclud
All lead pigments covered by the totals pl
1948 tonnage—white lead, dry, falling 32 pe
34 percent; red lead, 15 percent; and lithar

Quoted lead pigment prices were high
average values reported by producers like
values for red lead and litharge were 1 an
higher than in 1947 despite quantity losses

Lead pigments [1] shipped by manufacturers in

Pigment[2]	1947		
	Short tons	Value (at plant, exclusive of container)	
		Total	Average
Red lead	30,004	$12,022,585	$33
Litharge	167,050	52,345,041	31
White lead:			
Dry	30,075	12,036,554	30
In oil [3]	29,712	13,794,387	46

[1] Bureau of Mines not at liberty to publish figures for basic lead
[2] Weight of white lead only but value of paste.

Lead pigments shipped by manufacturers in the United States, 1944–48, in short tons

Year	White lead		Basic lead sulfate or sublimed lead		Red lead	Orange mineral	Litharge
	Dry	In oil	White	Blue			
1944 (sales)	46,466	39,260	5,263	1,080	53,972	284	138,203
1945	27,382	23,788	2,235	1,660	47,381	230	138,798
1946	[1] 41,892	24,600	(2)	(2)	32,526	123	133,799
1947	39,075	20,712	(2)	(2)	36,004	----	107,050
1948	26,561	19,519	(2)	(2)	30,787	----	154,775

[1] Basic lead sulfate included with white lead (dry); Bureau of Mines not at liberty to publish figure.
[2] Bureau of Mines not at liberty to publish figure.

ZINC PIGMENTS AND SALTS

Zinc-pigment shipments declined 12 percent in total quantity in 1948 from the record established in 1947, but increased 3 percent in total value to a new high peak. Higher average values for the three pigments covered accounted for the contrasting movements. Shipments of zinc oxide (lead-free) fell 6 percent from the high performance in 1947 but were smaller only than in 5 earlier years—1946, 1927–29, and 1925. Although shipments of the leaded variety decreased 17 percent, they failed to exceed only the previous peaks for 1947 and 1941, being relatively the same as the 1946 tonnage. Lithopone shipments dropped 15 percent and were the smallest since 1945.

Zinc chloride shipments, so far as can be ascertained, established a record in 1948, although the statistical picture for this product is somewhat incomplete. Zinc sulfate shipments were relatively unchanged from 1947 and second only to those for 1946.

Zinc pigments and salts shipped by manufacturers in the United States, 1947–48

Pigment or salt	1947			1948		
	Short tons	Value (at plant, exclusive of container)		Short tons	Value (at plant, exclusive of container)	
		Total	Average		Total	Average
Zinc oxide [1]	160,771	$29,873,382	$186	150,958	$32,862,368	$218
Leaded zinc oxide [1]	81,459	16,634,516	204	67,441	16,548,036	245
Lithopone	165,024	17,382,592	105	140,033	16,135,976	115
Zinc chloride, 50° B.	65,521	4,279,737	65	68,701	4,717,963	69
Zinc sulfate	21,547	2,235,683	104	21,513	2,443,869	114

[1] Zinc oxide containing 5 percent or more lead is classed as leaded zinc oxide. In this table data for leaded zinc oxide include a small quantity containing less than 5 percent lead.

Zinc pigments and salts shipped by manufacturers in the United States, 1944–48, in short tons

Year	Zinc oxide	Leaded zinc oxide [1]	Lithopone	Zinc chloride (50° B.)	Zinc sulfate
1944 (sales)	140,675	64,305	142,905	57,545	17,156
1945	127,955	62,598	130,101	56,230	20,854
1946	157,851	67,971	147,001	57,316	24,931
1947	160,771	81,459	165,024	65,521	21,547
1948	150,958	67,441	140,033	68,701	21,513

[1] Includes a small quantity containing less than 5 percent lead.

CONSUMPTION BY IN

WHITE LEAD

The down trend in use of white lead, in extended in 1948. Shipments of white le 1947 and were the smallest since 1934; were 34 percent below 1947 and less ov themselves the lowest since considerably present century. Total white-lead shipm tom since many years before the present scarcity of pig lead and all-time record p for the poor showing. Paint took at least in 1948; a more precise break-down of would add more to "paint" than to any pansion in the use of white lead for ce temporarily, in 1948.

Production of white lead (dry) amounte lead in oil to 17,672 tons, compared w respectively, in 1947.

Distribution of white lead (dry and in oil) shipm short tons

Industry	1944 [1]	19
Paints	70,948	4
Ceramics	946	
Other	4,832	
	86,726	5

[1] Reported as sales.
[2] Data for basic lead sulfate included with white lead; Bureau

BASIC LEAD SULF

The Bureau of Mines is not at liberty lead sulfate for 1946–48. Shipments in 1 of "white lead" (dry), but 1947 and 194 way. Basic lead sulfate is used almost tial quantities are used as an intermediat of leaded zinc oxide. Such quantities this series under leaded zinc oxide rather

Distribution of basic lead sulfate shipments, by

Industry	1944 [1]	19
Paints	5,496	
Rubber	268	
Storage batteries	2	----
Other	567	
	6,333	

[1] Reported as sales.
[2] Data for basic lead sulfate included with white lead; Bureau
[3] Bureau of Mines not at liberty to publish figures.

RED LEAD

Shipments of red lead dropped 15 percent from 1947 and were the smallest since 1938, exceeding that year by a narrow margin. The manufacture of storage batteries—the chief use of red lead—took 29 percent less than in 1947, when shipments were 31 percent below the all-time peak rate of 1944, but substantially the same as in late prewar years. Shipments for paint manufacture declined 4 percent, but this use about approximated prewar levels. Ceramics took 31 percent more red lead in 1948 and doubtless consumption was higher than in any previous year except 1941, being 20 percent below that year.

Production of red lead amounted to 29,698 tons in 1948 compared with 36,041 tons in 1947.

Distribution of red-lead shipments, by industries, 1944–48, in short tons

Industry	1944 [1]	1945	1946	1947	1948
Storage batteries	30,211	26,725	19,115	20,883	14,854
Paints	18,074	10,438	9,318	11,362	10,863
Ceramics	878	626	1,228	977	1,276
Other	4,809	3,592	2,865	2,842	3,705
	53,972	47,381	32,526	36,064	30,787

[1] Reported as sales.

ORANGE MINERAL

No shipments nor production of orange mineral was reported in 1948 and 1947.

Distribution of orange mineral shipments, by industries, 1942–48,[1] in short tons

Industry	1942 [2]	1943 [2]	1944 [2]	1945	1946
Ink manufacture	93	49	56	63	78
Color pigments	7	8	205	151	18
Other	28	22	23	16	27
	128	79	284	230	123

[1] No shipments reported for 1947–48.
[2] Reported as sales.

LITHARGE

Litharge gave the best performance in 1948 of all pigments covered by this report. Although shipments dropped 7 percent, compared with 6 percent for zinc oxide, they were smaller only than the all-time peak in 1947, whereas zinc oxide shipments were lower than in five earlier years. Storage batteries, as always by far the leading use and responsible for the 1947 peak record, took 10 percent less than the record tonnage, or more than the average decline. In 1947 and 1948, two-thirds of total litharge shipments went to storage-battery manufacturers, compared with an average of 44 percent in the 5-year period 1935–39. 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 for 1948—69,000 tons—was unchanged from the high record established in 1947 and was 13 percent above the previous peaks in 1944 and 1941. Black oxide production

required 66,000 tons of pig lead in both 1948 a
oxide tonnages are not included in Bureau of Mi

Ceramics, which have been taking increas
1945, established a new peak in 1948, exceedin
for 1947 and 1941 by 9 percent. The manufa
ments has been falling since 1945 and had the
drop (19 percent) among the uses of litharge.
much more than half of the peak established in
of litharge shipped for oil-refining use decreased 6
with 1947; the latter, however, was the large
insecticidal use of litharge has made the poore
years of the various outlets. The 17-percent
1948, on top of successive drops since the all-t
made the tonnage shipped for this purpose on
1944 peak. Varnish and rubber manufacture
the former 4 and the latter 29 percent. Sale
were the largest ever, so far as it is possible to
to rubber manufacturers were the greatest since

Litharge production totaled 159,489 tons in
174,341 tons in 1947.

