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LEAD¹

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GENERAL SUMMARY

The outstanding feature of the lead industry in 1944 was the decrease in new supplies, which failed to balance a high level of consumption. Production from domestic mines, which is the principal source of new supply, continued to decline, largely owing to a severe shortage of manpower. Imports of refined lead—a ready source of immediately usable metal—were lower, consumption was maintained at a high level, and Government stocks of refined lead were steadily reduced to a point considered below the margin of safety. At the end of the year a sweeping revision of existing General Preference Order M-38 was announced by the War Production Board to restrict consumption further and thereby help to ease a situation that had grown critical. The end of the European phase of the war in May 1945 was accompanied by signs of gradually diminishing military requirements, but the backlog of civilian needs for lead during the period of partial reconversion will maintain demand at a high level. The prospect for 1945 is one of the continuing insufficient supply for all potential consumers but of adequate supply for military and essential civilian requirements.

Refined primary lead production from domestic and foreign ores and foreign base bullion decreased 1 percent in 1944, the total being only 4,849 short tons less than the 1943 output. Year-end stocks at domestic refineries (physical inventory) were less than half the total at the beginning, and consumers' inventories were 22 percent lower.

Total imports of lead in all forms during 1944 showed a gain of lead than 1 percent. An increase in receipts of lead in ore, concentrates, and matte—largely from Newfoundland and Australia—offset a decline in imports of refined lead, the principal source of which was Mexico. A substantial amount of reclaimed lead and lead scrap from Australia partly balanced the absence of base bullion from the country.

The established price of 6.50 cents a pound for lead at New York remained unchanged throughout 1944.

¹ This report deals primarily with the smelting, refining, and consuming phases of the industry. For full details of mining operations, see separate reports issued for the various States.

LEAD

Salient statistics of the lead industry in the United States 1940-44, in short tons

	1925-29 (average)	1940	1941
Production of refined primary lead: From domestic ores and base bullion.....	680,825	433,065	470,817
From foreign ores and base bullion.....	123,104	100,114	100,460
Recovery of secondary lead.....	783,029	533,179	570,967
Imports: ¹	280,000	260,346	397,410
Lead in pigs, bars, and old.....	4,592	181,668	274,395
Lead in base bullion.....	95,747	19,624	24,704
Exports of refined pig lead.....	40,096	111,300	82,116
Lead remaining in bonded warehouse at end of period.....	98,048	449,079	14,369
Refined primary lead apparently shipped to domestic consumers.....	136,969	211,876	168,280
Estimated consumption of primary and secondary lead.....	690,916	633,969	612,863
Prices: New York: Average for year.....	900,250	782,000	1,050,000
Quotation at end of year.....	7.47	5.38	5.79
London average.....	6.25	5.50	5.85
Mine production of recoverable lead.....	5.87	(²)	(²)
World smelter production of lead.....	604,230	467,362	461,426
	1,860,000	(³)	(⁴)

¹ Revised figure.

² Data include lead imported for immediate consumption plus material and includes 25,324 tons of foreign refined lead reexported, according to American figures not available.

³ Includes 3,874 tons of foreign lead reexported in 1942 and 11,258 tons in 1943. Department of Commerce.

⁴ Data not available.

⁵ Official maximum price fixed by British Ministry of Supply at £25 per ton.

Figure 1 shows trends in the domestic lead industry

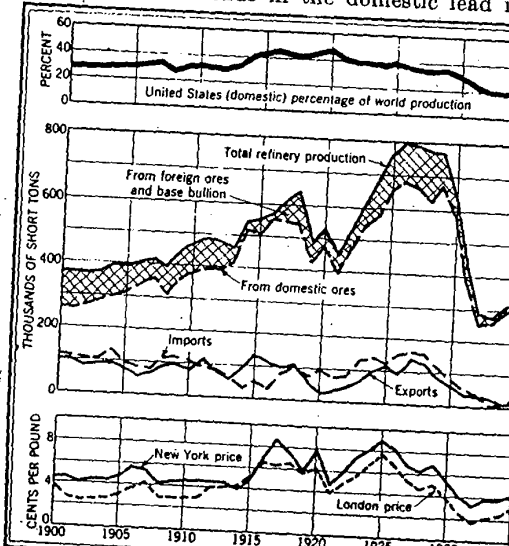


Figure 1.—Trends in the lead industry in the United States, 1900-1944. Includes base bullion, pig lead, and scrap; exports include pigs, bars, and scrap lead with benefit of draw-back. Data on lead exported in manufacturing not available for 1944.