Distribution of litharge shipments, by industries, 19

Industry	1944 [1]	1945	1
Storage batteries	72,342	79,931	
Ceramics	12,381	11,511	
Chrome pigments	8,233	11,394	
Oil refining	5,608	6,419	
Insecticides	25,957	18,061	
Varnish	2,988	2,752	
Rubber	3,023	1,864	
Floor coverings	117	115	
Other	7,554	6,701	
	138,203	138,798	1

[1] Reported as sales.

ZINC OXIDE

Shipments of zinc oxide (lead-free) dropped 6
were greater than in all other earlier years exce
1927–29, and 1925. The manufacture of rubber
shipments, slightly exceeded 1947, and except fo
probably the greatest on record; distribution
1929 are not available. Consumption of zinc o
facture declined for the second successive year.
differed little from the average for the prewar
clusive. Use of zinc oxide for ceramics rose 9 p
for the third successive year. This use did not
tionate importance during the war. Since the w
reached in 1942, however, shipments to ceramic
been continuously upward. Coated fabrics an
fourth place among users of zinc oxide in 1947, h
by ceramics, and continued below the latter u
fabrics and textiles, chiefly the manufacture of r
more zinc oxide in 1948 than in 1947. Floor cov
4 percent more zinc oxide in 1948.

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Production of lead-free oxide totaled 146,565 tons compared with 159,149 tons in 1947. Closing of the plant of the American Zinc Oxide Co. by a labor strike for several months in 1948 was principally responsible for the disparity between production and shipments. Of the 1948 total, 76 percent was made by the American process from ores and primary residues, 15 percent by the French process from metal and scrap, and 9 percent by other processes compared with 73, 17 (revised), and 10 (revised) percent, respectively, in 1947.

Distribution of zinc oxide shipments, by industries, 1944–48, in short tons

Industry	1944 [1]	1945	1946	1947	1948
Rubber	59,518	63,447	83,776	82,248	82,895
Paints	24,909	28,014	34,785	32,867	26,779
Ceramics	3,653	5,086	9,656	11,350	12,327
Coated fabrics and textiles [2]	9,563	12,177	10,022	9,100	9,474
Floor coverings			2,848	4,735	4,938
Chemical warfare	27,686	2,053			
Other	15,256	17,178	17,364	20,471	14,545
	140,675	127,955	157,851	160,771	150,958

[1] Reported as sales. [2] Includes the following tonnages for rayon: 1946—9,363; 1947—7,302; 1948—8,209

The varied uses of zinc oxide recently were reported in Zinc Bulletin 5, published by the Zinc Development Assoc., Oxford, England. Purposes served by zinc oxide in natural and synthetic rubber production, as given in the aforementioned bulletin, were outlined in the technical press.[6]

LEADED ZINC OXIDE

The use of leaded zinc oxide has continued at high levels in recent years. Shipments established a new high record in 1941, were close to record levels in 1944–46, inclusive, and established a new peak in 1947. Shipments in 1948 were 17 percent less than the 1947 peak but were smaller only than in 1947 and 1941, being approximately the same as in 1946. Of the total shipments in 1948, 96 percent was reported for paint. Doubtless a better break-down of the "Other" class would add to the paint classification. 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 67,480 tons in 1948 compared with 78,799 tons in 1947. The totals comprise grades as follows (1947 for comparison in parentheses): 53,915 (68,413) tons of 35 percent lead and under, and 13,565 (10,386) tons of over 35 percent lead.

Distribution of leaded zinc oxide shipments, by industries, 1944–48, in short tons

Industry	1944 [1]	1945	1946	1947	1948
Paints	62,223	58,852	64,816	77,994	64,912
Rubber	119	200	166	131	218
Other	2,053	3,546	2,989	3,334	2,311
	64,395	62,598	67,971	81,459	67,441

[1] Reported as sales.

[6] Chemical Age (London), Varied Uses of Zinc Oxide: Vol. 60, No. 1538, Jan. 1, 1949, p. 22.

LITHOPONE

Shipments of lithopone dropped 15 percen
smallest since 1945; the 1948 tonnage was lar
(1945, 1943, and 1942) since 1938. Paint
manufacturers took 23 percent less lithopone
for 1947, which was smaller than in only tv
1928 and 1929. Paints, etc., which regularl
more of the total shipments, took 75 percent
82 percent in 1947. Other broad classificatio
in 1948. Consumption for rubber, which has
1944, rose 36 percent and was the largest sinc
and coated fabrics and textiles together rose 1
total since 1941. The gain was due entirely t
took 12,423 tons compared with 9,048 tons in
for coated fabrics were 8,436 and 8,421 tons,
of lithopone by paper manufacturers was at
1944; it was 4,814 in 1948, 4,069 in 1947, 3,01
and 6,488 in 1944. Shipments for use in the
tinued in 1948 at about the 1947 rate—727 an
Sales for this use have been falling; the tonna
864 in 1945, and 830 in 1946. One manufac
tonnages for ink as not separable from those
tonnages in the foregoing sentences are fo
Exports are included mainly under "Other," b
classifies part of its exports according to end

The lithopone statistics in this report are
ordinary lithopone sold as such plus the ordi
of the high-strength product. This method o
conceal the operations of one company that
output of the high-strength product and has
in some years. In 1948, as in 1947, one c
plants produced high-strength lithopone.

Production of lithopone amounted to 151,00
with 162,685 tons in 1947. Plant capacity
lithopone was reported to be 157,000 tons
from 1947.

Distribution of lithopone shipments, by industries

Industry	1944 [1]	1945
Paints, varnishes, and lacquers [2]	108,800	109,398
Floor coverings and textiles	14,740	15,821
Rubber	726	977
Other	18,633	9,965
	142,905	136,161

[1] Reported as sales. [2] Includes a quantity, not separable, used

Consumption of ordinary lithopone in the
lithopone has trended downward almost contin
19,400 tons—was used in 1937. There was a
1,700 tons or only 9 percent of the peak to
figures in the following table are included in
lithopone in the preceding table.

Titanated lithopone produced in the United States and ordinary lithopone used in its manufacture, 1944–48, in short tons

Year	Titanated lithopone produced	Ordinary lithopone used	Year	Titanated lithopone produced	Ordinary lithopone used
1944	9,800	8,300	1947	2,600	2,200
1945	9,200	7,800	1948	2,100	1,700
1946	7,500	6,350			

ZINC SULFIDE

In 1948, as in several preceding years, only one company produced zinc sulfide; the Bureau of Mines is not at liberty to publish figures for this pigment.

ZINC CHLORIDE

A new high record doubtless was established by zinc chloride shipments (50° B. solution) in 1948; they were 5 percent higher than those in 1947, believed to have been the previous peak. The record for 1935–41 is somewhat incomplete, making a more precise statement impossible. 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 67,908 tons in 1948 compared with 67,475 tons in 1947.

ZINC SULFATE

Zinc sulfate shipments in 1948 continued at the high level of 1947, second only to the peak in 1946. Rayon, which was displaced by agriculture in the record year, continued in the first place regained in 1947 and required 19 percent more zinc sulfate (dry basis) than in that year. This use established a new top in 1948, whereas agriculture, in second place, dropped 31 percent from 1947 and took little more than half of its peak tonnage for 1946. Chemicals, regularly in third place, continued to decline in 1948, decreasing 17 percent from

Distribution of zinc sulfate shipments, by industries, 1944–48, in short tons

Industry	1944 [1]	1945		1946		1947		1948	
	Gross weight	Gross weight	Dry basis	Gross weight	Dry basis	Gross weight	Dry basis	Gross weight	Dry basis
Rayon	5,954	6,720	5,303	7,634	5,883	8,210	6,173	9,000	7,333
Agriculture	4,974	6,615	5,062	10,816	8,178	7,827	6,125	5,210	4,248
Chemicals	1,459	2,617	1,740	2,254	1,488	2,120	1,439	1,734	1,193
Flotation reagents	1,131	1,232	935	1,084	843	1,112	717	1,632	1,366
Glue	293	260	180	511	335	624	444	661	462
Electrogalvanizing	278	255	161	488	315	233	146	319	205
Paints and varnish processing	1,330	589	539	174	151	61	51	121	104
Textile dyeing and printing		534	474	552	491	60	38	102	66
Other	1,737	1,093	1,342	1,418	943	1,300	864	1,934	1,191
	17,156	20,854	15,841	24,931	18,427	21,547	15,007	21,513	16,168

[1] Reported as sales.

1947. (The lowering of tonnages for chemi precise separation of distribution data.) S facture of flotation reagents nearly doubl established a new high record, although dat ments are somewhat incomplete. The oth increased notably in 1948 but accounted for total shipments.

In 1948, 20,125 tons of zinc sulfate were 23,423 tons in 1947.

RAW MATERIALS USED IN MANUFACTU PIGMENTS AND ZINC

Figures covering the raw materials used salts in 1948 were not available when t Data for 1947 are given below, and those f next annual issue of this volume.

Lead pigments and zinc pigments and sal a variety of materials, including ore, refine ary materials as scrap. In 1947, roughly pigments was derived from pig lead and the the lead in ore used to make leaded zinc ox from foreign sources. The proportion for z 72 percent from ore and concentrates, 9 pe 19 percent from secondary materials; about was foreign.

The following tables give the source of th turing each pigment and salt. Pig lead either directly or indirectly, in the manufact red lead, and orange mineral and is used al basic lead sulfate. The lead content of lea basic lead sulfate, which in turn was made to pig lead in the table. Zinc oxide is the o siderable slab zinc is used. Ore is employ zinc oxide, leaded zinc oxide, lithopone, zinc basic lead sulfate. A substantial proportio (63 percent in 1947) and most of that in z United States are derived from secondary of years before the United States entered the had been a large increase in the quantity the manufacture of zinc oxide. The scarcity and scrap caused the proportion of the total process, which uses only metal and scrap, to to continue comparatively low in 1943–46, percentage from metal and scrap rose in 19 in 1944–47. The production of zinc oxid accounted for the following percentages in tion: 41 percent in 1939, 16 percent in 194 percent in 1944, 25 percent in 1945, 26 perce in 1947.

Lead content of lead and zinc pigments produced by domestic manufacturers, by sources, 1946–47, in short tons

Pigment	1946				1947			
	Lead in pigments produced from—			Total lead in pigments	Lead in pigments produced from—			Total lead in pigments
	Ore		Pig lead		Ore		Pig lead	
	Domestic	Foreign			Domestic	Foreign		
White lead			49,825	49,825			57,791	57,791
Red lead			27,084	27,084			32,675	32,675
Litharge			123,698	123,698			101,823	101,823
Orange mineral			113	113				
Basic lead sulfate	(1)		(1)	(1)	(1)		(1)	(1)
Leaded zinc oxide	17,412	1,434	170	19,016	18,669	2,355		21,024
	[2] 17,412	1,434	[2] 200,890	[2] 219,736	[2] 18,669	2,355	[2] 252,289	[2] 273,313

[1] Bureau of Mines not at liberty to publish figure.
[2] Excludes lead in basic lead sulfate, data for which Bureau of Mines not at liberty to publish.

Zinc content of zinc pigments and salts produced by domestic manufacturers, by sources, 1946–47, in short tons

Pigment or salt	1946					1947				
	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	68,113	15,799	17,991	12,050	113,953	72,639	19,164	17,332	18,106	127,241
Leaded zinc oxide	31,845	3,010	278		35,133	34,567	5,067			39,634
Lithopone	11,370	110	26	17,582	29,088	10,592	1,280	12	20,237	32,121
Total pigments [2]	111,328	18,919	18,295	29,632	178,174	117,798	25,511	17,344	38,343	198,996
Zinc chloride				12,559	12,559			7	14,863	14,870
Zinc sulfate	3,673	75		3,837	7,585	2,506	10	55	4,412	7,081

[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. For the second successive year, average values for lead pigments for 1948 were the highest ever recorded, and those for zinc pigments and salts were again the highest in many years and in some instances probably for all time.

Quoted prices for lead pigments repeated the 1947 performance. They were at all-time peaks at the beginning of the year, and all changes during the year were upward, the quotations following the movement of pig-lead prices. All price changes for the zinc pigments likewise were upward during 1948 as in 1947.

Range of quotations on lead pigments and zinc pig (or delivered in the East), 1945–48, in

[Oil, Paint and Drug Reporte

Product	1945	
Basic lead sulfate, or sublimed lead, less than carlots, barrels	7.50– 7.75	7.
White lead, or basic lead carbonate, dry, carlots, barrels	8.25	8.
Litharge, commercial, powdered, barrels	8.00– 9.00	8.
Red lead, dry, 95 percent or less, less than carlots, barrels	9.50–10.00	9.
Orange mineral, American, small lots, barrels	12.00–12.50	12.
Zinc oxide:		
American process, lead free, bags, carlots	7.25	7.
American process, 5 to 35 percent lead, barrels, carlots	7.25– 7.38	7.
French process, red seal, bags, carlots	8.50	8.
French process, green seal, bags, carlots	9.00	9.
French process, white seal, barrels, carlots	9.75	9.
Lithopone, ordinary, small lots, bags	4.50	4.
Zinc sulfide, less than carlots, bags, barrels	8.50– 8.75	8.
Zinc chloride, works:		
Solution, tanks	2.50	
Fused, drums	5.00– 6.50	5.
Zinc sulfate, crystals, barrels	3.65– 4.40	3.

[1] Quotations for bags.

FOREIGN TRADE

Imports of lead and zinc pigments are i
domestic shipments of the items. The tota
more than quadrupled in 1948 owing to sha
for the various constituents, and to the more

Value of foreign trade of the United States in lead 1947–48

[U. S. Department of Commer

	Imports
Lead pigments:	
White lead	$238
Red lead	7,087
Litharge	127,375
Other lead pigments	15,060
	150,360
Zinc pigments:	
Zinc oxide	30,594
Lithopone	21
	30,615
Lead and zinc salts:	
Lead arsenate	20,700
Other lead compounds	
Zinc sulfate	16,867
	37,567
Grand total	218,542

[1] Data not available.

[2] Figures on imports and exports compiled by M. B. Price, of th
U. S. Department of Commerce.

of litharge, the chief item. Despite rising prices, zinc pigments fell to less than one-fourth of the small total for 1947.

Total values of exports of lead pigments, zinc pigments, and lead and zinc salts all dropped in 1948 despite higher prices characteristic of that year. All lead pigments except red lead were shipped abroad in smaller quantities in 1948 than in 1947. Of the two larger zinc-pigment classes, exports of the higher-valued zinc oxide were cut almost in half, while those of lithopone were more than half again as large as in 1947.

Lead pigments and salts imported for consumption in the United States, 1944–48

[U. S. Department of Commerce]

Year	Short tons					Total value
	Basic carbonate white lead	Red lead	Litharge	Suboxide of lead	Other lead compounds	
1944	(1)		1	10		$5,962
1945	1		8	10	(1)	7,801
1946	1	54	15	11		[2] 13,038
1947	1	22	410	33		[2] 171,060
1948	203	247	1,064	34	1	[2] 633,776

[1] Less than 1 ton.
[2] Includes also lead pigments, n. s. p. f., as follows: 1946, $97 (522 pounds); 1948, $13,257 (60,573 pounds); lead arsenate: 1946, $5 (552 pounds); 1947, $20,700 (120,000 pounds).