WAR AGENCY REGULATIONS

Lead remained under Government control throughout 1944, under War Production Board General Preference Order M-38, which provides for the regulation of shipments, deliveries, and a reserve pool for allocation. In actual practice the control of lead was confined to the allocation of Government-owned stocks of foreign lead and to prohibition of the use of lead for certain purposes; all essential uses were free from control, subject, of course, to limitations imposed by virtue of regulations on the use of other materials needed for the manufacture of lead-containing products. As a result of a decrease in new supplies, Government stocks of refined lead were steadily reduced. To help ease the resultant critical supply position the War Production Board amended Order M-38, effective December 26, to restrict most civilian uses of lead to an annual rate of 60 percent of the 1944 level of consumption. Under the revised order, restrictions and availability of lead were defined under three listings: A, prohibited uses; B, end uses for storage batteries, cable covering, tetraethyl, and ammunition for military use only (for which lead was made available 100 percent), and for solders, bearing metals, brass and bronze for which the use of lead was unrestricted; and C, the greater portion of civilian uses with the restriction mentioned above. Greater restrictions were placed on other than essential uses by an amendment to the order on January 15, 1945, followed by the prohibition of certain end uses in the order by another amendment on February 1. Because the lead supply became increasingly critical, permissible uses of the metal were again curtailed, in an amendment to the order on March 31, to include only end products. A list of 64 permissible uses was substituted for the previous lists A, B, and C which covered restricted uses, unrestricted uses, and quota percentage restrictions.

To conserve further the foreign supply of lead available to the United States for war purposes, War Production Board General Imports Order M-63—governing imports of strategic materials—was amended, effective February 14, to place collapsible lead tubes, storage batteries, and lead foil under import control. Later, in April, another amendment included lead disks, slugs, and other semifabricated forms manufactured in whole or in part from lead or lead alloy.

Limitation Order L-180, affecting storage batteries, was amended in April 1945, to insure that the lead shortage was not reflected in the quality of replacement storage batteries produced in 1945 and to prevent the sale of batteries except under conditions in which replacement was imperative.

The Premium Price Plan for overceiling payment for production of lead in excess of quotas was maintained throughout 1944. A brief outline of the Premium Price Plan and an accompanying table giving production and payments from 1942 through 1944 are given in this chapter under the heading Prices.

RECIPROCAL TRADE AGREEMENTS

Marked opposition was voiced early in 1945 against certain proposals embodied in a bill (H. R. 2652) placed before Congress to extend the Reciprocal Trade Agreements Act. The lead industry as a whole opposed the proposed delegation of power to the President to make a further cut of 50 percent in the rates of duty prevailing

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on January 1, 1945, and asked that any extension be for 1 year. The cause for alarm was certain language which could be interpreted to make permanent per-cent reduction under the existing Mexican Tariff Act of 1942. As finally written and passed by the Senate, the bill extends the act for 3 years and allows for as much as a 50 percent reduction in the rates of duty prevailing on January 1, 1945, under temporary reduction under wartime agreements remain in effect, however, and any cut in the duty will be with respect to the rates published by the 1930 tariff act. Under the "most favored nation" policy, any reduction embodied in a reciprocal trade agreement will apply equally to virtually all countries.

POSTWAR OUTLOOK

The outlook for lead for the few years following the war will depend upon the interrelated factors of production, importation, consumption, and price. These in turn depend to a great extent upon the end of the war in the Pacific and how soon the productive capacity—as a whole—can be directed to the production of lead under competitive conditions.