Lead pigments and salts exported from the United States, 1944–48

[U. S. Department of Commerce]

Year	Short tons						Total value
	White lead	Red lead	Litharge	Orange mineral	Sublimed lead	Lead arsenate	
1944	3,052	2,117	2,391	13	82	2,133	$1,888,129
1945	4,079	1,922	2,512	3	53	3,170	2,162,548
1946	910	1,355	2,180	(1)	(1)	1,398	1,184,872
1947	863	787	1,212	(1)	(1)	1,552	1,032,143
1948	663	953	644	(1)	(1)	1,019	1,404,001

[1] Data not available.

Zinc pigments and salts imported for consumption in the United States, 1944–48

[U. S. Department of Commerce]

Year	Short tons						Total value
	Zinc oxide		Lithopone	Zinc sulfide	Zinc chloride	Zinc sulfate	
	Dry	In oil					
1944	(1)	5		(1)		542	$30,220
1945	(1)		(1)			421	16,806
1946	41		(1)	(1)	2	415	26,528
1947	117	1	(1)			295	47,482
1948	27	(1)				180	17,758

[1] Less than 1 ton.

Zinc pigments and salts exported from the United

[U. S. Department of Commerce]

Year	Short tons		Total value [1]	Year
	Zinc oxide	Lithopone		
1944	5,511	11,551	$2,194,203	1947
1945	7,102	11,576	2,554,177	1948
1946	10,955	9,651	2,911,457	

[1] Includes also—1944: Zinc sulfide, $7,195 (40,223 pounds); zinc chloride, sulfate, $83,666 (2,029,801 pounds); other zinc salts and compounds, $46,587 (fide, $25,399 (173,475 pounds); zinc chloride, $93,590 (1,499,755 pounds); zinc sul other zinc salts and compounds, $179,747 (750,108 pounds). Beginning Janua classes separately recorded.

WORLD REVIEW

Australia.—The Glidden Co. is said [7] to have Lead Co., Ltd., of Australia, to use the Euston p facture of white lead. The Australian company constructed a plant at Melbourne, expected to the end of the year or the beginning of 1949. said the plant was to have an initial capacity of

Canada.—A report of the Dominion Bureau of published in 1949 gave data on pigments consum varnish industry in Canada in 1946 and 1947. are as follows (1946 figures for comparison in carbonate white lead (dry) 3,264 (2,989) short t white lead in oil 1,741 (2,087) tons, basic sulfate w red lead including orange mineral 625 (567) tons tons, zinc oxide (lead-free) 5,209 (4,923) tons, lea (700) tons, lithopone (30 percent zinc sulfide) titanium dioxide 4,117 (3,416) tons, extended tit ments 7,199 (6,442) tons, and "other white pigmen

Canada's imports of lithopone, 12,736 and 8,85 in 1947 and 1946, were large enough to more tha years. Imports of zinc white (zinc oxide) were respectively. Imports of the other items give paragraph are very small, although titanium pigr separately. According to United States records and pigments, 13,274 tons were exported to C 12,020 tons in 1946.

Union of South Africa.—According to the Febr of Foreign Commerce Weekly, a branch factory of red lead, white lead, and litharge is being co South Africa, by Associated Lead Manufacturers Kingdom.

[7] Chemical Industries, vol. 63, No. 3, September 1948, p. 522.
[8] Chemical Engineering, vol. 55, No. 3, March 1948, p. 220.

Titanium

By HELENA M. MEYER

GENERAL SUMMARY

PUBLIC interest in titanium has been stimulated by recent developments that foreshadow large-scale use of the metal as a structural material. The popular (as well as technical) press has given much space during the past year or more to information on titanium and predictions as to its future. Despite the very recently acquired public awareness of this metal, the paint pigment—titanium dioxide—has been an important article of commerce for years; since the late nineteen thirties it has been manufactured in greater quantities than any other white pigment. Production of titanium pigments has followed annual expanding plant capacity and has established new peaks each year since 1943. Production facilities, however, have been inadequate to supply the total extra tonnages required for war and subsequently for swollen postwar consumer needs.

The titanium industry in 1948 was featured by the new record high production and shipments of pigments for the fifth consecutive year, by new peak domestic production and shipments of ilmenite for the second successive year, by new maximum consumption for the sixth year, by higher domestic shipments of rutile than ever before, by imports of ilmenite that were smaller than in only two preceding years—1947 and 1939 (being about the same as in 1946) and by extensive research in connection with titanium metal and alloys.

The United States postwar titanium supply differed markedly from the prewar balance. Before World War II India was supplying United States consumers with most of their needs for ilmenite, chief source of titanium. War disruption to sea-borne trade gave impetus to the search for alternate supplies, with the result that the United States now has the largest single ilmenite-producing mine in the world, the property of the National Lead Co. at Tahawus, N. Y., and that other new properties are in production, plan to produce in the near future, or are being investigated. Doubtless the prospective need for nearby sources, capable of assuring large tonnages of titanium-bearing ores, for the time when the metal will come into large-scale production, was a contributory factor in the development of new sources of supply. In this connection the announcement in 1948 that the Kennecott Copper Corp. and the New Jersey Zinc Co. were to exploit a very large deposit of ilmenite in Quebec, Canada, was an outstanding event of the year. Titanium from this property

is destined for pigment purposes in the early d
the operators are looking forward to an even
reduction to metal.

Production and shipments of ilmenite in th
both 14 percent greater than in 1947. Imp
below 1947 but were above all earlier years exc
ing those for 1946. Shipments and imports
cent more than consumption; stocks in indu
percent and were equivalent to nearly 1 year's
sumption rate maintained in 1948. Consum
creased 18 percent in 1948 to a new top.

Earlier reports of this series have discussed
of Mines investigations in connection with the
titanium, resulting in the development of at le
cable to large-scale operation. Later technolo
cussed under Technology.

Rutile production declined 14 percent from
1947, but shipments rose 92 percent over the lo
and exceeded all earlier years. Imports fell
owing to curtailment in receipts of rutile in mixe
concentrates from Australia. Industry stocks
in 1948 and at the end of the year would suppo
1948 rate for nearly 1 year.

Quotations for ilmenite were virtually unch
year, a slight downward revision during the y
drop in the content of titanium dioxide sp
(57–60 percent TiO_2) per gross ton, f. o. b. Atla
ing to grade and impurities, were quoted at the
at $19–$20, and at the end of the year 56–59
were $18–$20. All the quotations were repo
Rutile quotations continued to be nominally 8-
concentrate guaranteed minimum 94 percent T
number of years, until December when they we

DOMESTIC PRODUCTION

Both production and shipments of ilmenite w
1947, and both established new all-time peaks fo
year. Rutile production was 14 percent lower
in 1947. Shipments, on the other hand, were n
tively low rate for 1947, were one-third larger
were the largest in the industry's history. S
ranged from 44 to 60 percent TiO_2 and of rutile
TiO_2.

California.—Live Oak Mines and Ferro-Tita
ating in Los Angeles County, produced small
and of mixed ilmenite-magnetite concentrates
expansion appeared to hinge on the developme
on the west coast or on sufficient reduction in prod
entering more distant markets.