Production.—Mine production during the war has averaged 664,230 tons, or 1.5 percent of the peacetime 1925-29 average of 664,230 tons. The depletion of ore reserves in certain districts and to a considerable extent the lack of manpower. A considerable proportion of the output has been produced at the expense of the prospecting and development necessary to the sustained economic operation of a mine. The availability of labor will not make up for depletion of reserves some time will elapse before development can bring the industry to a normal position in relation to actual mining. Certain countries could fill the demand for new lead for a considerable time, but the past experience on foreign lead is expected to continue to an increasing extent as resources are drained further.

Imports.—Postwar readjustments of international trade will be accompanied by an inevitable competitive world market for lead. The smelting countries—particularly those which are dependent on imported ore, such as France, Belgium, and the Netherlands—will be actively seeking for such raw material in the countries that were the source for much of our supply during the war. In all probability such supplies as we may need will come from the Western Hemisphere—principally Mexico. The refined lead, as indications point to the production of lead being absorbed by expanded industry at home and abroad elsewhere than the United States. Any future trade agreements, of course, will have its effect upon the flow of lead into the United States and upon domestic production.

Consumption.—The pent-up consumer demand for lead in the immediate postwar period will result in an annual consumption of new lead as metal and in ore of at least 500,000 tons for some years. Aside from the large potential consumption in storage batteries and tetraethyl for the forthcoming resumption of automobile manufacture and their operation, the quantity of lead required for the production of lead-acid storage

for postwar construction at home and reconstruction abroad will go far toward balancing the decreased use for direct military purposes.

Price.—Bonuses and premiums probably will be dropped eventually and prices freed of all control and allowed to return to a condition of normal fluctuations in a competitive market. In the absence of control, the price for lead immediately after the war may rise above the established wartime ceiling, but it is probable—taking the longer-term view—that the price will be lower than at present, although not as low as the general prewar level. Assuming that some tariff protection will remain in force, the factors of demand by consumers and higher production cost to smelters and refiners will tend to keep the price on a plane relative to an expected generally higher-cost level for all commodities. The marked reduction in stocks during 1944 has largely precluded any possibility of postwar dumping of excess inventories of lead on the market with a resultant depressing effect upon the price. Further protection against such a possibility is given by the Surplus Property Act of 1944, which provides for stock-piling excess materials owned by the Government.

DOMESTIC PRODUCTION

Pig lead is produced at primary plants that treat ore, base bullion, and small quantities of scrap and at secondary plants that process scrap exclusively. Both types of 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. Figures for the production of refined lead and alloys at secondary plants are given in the section on Secondary Lead. The 17 smelters and refiners in the United States canvassed in 1944 (including one smaller smelter which reported for the first time) consumed 477,765 short tons (lead content) of ore, only 15 percent of which originated in foreign countries.

REFINED LEAD

Despite the continuing labor shortage, the 10 primary refineries in the United States were able to produce 476,131 tons of refined lead 1 percent above the 1943 output of 471,475 tons.

Refined lead produced at primary refineries in the United States, by sources, 1940-44, in short tons

Source	1940	1941	1942	1943	1944
Refined lead:					
From domestic ores and base bullion	433,065	470,517	407,367	406,544	394,111
From foreign ores	83,663	74,166	81,485	62,938	70,211
From foreign base bullion	10,551	20,284	17,987	1,132	11,111
Total from primary sources	527,279	564,967	506,839	469,612	475,433
From scrap	16,588	13,454	12,850	1,863	11,111
Total refined lead	543,867	578,421	519,689	471,475	486,544
Average sales price per pound	\$0.050	\$0.057	\$0.063	\$0.064	\$0.064
Total calculated value of primary refined lead	\$53,318,000	\$65,090,000	\$71,422,000	\$60,110,000	\$59,490,000

¹ Revised figure.

² Excludes value of refined lead produced from scrap at primary refineries.

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Of the 464,763 tons of primary lead produced and base bullion supplied 85 percent, and 15 percent foreign ores and imported base bullion. In 1944, 15 percent domestic and 13 percent foreign. A quantity of refined lead produced from foreign ores is negligible. Imports of this material, from Mexico, are only a few tons. This suggests that practical production of base bullion (a large proportion of the total) to the United States each year before 1942) comes from Mexico. The following table gives the production of lead by country of origin of the ore. Details of the domestic ores are given in the section on Mine

Refined primary lead produced in the United States, by sources, 1940-44, in short tons

Source	1940	1941
Domestic ore and base bullion	433,065	470,517
Foreign ore:		
Australia	14,856	10,551
Canada	9,099	5,708
Europe	3,850	123
Mexico	1,303	390
South America	34,744	27,173
Other foreign	20,001	21,211
Total foreign	83,663	74,166
Foreign base bullion:		
Australia		831
Mexico	16,161	25,358
South America		47
Other foreign	300	46
Total foreign	16,561	25,284
Total foreign	100,114	100,450
Grand total	533,179	570,967

Revised figures.

ANTIMONIAL LEAD

Antimonial lead production at primary refineries was 57,902 tons in 1944. The distribution of this production is given in the following table, according to source. The lead content recovered from scrap in 1944 was 1.1 percent, largely to the greater quantity of battery lead scrap. The specific production of antimonial lead showed an increase for the first time since 1940. This increase to 8.1 percent antimony in 1944 is the decrease in small-arms ammunition and consequent smaller demand for the lower price used for bullet core rod. In addition to antimony, a byproduct of the process of refining base bullion was obtained from smelting antimonial materials. Production data from lead-smelting materials exclusively are summarized in the following table. Discussed in detail in the chapter on Secondary Lead.

Antimonial lead produced at primary lead refineries in the United States, 1940-44

Year	Production (short tons)	Antimony content		Lead content by difference (short tons)			
		Short tons	Percent	From domestic ore	From foreign ore	From scrap	Total
1940.....	29,762	2,944	9.9	7,364	3,023	16,431	26,818
1941.....	40,237	3,510	8.7	14,852	8,013	13,862	36,727
1942.....	51,762	3,524	6.8	24,512	12,165	11,561	48,238
1943.....	63,515	3,371	5.3	16,674	10,593	32,887	60,144
1944.....	57,902	4,670	8.1	13,280	5,477	34,475	53,232

¹ Revised figures.

SECONDARY LEAD

Although some scrap lead is treated at primary smelters and refineries, the greater part is received at a large number of plants that treat secondary materials exclusively. Secondary lead is recovered in the form of refined lead, antimonial lead, and other alloys. Recovery at primary and other plants in 1943 and 1944 is shown in the following table. Secondary lead recovered in 1944 was 3 percent less than in 1943 and was equivalent to 71 percent of the total refined primary lead produced in the United States. Further details appear in the chapter on Secondary Metals—Nonferrous.

Secondary lead recovered in the United States, 1943-44, in short tons

	1943 ¹	1944
As refined metal:		
At primary plants.....	1,863	11,368
At other plants.....	56,459	43,678
	58,322	55,046
In antimonial lead:		
At primary plants.....	32,887	34,475
At other plants.....	144,040	146,343
	176,927	180,818
In other alloys.....	108,845	95,583
Grand total:		
Short tons.....	342,004	331,447
Value.....	\$43,788,000	\$42,421,100

¹ Revised figures.

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 lead ore and metal. Details of the production of lead pigments and salts are given in the chapter on Lead and Zinc Pigments and Zinc Salts.

MINE PRODUCTION

The mine production of recoverable lead (including that made in lead pigments) in the United States and Alaska decreased 8 percent in 1944 and was 16 percent under the war-period peak reached in 1943. Of the 23 States and Alaska where lead is commonly produced, 11 States and Alaska showed a decline in output, 7 States recorded

gain, 1 remained the same, and 1 showed no production in any consecutive year. The reason for the decline was primarily a critical shortage of manpower.