Florida.—The report of this series for 1947 disc
advent of a new producer of titanium-bearing
The E. I. duPont de Nemours & Co., Inc., oper

Production and mine shipments of titanium concentrates from domestic ores in the United States, 1944–48, in short tons

Year	Ilmenite				Rutile			
	Production	Shipments			Production	Shipments		
		Gross weight	TiO_2 content	Value		Gross weight	TiO_2 content	Value
1944	278,610	280,791	128,095	$7,371,270	6,922	6,770	6,312	$1,088,112
1945	308,516	308,518	141,852	7,350,170	7,179	6,837	6,414	869,920
1946	282,447	282,708	130,624	4,878,917	7,453	7,514	7,046	906,989
1947	330,533	336,001	157,328	5,029,400	8,562	5,157	4,813	533,548
1948	383,745	381,508	177,447	5,793,973	7,380	9,907	9,226	647,334

not get into production in 1948 but was expected to begin early in 1949. Production of ilmenite and rutile in Florida in 1948 came from the Rutile Mining Co. of Florida near Jacksonville and the Riz Mineral Co. near Vero Beach. The latter property was operated under the name as given and under the name of the Florida Ore Processing Co., Inc.

New York.—Production of titanium-bearing ore at Tahawus, Essex County, by the National Lead Co. continued to break records in 1948 and was again the predominating reason for the record performance of the United States as a whole. The mine continued to lead all others in the world in production of ilmenite. Drilling and blasting at Tahawus were recently described.[1]

North Carolina.—The Yadkin Mica & Ilmenite Co., subsidiary of the Glidden Co., produced 28,990 tons of ilmenite (averaging 51 percent TiO_2) at Finley, Caldwell County, and shipped 28,790 tons. The 1948 output was 6 percent above 1947, itself 60 percent higher than in 1946.

Virginia.—Ilmenite and rutile were produced in Virginia again in 1948 near Roseland, Nelson County, by the American Rutile Corp., subsidiary of the Metal & Thermit Corp. The Calco Chemical Division of American Cyanamid Co. continued to produce ilmenite at Piney River, Nelson County. The Roseland property was closed from January through August, there being no mine nor mill activity during this period.

CONSUMPTION AND USES

The consumption of ilmenite in 1948 was 18 percent higher than in 1947, marking continuation of the establishment of new high record rates of use for the sixth consecutive year. The manufacture of pigments, as usual, took 99 percent of all ilmenite consumed. Rutile consumption, which had dropped notably since the end of the war, gained 28 percent in 1948 and was the highest since 1944. Welding-rod coatings took 80 percent of the total compared with 84 percent in 1947.

[1] Begor, C. R. and Quam, C. A., Drilling and Blasting at Tahawus: Min. Cong. Jour., vol. 34, No. 8, August 1948, pp. 24–27.

Consumption of ilmenite and rutile in the United States, 1947–48, by products, in short tons

Product	Ilmenite	
	Gross weight	
1944	360,941	
1945	381,178	
1946	404,283	
1947		
Pigments (manufactured titanium dioxide) [1]	473,154	
Welding-rod coatings [1]	144	
Alloys and carbide	5,972	
Ceramics		
Miscellaneous	254	
Total consumption	479,524	
1948		
Pigments (manufactured titanium dioxide) [1]	558,448	
Welding-rod coatings [1]	145	
Alloys and carbide	6,377	
Ceramics		
Miscellaneous	30	
Total consumption	565,000	

[1] "Pigments" include all manufactured titanium dioxide, consump
was 1,257 tons in 1947 and 1,338 tons in 1948.

Titanium Pigments.—Production and ship
ments in 1948 were greater than ever before,
for the fifth successive year. Recent produ
largely by pigment plant capacities, because
over-all demand has called for even larger to
quantities made available. Figures on this i
confidence and, consequently, are not giv
increases in pigment-plant capacities for severa
owing to difficulties in obtaining structura
Total capacity was expanded another 10 pe
1948, and still further gains are expected in
ilmenite was at a new maximum in 1948.
series have pointed out that use of titanium p
largely on merit, have been influenced also
petitive products, notably those made from le

According to information received from a
the use pattern for titanium pigments in 1
percent was for paint, varnish, and lacquer
3 percent for rubber and plastics, 2½ percent
2 percent for floor coverings, 1½ percent for w
cent for other purposes.

Paint capable of resisting temperatures o
have been developed as a result of research by
for Scientific and Industrial Research.[2] Bas
butyl titanate.

[2] Metal Bulletin (London), Titanium: No. 3346, Nov. 30, 1948, p. 17.

According to the November 5, 1948, issue of Chemical Trade Journal and Engineer (London), titanium dioxide is being made from rutile on a pilot-plant scale at Melbourne, Australia, by Zircon Rutile, Ltd. If the pilot-plant results justify it, consideration is to be given it was said, to the erection of a larger plant.

Welding-Rod Coatings.—Production of titanium-coated welding rods was 188,000 short tons in 1948, a gain of 23 percent over 1947, itself 15 percent above 1946; 267,000 tons were produced in 1945, 382,000 in 1944, and 481,000 in 1943. In 1948, 56 percent of the rods were coated with natural rutile, 32 percent with manufactured titanium dioxide, and 6 percent each with both varieties and with ilmenite.

Other Uses.—Titanium metal, a laboratory curiosity until recently, has become a widely discussed subject with the advent of production on a commercial basis and with publicity that production at costs that would invite large-scale operations is an early possibility. The metal is discussed under Technology.

Developments in titanium enamels were discussed [3] in a recent article, which said that the superior performance of titanium enamels has enabled them to make inroads into the zircon business, despite higher cost. Antimony enamels were said still to lead where acid resistance is the principal requirement and where low opacity is no draw-back. Another article [4] discussed the improved physical properties of titanium enamels.

STOCKS

Inventories of ilmenite rose 17 percent in 1948 and those of rutile fell 34 percent. Totals for each closely approximated 1 year's needs at the consumption rates maintained in 1948.

Stocks of titanium concentrates in the United States at end of year, 1947–48, in short tons

Stocks	1947				1948			
	Ilmenite		Rutile		Ilmenite		Rutile	
	Gross weight	Estimated TiO_2 content	Gross weight	Estimated TiO_2 content	Gross weight	Estimated TiO_2 content	Gross weight	Estimated TiO_2 content
Mine	1,706	776	3,953	3,687	3,983	1,800	1,500	1,398
Distributors [1]	5,684	3,126	8,642	8,123	4,499	1,809	4,218	3,998
Consumers	[2] 446,052	[2] 229,128	1,342	1,232	522,077	250,559	3,493	3,255
Total stocks	[2] 453,442	[2] 233,030	13,937	13,042	530,559	254,168	9,211	8,649

[1] Includes ilmenite and rutile content of mixed zirconium-titanium concentrates.
[2] A large quantity previously counted as stocks was written off company books in 1947.

PRICES

Quotations in E&MJ Metal and Mineral Markets covering ilmenite were virtually unchanged throughout the year. A slight downward

[3] Chemical Industries, Titania on Top: Vol. 63, No. 5, November 1948, pp. 770–771.
[4] King, Burnham W., Titanium Enamels: Steel, vol. 122, No. 25, June 21, 1948, pp. 108, 111, 128, and 130.

revision coincided with a drop in cont
from a range of 57–60 percent TiO_2 co
tions for 57–60 percent TiO_2 concer
Atlantic seaboard, according to grad
when the year began; beginning Ja
content specified was dropped to 56
reported as $18–$19; and from Septem
with no change in grade indicated. T
as nominal. Nominal quotations for
pound for concentrate guaranteed m
number of years until December 19
was reported.

At the beginning of the year, Stee
Zone, contract, ton lots at $1.35 and
of contained Ti for 20 to 25 percent,
C 0.10 percent, the last three all ma
$1.23 and $1.25, respectively, for ton
cent Ti, with the following maximur
and C 0.10 percent. For the Central
for 20–25 percent Ti grade and 2.1
Western, 13.5 cents for 20–25 percent
For high-carbon ferrotitanium, 15–20
ton, f. o. b. Niagara Falls, N. Y., fre
of Mississippi river and north of Balti
C, the quotation was $142.50; 3–5 per
tions held until October 4 when the
for the remainder of the year as follov

Ferrotitanium, Low-Carbon: (Ti 20–25 pe
percent maximum, C 0.10 percent maximu
per pound of contained Ti; less ton $1.45
maximum, Si 4 percent maximum, C 0.10
less ton $1.35, f. o. b. Niagara Falls, N. Y.
add 5c.