Mine production of recoverable lead in the United States, 1940-44, by States, in short tons

State	1925-29 (average)	1940	1944
Western States and Alaska:			
Alaska.....	982	779	10
Arizona.....	9,743	13,268	15
California.....	2,070	1,772	3
Colorado.....	30,112	11,476	12
Idaho.....	141,610	104,834	104
Montana.....	18,871	23,036	21
Nevada.....	9,807	7,499	9
New Mexico.....	6,730	3,822	4
Oregon.....	6	35	1
South Dakota.....	21	7	1
Texas.....	213	205	1
Utah.....	140,569	76,088	69
Washington.....	1,323	2,555	3
Wyoming.....			
	370,997	244,974	246
Central States:			
Arkansas.....	38	55	2
Illinois.....	552	1,508	2
Kansas.....	26,121	11,027	14
Kentucky.....	135	360	1
Missouri.....	202,240	172,052	165
Oklahoma.....	58,306	21,240	25
Wisconsin.....	1,745	445	1
	289,137	207,587	209
Eastern States:			
New York.....		1,973	2
Tennessee.....	250	573	1
Virginia.....	3,846	2,286	1
	4,096	4,831	5
	664,230	457,392	461

Lead mining is centered largely in three States: Missouri; the Tri-State area (Joplin region), consisting of Missouri, Southeastern Kansas, and Northwestern Oklahoma; and the Western States (principally Idaho, Utah, and Montana). Of the total produced in the United States, the part is supplied from a relatively small number of producing areas. The Southeastern Missouri district continued to be a producing area, supplying 41 percent of the total production despite a 5-percent decline from 1943. The production from this district, as in the past, came from the Joseph Lead Co. The Tri-State area—principally the Joplin district in the United States—supplied 7 percent of the total lead output compared with 8 percent in 1943. The producer in the region was the Eagle-Picher Co. The Western States contributed 50 percent of the total production in 1944, Idaho being the largest producer and second-largest in the United States, notwithstanding a decline of 13 percent. Ten properties in Idaho contributed 75 percent of the State total lead output, and 90 percent of this was from zinc-lead ore and old tailings.

principally from lead ore. Utah again ranked second among the Western States and third in the United States, although the output of 52,519 tons of recoverable lead was 20 percent less than in 1943 and the lowest production since 1921. The United States & Lark property in the Bingham district, operated by the United States Smelting, Refining & Mining Co., was by far the largest lead producer in the State. In Arizona, four mines furnished two-thirds of the State total lead output which advanced 22 percent above that for 1943. One-half of the production from Colorado and Montana came from three mines in each of these States. Additional details on production by mines and districts can be found in the State chapters.

Mine production of recoverable lead in the United States, by districts that produced 1,000 tons or more during any year, 1940-44, in short tons

District	State	1940	1941	1942	1943	1944
Southeastern Missouri region.	Missouri	160,893	164,342	197,291	170,012	169,222
Coeur d'Alene region.	Idaho	95,600	95,520	106,474	89,813	76,812
West Mountain (Bingham)	Utah	37,857	34,512	30,996	35,437	31,199
Joplin region.	Kansas, Southwestern Missouri, Oklahoma.	35,311	41,080	34,341	34,722	28,099
Park City region.	Utah	19,749	19,094	15,278	16,022	11,660
Leadville.	Colorado	794	1,112	3,348	4,950	5,793
Tintic.	Utah	6,536	9,424	10,176	8,261	6,319
Metaline.	Washington	2,495	3,810	4,553	4,581	5,278
Central.	New Mexico	3,245	3,902	3,026	3,571	4,428
Austinville.	Virginia	2,285	3,390	1,661	1,700	4,231
Old Hat.	Arizona	1,908	2,172	1,801	3,140	4,161
Floche.	Nevada	5,520	6,822	2,764	2,942	4,066
Warren.	Arizona	692	970	813	712	3,497
Warm Springs.	Idaho	5,050	5,334	3,783	3,635	3,355
Summit Valley (Butte)	Montana	8,859	8,630	7,206	3,290	3,261
Rush Valley.	Utah	4,760	4,168	3,088	3,505	2,901
Pioneer (Rico).	Colorado	1,028	2,525	2,282	2,569	2,828
Coso.	California	40	700	755	2,448	2,608
Pima (Sierritas, Papago, Twin Buttes).	Arizona	6	4	11	678	2,448
Hedderston.	Montana	50	967	2,200	2,350	2,438
Animas.	Colorado	2,471	3,045	2,124	2,657	2,226
Harshaw.	Arizona	4,581	5,541	6,132	3,496	2,213
Daybore.	Idaho	935	1,378	1,644	1,481	2,071
Kentucky—Southern Illinois.	Kentucky, Southern Illinois	1,860	2,638	2,540	2,199	2,048
Resting Springs.	California	870	2,581	4,044	2,938	1,800
St. Lawrence County.	New York	1,973	2,100	2,434	2,355	1,644
Magdalena.	New Mexico	65	424	804	1,320	1,530
Upper Mississippi Valley.	Iowa, Northern Illinois, Wisconsin	453	1,346	908	1,004	1,530
Red Cliff.	Colorado	1,412	1,710	2,240	1,761	1,444
Upper San Miguel.	do.	1,278	1,408	1,716	2,074	1,444
Smelter (Lewis and Clark County).	Montana	1,363	1,527	1,088	2,389	1,444
Big Bug.	Arizona	690	594	953	1,145	1,244
Eagle.	Montana	4,108	3,294	1,999	1,580	1,171
Wallapai.	Arizona	2,304	2,408	1,056	1,302	798
Montana.	Montana	955	1,501	1,025	509	285
Ophir.	Utah	5,364	1,437	1,623	1,481	285
Catact.	Montana	1,101	355	26	115	285
Barker.	do.	1,231	22	1,712	1,633	285
Port Hill.	Idaho	1,837	1,537	1,044	316	285
Hog Heaven.	Montana	3,588	2,824	614	.....	285

¹ Total for Virginia, but almost entirely from Austinville district.

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 so

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lead, plus foreign lead smelted and refined in the United States, entered for domestic consumption. According to reports released by the American Bureau of Metal Statistics, stocks of refined lead and antimonial lead fluctuated during the first 4 months of 1944, but for the remainder of the year they moved downward. From 27,996 tons on hand at the end of 1943, stocks advanced to a year-end total of 33,096 tons on January 31. This increase to 37,590 tons on January 31. This increase to 34,379 tons by the end of March, with a further increase to 39,830 tons on May 1, the highest point reached. From the remainder of 1944 stocks steadily declined, ending the year with a minor increase at the end of November, being 19,536 tons, a net decrease of 41 percent from the end of 1943.

Lead stocks at end of year at smelters and refineries in short tons

	1940	1941	1942	1943	1944
Refined pig lead.	32,458	15,468	15,468	15,468	15,468
Antimonial lead.	4,928	20,000	20,000	20,000	20,000
Lead in base bullion—					
At smelters and refineries.	9,166	8,467	8,467	8,467	8,467
In transit to refineries.	3,457	2,171	2,171	2,171	2,171
In process at refineries.	18,141	17,000	17,000	17,000	17,000
Lead in ore and matte and in process at smelters.	30,764	28,000	28,000	28,000	28,000
	143,412	100,000	100,000	100,000	100,000

The results of the Bureau of Mines annual survey of smelters and refiners showed stocks of 36,464 tons of refined lead and 16,788 tons of antimonial lead at the beginning of 1944. At these same plants antimonial lead stocks were 16,788 tons (lead content) at the beginning of 1944. In terms of lead content, stocks of ore and refined lead (including 1 small plant not covered in the survey) declined 19 percent from 50,935 tons to 41,480 during 1944. Inventory of base bullion at refineries that receive raw material and at smelters that produce base bullion totaled 8,110 tons at the beginning of 1944. Stocks of refined lead at the end of December 1944. Stocks of refined lead or work lead at 5 combination smelters not included in reports to the Bureau of Mines can be made between these data and the Bureau of Metal Statistics. Figures reported by the Bureau represent physical inventory at the ownership, and do not include material in process. *Consumers' stocks.*—According to reports of the Bureau of Metal Statistics, stocks of refined lead at the end of December 31, 1944, a 22-percent decline from the end of 1943.