Ferrotitanium, High-Carbon: (Ti 15–18
$160 per net ton, f. o. b. Niagara Falls, N. Y
of Mississippi river and north of Baltimore

Ferrotitanium, Medium-Carbon: (Ti 17–21
$175 per ton, f. o. b. Niagara Falls, N. Y.,
allowed.

Titanium metal, 96–98 percent, wa
the beginning of the year, dropping
which level it continued for the rem
Pont de Nemours' production was av
sponge metal and in ingots of 10 and

Manufactured titanium dioxide (a
and (rutile) nonchalking, in bags, car
the Oil, Paint and Drug Reporter at 1
respectively, when the year began.
range of 17½–18 cents in midyear, con
in September, when they were establi
chalking grade moved to 20 cents.
resistant and plain grades were quo
nonchalking at 20–21½; they were the
of the range, where they continued fo

FOREIGN TRADE [5]

Imports.—Receipts of ilmenite were only 80 percent of the peak quantity imported in 1947 but were smaller only than that year and 1939, approximating the total for 1946. India continued to be by far the chief source of imported concentrates, supplying 76 percent of the total compared with 87 percent in 1947. Norway continued to ship increasing quantities to the United States, the total for 1948 being 37 percent above that in 1947; Norway supplied 17 percent of total imports. A noteworthy gain was made in receipts of ilmenite from Brazil, and British Malaya appeared in the import declaration as a supplier for the first time. Australia was the only country to ship rutile of the United States in 1948. Receipts dropped, owing to discontinuation of entries of mixed zircon-rutile-ilmenite concentrates from that country. Imports of ferrotitanium for consumption, all from the United Kingdom, were 28 short tons.

Titanium concentrates [1] imported for consumption in the United States, 1944–48, by countries, in short tons

(U. S. Department of Commerce)

Country of origin	1944	1945	1946	1947	1948
ILMENITE					
Australia [2]	79	1,753		[3] 1,659	(4)
Brazil	5,511	10,508	2	1	8,708
British Malaya					3,335
Canada	32,580	6,987	1,260	7,122	4,519
Ceylon	4,648				
India	62,066	179,693	218,623	262,503	184,309
Norway		9,895	21,077	30,026	41,248
Total as reported	104,884	208,836	240,952	301,311	242,119
Australia: In "zirconium ore" [2]	4,064	[4] 1,236	1,388		
Grand total	108,948	210,072	242,340	301,311	242,119
Value of "as reported"	$596,034	$1,217,339	$1,440,112	$1,791,029	$1,758,838
RUTILE					
Australia [2]	1,806	3,070	4,377	7,460	8,771
Brazil	1,809	234	31		
Cameroun (French) [6]				3	
India	134			113	
Norway					(4)
Total as reported	3,099	3,304	4,408	7,576	8,771
Australia:					
In "zirconium ore" [2]	6,320	7,208	1,456		
In "ilmenite"				[3] 5,061	
Grand total	10,019	10,602	5,864	12,637	8,771
Value of "as reported"	$272,283	$98,170	$213,795	$468,810	$588,713

[1] Classified as "ore" by the U. S. Department of Commerce.
[2] Most of the imports of titanium from Australia in 1944–47 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 3 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 1,659 were ilmenite, 12,521 rutile, and 21,894 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 ilmenite as reported.
[4] Less than 1 ton.
[5] Includes 309 tons not recovered from mixed concentrates.
[6] Includes quantities reported by the U. S. Department of Commerce as originating in French Equatorial Africa, from which no rutile production has been recorded.

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

Exports.—Of the concentrates expor
Canada, 474 to Netherlands, 141 to B
of South Africa. Of the pigments, 19,7
to Netherlands, 1,005 to Belgium, 848 t
to Mexico. Virtually all of the ferro-
to Canada. Total titanium product
$7,400,000; tetrachloride and other com
separately and are not included in this t

Exports of titanium products from the Uni

(U. S. Department of C

Year	Concentrates		Ferro-alloys	
	Short tons	Value	Short tons	Value
1944	291	$51,828	[1] 793	[1] $127,
1945	609	121,951	744	122,
1946	1,385	200,866	550	63,
1947	1,266	192,703	509	80,
1948	1,454	187,225	480	82,

[1] Includes metal and nonferrous alloys.
[2] Beginning Jan. 1, 1946, not separately classified.

TECHNOLOG

Many reports on titanium technolog
year.

The interest of the Department of the
its promise as a structural material led to
sponsored by the Office of Naval Resear
Washington, D. C. The papers submitt
entitled "Titanium" and included the fo

The Bureau of Aeronautics' Titanium Prog
Materials Branch, Bureau of Aeronautics, Nav
The Program of the Air Matériel Command
R. Kennedy, Wright-Patterson Air Force Base.
The Titanium Program of Army Ordnance, b
Arsenal Laboratory.
Production of Titanium Powder at Boulder
lurgist, Bureau of Mines, Boulder City, Nevada
Fabrication of Titanium and Investigations
Bureau of Mines Laboratories, by J. R. Long, C
Division, Bureau of Mines.
Physical and Mechanical Properties of Comm
Bradford, J. P. Catlin, and E. L. Wemple, Remi
Production and Properties of Iodide Titanium
Supervisor, Battelle Memorial Institute, Columl
Properties of Iodide-Type Titanium, by F. B.
Induction Melting of Titanium Metal in Gra
Department, E. I. DuPont de Nemours & Co.
The Production and Arc Melting of Titaniun
Eastwood, Battelle Memorial Institute.
Some Preliminary Tests to Determine Applic
Williams, U. S. Naval Engineering Experiment
Some Preliminary Data on Alloys of Titaniur
L. S. Busch, and R. H. Freyer, P. R. Mallory &
Titanium-Base Alloys, by Howard C. Cross, I

Some Aspects of the Metallurgy of Titanium Alloys, by P. H. Brace, Westinghouse Research Laboratories.

The Titanium-Base Alloys Program of the Naval Research Laboratory, by E. J. Chapin, Metallurgy Division, Naval Research Laboratory.

First Progress Report on Titanium-Carbon and Titanium-Nitrogen phase Diagrams, by J. P. Nielsen, College of Engineering, New York University.

Long's paper summarized two recently completed reports, subsequently published,[6] and concerned the fabrication of titanium and the studies of titanium-rich alloys being conducted in the laboratories of the Bureau of Mines. Titanium is active chemically and at high temperatures reacts readily with the atmosphere, making it extremely difficult to produce a pure metal by melting and casting, as with most other metals. However, the Bureau developed a process in which titanium powder can be heated to elevated temperatures while sealed in ductile, gastight containers. Hot-rolling the complete assembly produces a solid, nonporous metal for working into construction members, machinery parts, and other materials. As a byproduct of research on pure metallic titanium, Bureau metallurgists also are investigating the possibilities of titanium alloys for engineering purposes, as pure metals in general show relatively large improvements in properties when alloyed with other metals. The titanium-nickel series is the first of several alloys to be tested in Bureau laboratories. The report describes experiments on alloys containing up to 40 percent nickel.

The article by Bradford and others stated that Remington's program has progressed to the point where 20- to 25-pound ingots are being cast and small quantities of narrow sheet and round rod are being produced. Most of the company's effort was said to be devoted to research on titanium-rich alloys. Preliminary work indicated that the machinability of titanium is similar to that of austenitic stainless steel. The General Electric Co. River Works at West Lynn, Mass., and several other companies were said to be conducting preliminary welding experiments with Remington titanium. The experiments indicate that titanium can be readily spot-welded, seam-welded, and inert-arc-welded to other pieces of titanium. Titanium's sea-water and marine atmospheric corrosion resistance were said to be truly outstanding, being better than austenitic stainless, Monel, and the cupronickel alloys, and as good as the best-known materials—platinum and Hastelloy C.

In his paper, Gonser says that interest in the production of titanium by the iodide process is broader than merely the production of a relatively pure metal as a base for investigations, almost regardless of cost. It is a method for making a high-quality metal in a compact form, which can be processed directly without smelting or without compacting and sintering into ingots by powder metallurgy. Essentially, he says, the process depends upon the formation of a volatile iodide by reacting crude titanium with iodine in the absence of any other reactive gas, then depositing the titanium on a hot filament by thermal decomposition of the iodide. This action is cyclic, as the gaseous product of decomposition reacts with more crude metal;

[6] Long, J. R., Hayes, E. T., Root, D. C., and Armantrout, C. E., A Tentative Titanium-Nickel Diagram: Bureau of Mines Rept. of Investigations 4463, 1949, 13 pp.
Long, James R., and Hayes, Earl T., Sheath Working of Metal Powders: Bureau of Mines Rept. of Investigations 4404, 1949, 13 pp.

so the action in its simplest form is refi
At present iodide titanium is still on a la
produced by this method, Gonser states,
alloying and for studies of fundamental pr

E&MJ Metal and Mineral Markets of
the Northern Miner as stating that Dom
producing a few pounds of titanium metal
plant production, using a process said to
practice, points to a price of around $1.
used by the Canadian company was dev
and D. W. Rostrom.

An article[7] recently published discussed
in Australia. It commented on the large
titanium tetrachloride from rutile sand d
of purified titanium tetrachloride with
on a small scale and reasonably pure me
either cold or at 500° to 600° C., has
process, it is stated, could easily be modi
alloys directly, for example, alloys of tita
silicon, and tantalum.

WORLD REVIEW

Available data on world production of il
years are shown in the accompanying ta
in certain important producing and consu
world table.

World production of titanium concentrates (ilm countries, in metric t

[Compiled by B. B. Mitch

Country	1941	1942	1943	
ILMENITE				
Australia:				
New South Wales	3,521	3,651	3,815	
Queensland	258	937	1,655	
Tasmania				
Brazil (exports)	4,471			
Canada	11,477	9,100	62,992	3
Egypt	2	[3] 601		
India	131,111	49,977	38,396	10
Malayan Union	[4] 44			
Norway	61,086	60,713	66,191	6
Portugal	798		121	
Senegal [5]	1,000	4,840	730	
Spain	71	85	178	
United States	21,135	70,042	184,657	25
Total ilmenite	234,974	200,036	358,735	46
RUTILE				
Australia:				
New South Wales	3,549	4,496	4,828	
Queensland	267	1,007	1,902	
Brazil (exports)	2,369	4,615	4,557	
Cameroun (French)	1,800	2,400	2,735	
India	1,801	2,295	2,396	
Norway	172	77	116	
United States	2,839	2,402	3,617	
Total rutile	12,887	17,292	20,151	21

[1] Data not available.
[2] Includes 26 tons of garnet-ilmenite.
[3] January to September, inclusive.
[4] Exports.
[5] Approximately 20 pe

[7] Worner, H. W., Titanium and Zirconium, New Metals in A
Min. Rev. (Melbourne), vol. 40, No. 7, Apr. 10, 1948, pp. 254–262.

AUSTRALIA

Details covering heavy mineral production and other data were made available [8] in the latter part of the year. The most extensive known deposits of black sands were said to occur along the coast near the border of New South Wales and Queensland, largely between Southport, 17 miles north of the border, and Ballina, 50 miles below the border. (See fig. 1.) Information on reserves is fragmentary, but

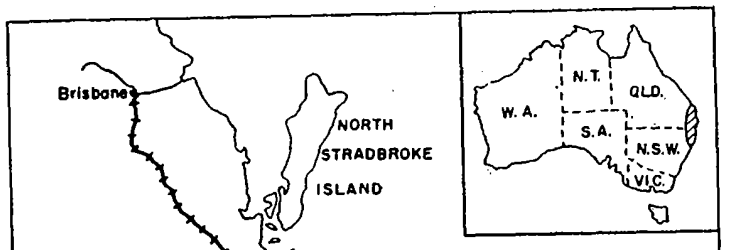

FIGURE 1.—Map showing location of heavy mineral deposits in Northern New South Wales and Southern Queensland.

investigations of all deposits are in progress in connection with the question of the probable amount of monazite available. In the areas close to the beach along the New South Wales-Queensland coast, now being worked, it has been estimated that reserves of high-grade sands are sufficient to last only 10 to 20 years at the current rate of production. Much larger unworked deposits, however, are said to occur in

[8] Lamm, Donald W., Heavy Minerals of the Australian Beach Sands: Consular Rept. 86, American Embassy, Canberra, Australia, Sept. 9, 1948, 17 pp.

the sand dunes behind the present beach
Bay, New Brighton—Cudgera, Cudgen,
areas. The report states that competent
"very large" reserves of sands on the eas
Island. The average mineral content is
workable by methods now being used in

Production figures are given in the
Domestic demand for rutile and zircon i
markets are necessary to keep production
ly refrain from expanding production to u
accumulation of cumbersome surpluses.

In the fiscal years 1945–46 and 1946–47
and 11,090 long tons, respectively, and o
respectively. The United States was th
percent and the United Kingdom 21 and
the rutile shipped from the country.

The ilmenite produced on the east c
content to be usable for pigment purpos
ilmenite stock piles are said to have accu

In earlier years Australian rutile, ilmen
shipped from the country chiefly in the fo
separation in the importing country.
monazite content of the concentrates h
however, has made exportation of mi
possible.

Seven firms are actively engaged in co
for zircon and rutile; another company
temporarily, and two others were planning
tion on these companies, given in the repo

Mineral Deposits Syndicate.—Deposits
area and plant at Southport, Queensland
of mixed concentrates is 600 long tons.
the overburden with a bulldozer and selec
trucks, the overburden being replaced.
plant by the use of Wilfley tables, drainin
magnetic separators are used to elimina
electrostatic separation of the zircon-rut
netic separator. Products are zircon an
and 95-percent purity, respectively.

Associated Minerals.—Deposits in the
and plant at Southport. Average mon
tons. Mining methods same as foregoi
by Wilfley and curvilinear tables, rotary
and electrostatic separation of the zirc
cleaning of each product by both electr
methods. Products are zircon (93-per
percent) concentrates.

Rutile Sands Pty.—Deposits on the Tu
plant at Currumbin, Queensland. Ave
650 long tons. Mining methods same
The sands are treated by Wilfley tables
followed by electrostatic and electrom
concentrates of 90 percent and rutile of 96-

Tweed Rutile Syndicate.—Deposits at Cudgen and the adjacent beach area and plant at Cudgen, N. S. W. Monthly output is 500 long tons. The sands are mined by stripping the overburden with horse-drawn scoops, then loading the black sands on motor trucks by use of a small Diesel shovel. The sands are treated by the use of Wilfley tables, then moved by conveyor to the drier and separated and cleaned by electrostatic and electromagnetic methods. Products are zircon and rutile concentrates of 95- and 96-percent purity, respectively.

Titanium Alloy Manufacturing Co., Ltd.—Deposits and plant the same as Tweed. Average monthly production is 900 long tons. The overburden is removed by power scoops, and the heavy minerals are then piled, and loaded by use of a small drag scraper into 2-foot-gage railway trucks drawn by a Diesel locomotive. The sands are treated by using Wilfley tables, draining, rotary drier, then electrostatic treatment (the company has six units). The ilmenite is removed by a magnetic separator. Products are zircon and rutile concentrates of 98- and 94-percent purity, respectively.