Consumers' stocks of refined soft lead at the end of 1943 and 1944, by grades, in short tons

	Domestic and foreign					Foreign (all grades)
	Corrod- ing	Chem- ical	Com- mon	Other	Total	
Dec. 31, 1943	25,891	18,892	65,921	4,448	115,152	13,291
Dec. 31, 1944	28,789	13,680	44,425	2,839	89,743	10,702

¹ Revised figures.

Government stocks.—In addition to industry-owned stocks, a sizable though diminishing supply of Government-owned lead was held at various depots throughout the United States for release through allocation to consumers as needed. According to reports submitted to the Tin-Lead-Zinc Division of the War Production Board, Government stocks totaled 90,454 tons of refined lead on December 31, 1944, compared with 173,875 tons of refined lead on January 1, 1944.

DOMESTIC CONSUMPTION

A survey of 570 plants in 1944 (530 (corrected figure) in 1943) representing an estimated 90 percent of the consumers of refined lead showed a total consumption of 722,820 short tons of refined lead, a gain of 7 percent over 1943. Some secondary as well as primary refined lead is included in this figure. Antimonial lead, unrefined scrap lead, and lead in alloys are excluded. The additional number of plants covered in the 1944 survey include for the most part small consumers that did not report in previous years. The lead consumed by these plants was small in relation to the total and does not measurably affect the trends indicated by comparison with the 1943 data.

Of the total consumed, 22 percent was used to make red lead and litharge, 15 percent for cable covering, 11 percent for tetraethyl, 10 percent for storage batteries, 4 percent for sheet lead, 4 percent for ammunition, and the remaining 34 percent for a variety of products and uses shown in the accompanying table.

Consumption of refined lead in the United States, 1941-44, by uses, in short tons

	1941	1942	1943	1944
Ammunition	32,959	48,025	64,023	31,479
Bearing metals	10,160	8,466	10,189	15,941
Brass and bronze	(¹)	5,294	5,748	7,845
Cable covering	141,161	128,535	117,802	110,417
Calking lead	32,380	9,047	8,618	9,411
Casting metals	9,243	3,100	3,072	4,425
Collapsible tubes	3,726	9,066	11,425	12,483
Foil	51,516	9,350	5,816	11,190
Pipe, traps, and bends	32,946	21,411	18,724	24,587
Sheet lead	35,480	11,700	27,738	31,545
Solder	35,630	13,371	15,472	22,390
Storage batteries	73,982	62,604	68,239	68,769
Tenne plate	2,069	2,336	815	2,100
Type metals	2,975	943	812	1,260
White lead	83,230	50,476	30,809	54,338
Red lead and litharge	143,496	100,563	124,715	157,080
Tetraethyl lead	48,327	50,152	65,320	35,067
Chemicals and insecticides	8,861	6,208	8,172	10,703
Annealing	(¹)	5,229	5,987	5,719
Galvanizing	(¹)	484	810	1,073
Lead plating	(¹)	(¹)	941	494
Weights and ballast	(¹)	(¹)	9,260	22,904
Other	64,606	33,740	64,940	33,642
Total	812,647	607,111	675,465	722,820

¹ Included under "Other."

LEAD

A distribution of the total consumed by percent consumed for metallic products, 31 percent in chemicals, and 5 percent in miscellaneous uses, including annealing, galvanizing, lead plating, and weights. Reports to the Tin-Lead-Zinc Division of the War Production Board indicate that the consumption of primary refined lead totaled 1,119,000 tons in 1944 compared with 1,119,000 tons in 1943.

The following table shows the calculated refined primary lead to domestic consumers. The total consumption of 775,095 tons in 1944 are probably more than the actual receipts of 697,411 tons reported by the Tin-Lead-Zinc Division of the War Production Board, because of incomplete coverage of the survey.

Apparent shipments of refined primary pig lead to domestic consumers, in short tons

	1940	1941
Supply:		
Stocks at primary refineries on Jan. 1	(¹)	(¹)
Government-owned stocks on Jan. 1	(¹)	(¹)
Production	533,179	570,179
Imports	149,889	274,179
Total available	683,068	844,358
Withdrawn:		
Stocks at primary refineries on Dec. 31	(¹)	(¹)
Government-owned stocks on Dec. 31	(¹)	(¹)
Exports	49,079	14,179
Total withdrawn	49,079	32,179
Apparent shipments to domestic consumers	633,989	812,179

¹ Official figures not available.