Metals Recoveries, Ltd.—Deposits in the area between Cudgera and New Brighton and plant at Crabbe's Creek and Mooball Landing, N. S. W. Approximate monthly production is 250 long tons. The overburden is removed by horse-drawn scoops, and there is selective hand loading of the black sands into trucks. The sands are treated by the use of Wilfley and curvilinear tables at Crabbe's Creek and carted to Mooball where they are dried, passed through a electromagnetic separator, and through an electrostatic separator. Products are zircon and rutile concentrates of 97-percent purity each.

Zircon Rutile, Ltd.—Deposits at Seven Mile and Tallow Beach, Byron Bay, and plant at Byron Bay. Largest of the operating firms with an average monthly output of 1,000 long tons. Mining by removing overburden with bulldozers and stacking the heavy mineral sands, then loading on trucks by an overloader. A dragline loader is also used. The Wilfley tables are at the beach, and the concentrates are carted to the main plant at Byron Bay. The zircon is removed by flotation, the tailings, being passed over cleaner curvilinear tables then through the drier. The ilmenite and other slightly magnetic minerals are removed magnetically, and the zircon concentrate is dried and cleaned magnetically. The zircon concentrate is graded at 99.5 percent and the rutile at 96-percent pure.

Swansea Minerals.—Deposits and plant at Swansea Beach, N. S. W. when firm was producing, average monthly output was 300 long tons, but operations closed temporarily at end of June 1948. The black sands were hand-loaded into trucks and only Wilfley tables used in treating them. The firm marketed a mixed concentrate consisting of 44 percent zircon, 41 percent ilmenite, 10 percent rutile, and 5 percent other heavy minerals.

Alluvial Gold, Ltd.—Leases covering about 590 acres in the Murwillumbah district, N. S. W. Preliminary borings indicate that the area contains 130,000 tons of rutile and 250,000 tons of zircon ore.

Zinc Corp.—Large mining firm investigating deposits on North Stradbroke Island, for which it has important lease holdings. Leases apparently taken in the name of Australian Mining & Smelting Co., Ltd., and later transferred to the Titanium & Zirconium Industries

Pty., Ltd., which is doing preliminary
subsidiaries of the Zinc Corp.

James Scott-Moffatt.—He has applie
80-acre area on South Stradbroke Islan
Plans to concentrate heavy minerals on
Brisbane to be separated.

Rare Metals Pty., Ltd.—Had just co
mercial scale when report was prepared
40 miles east of Albany, Western Aus
100 tons of sand sent to England had a
percent. Concentrating plant will be
planned soon to send 10,000 long tons th
in this deposit is virtually free of chrom
of Australia's ilmenite) and is thus s
Zircon and rutile will also be marketed.

British Titan Products.—A subsidiary
tries (British). No information avail

CANADA

Announcement was made during the
ment program in new titanium-iron ore
of eastern Quebec. The work has been
and has been carried on jointly by the
the New Jersey Zinc Co. According to t
of 125,000,000 tons of high-grade, easily
ore has been outlined by diamond drillin
credits discovery of the deposit to J. A.
of Mines, who carried out in 1941 the firs
in the Lower Romaine River area, in Sag
shore of the Gulf of St. Lawrence, abo
City. Dr. Retty called attention to th
masses of anorthosite rocks, some of w
and indicated that ore bodies of consi
developed.

The Quebec Iron & Titanium Corp.—
cott and one-third by New Jersey Zinc—
operate the property, according to the
holders of the Kennecott Copper Corp.
will be required to transport the ores to
Havre St. Pierre, and grading for 4½ mil
completed early in 1949. From Havre St.
up the St. Lawrence about 600 miles to
operation will be conducted utilizing the h
in that area. Production on a small sca
in 1950, and the company hopes to be
day by the end of 1951. An over-all
about two-thirds in the Sorel area, is exp
the operation to the initial capacity ind
research an electric smelting method for

[1] Northern Miner, New Titanium-Iron Ore Fields Add Impo
1948, pp. 1, 8-9.

chantable iron and high-grade titanium oxide slag was developed. In speaking of the market for their product, Kennecott stated:

> At the beginning of operations the principal demand for the titanium slag will be for conversion into titanium oxide for use in the paint, white rubber, paper and ceramic industries. Eventually, however, there should be a substantial market for the slag to process into titanium metal, which, because of its strength, corrosion resistance and relatively light weight, should be superior to other metals for many purposes. As research is currently being carried on by many organizations to find a low-cost process for producing the metal, it is quite possible that developments in this direction will be realized within a reasonable length of time.

According to the Northern Miner of January 20, 1949, plans cover an initial 1,500-ton unit, but the plant is laid out to accommodate four such units. The annual treatment of 550,000 tons of ore is expected to yield 175,000 tons of high-grade iron and 250,000 tons of TiO_2 slag.

OTHER COUNTRIES

Czechoslovakia.—Production of titanium oxide at Aussig was discussed in a recent report.[10] The data were given entirely from memory. The plant was said to have had a capacity of 600 to 900 metric tons of titanium oxide before the war. Planned extensions to 1,200–1,500 tons were not completed. Supplies of ilmenite had come from Travancore, Portugal, and Norway and just before the war were largely from Malaya. Norwegian ilmenite was used solely during the war. Another report [11] stated that a deposit of ilmenite of excellent quality had been located near Pilsen.

United Kingdom.—The British Titan Products Co., Ltd., which has operated a titanium pigments plant at Bellingham since 1934, planned [12] to complete a new plant at Grimsby before the end of 1948. Production was expected to begin early in 1949 and to expand to 10,000 tons of rutile-grade titanium oxide pigment annually. The Grimsby works will have its own sulfuric acid plant, which is expected to produce 110 tons of sulfuric acid a day and is said to be the largest single contact unit in the country. Imports of titanium ores into the United Kingdom totaled 57,493 long tons in 1948 compared with 71,250 tons in 1947.

[10] Richmond, J. T. (Interrogation of Walter Neumann, Nov. 17, 1947), Production of Titanium Oxide at Aussig: British Intelligence Objectives Subcommittee Final Rept. 1410, 1947, 4 pp.
[11] Chemical Engineering, vol. 55, No. 10, October 1948, p. 226.
[12] Chemical Age (London), A Triumph for Engineers: Vol. 59, No. 1516, July 31, 1948, pp. 157–159.

Tungst

By HUBERT W

GENERAL SUM

GREATLY expanded domestic p
level of consumption, reduction
prices were features of the tungs
Despite a 24-percent reduction in t
put and shipments of tungsten concen
ward trend. Production and shipmen
percent WO_3 basis) were 4,210 and 4,
1948, increases of 32 and 29 percent o
Nevada as the premier tungsten-prod
max Molybdenum Co. began commer
centrate as a byproduct of molybde
mine in Lake County, Colo., in May 1

Salient statistics of tungsten ores and concen
in pounds of contain

Year	Production	Shipments from mines	Imports for consumption
1944	9,764,647	9,786,537	18,396,277
1945	5,388,639	5,260,818	4,773,801
1946	4,671,042	4,942,282	6,809,438
1947	3,026,470	2,944,622	6,018,005
1948	4,006,741	3,811,639	7,548,101

[1] Revised figure.

Imports of tungsten ores and conce
United States were also larger in 1948;
percent WO_3 basis), an increase of
chiefly China, supplied 68 percent of th
percent more than in 1947. Imports
were 28 percent smaller in 1948 than i
1,792 tons (60 percent WO_3 basis) were
for the United States Government.
Consumption of tungsten concentra
the United States was 9,300 short tons
tons in 1947. The quantity of concen
sten was 8 percent greater in 1948 than i