² Estimate based upon American Bureau of Metal Statistics data.

³ According to reports submitted to the Tin-Lead-Zinc Division of the War Production Board.

⁴ Revised figure.

⁵ Includes 25,324 tons of foreign refined lead reexported, according to American Bureau of Metal Statistics data.

⁶ Includes 3,874 tons of foreign refined lead reexported in 1942 and 1943, according to American Bureau of Metal Statistics data.

PRICES

The two major markets for lead in the United States are New York and St. Louis; much of the lead produced in the United States is sold in these two markets. Prices normally based upon quotations in the London Metal Exchange dealing in lead. The London market has had no direct influence on the domestic market and the differential between St. Louis and New York has remained at 0.15 cent a pound, an amount approximately equal to the charges between the two points.

The ceiling price for common lead—6.35 cents a pound, New York—remained unchanged in 1944. For comparison it is of interest to note that the price received by the primary producers for all grades of refined lead (including antimonial lead) sold in 1944 was 6.4 cents a pound, the same as in 1943. The 1944 price of 8.0 cents a pound in the separate State chapters, represents the price received for refined lead plus the increment per pound based upon the total domestic mine production of \$13,745,815 in overquota premiums and discounts paid by the Metals Reserve Company.

The Premium Price Plan, whereby producers (miners) of lead (copper and zinc were also included in the plan) receive increments above the ceiling price (through Metals Reserve Company) for over-quota production, was maintained throughout 1944. As the plan is operative only until July 31, 1945, Congress passed the Hayden-McFarland bill, S. 502, on June 14, 1945, to extend the time limit to June 30, 1946. More complete details of the scope of the Premium Price Plan—which was effective February 1, 1942—can be found in the chapter on Lead in Minerals Yearbooks for 1942 and 1943. In May 1945 the Office of Price Administration released a comprehensive compilation of data showing production of copper, lead, and zinc under the Premium Price Plan since February 1942, at the various quota levels and the payments made. The salient statistics from this report, with reference to lead, are given in the following table.

Salient statistics on lead with regard to the operation of the Premium Price Plan, 1942-44

	1942 ¹		1943		1944	
	Tri-State district	United States exclusive of Tri-State	Tri-State district	United States exclusive of Tri-State	Tri-State district	United States exclusive of Tri-State
Total production of recoverable lead ² short tons.....	30,746	416,310	34,830	409,170	28,056	381,060
Ceiling production at 6.50 cents a pound.....do.....	10,811	358,447	1,863	294,001	3,138	200,619
Percent of ceiling production to total production.....percent.....	35.10	86.10	5.35	71.85	10.84	52.65
Production under Premium Price Plan:						
"A" quota (9.25 cents a pound) short tons.....	19,700	56,321	26,269	83,023	19,404	142,925
"B" quota (12.00 cents a pound).....do.....	235	1,542	6,514	32,146	5,633	37,516
Total premium production.....do.....	19,935	57,863	32,773	115,169	25,127	180,441
Metals Reserve Company mine contracts.....do.....			101		691	
Total overceiling production.....do.....	19,935	57,863	32,967	115,169	25,818	180,441
Percentage of overceiling production to total:						
Production under Premium Price Plan:						
"A" quota.....percent.....	64.07	13.53	75.39	20.29	67.32	37.51
"B" quota.....do.....	0.77	0.37	18.70	7.86	19.45	9.84
Total premium production.....do.....	64.84	13.90	94.09	28.15	86.77	47.35
Metals Reserve Company mine contracts.....percent.....			0.56		2.39	
Total overceiling production.....do.....	64.84	13.90	94.65	28.15	89.16	47.35
Payments under Premium Price Plan: ³						
"A" quota.....dollars.....	1,096,435	3,182,450	1,802,407	6,334,273	1,381,983	9,924,261
"B" quota.....do.....	12,910	81,789	368,270	1,708,050	809,813	2,003,364
Total premium production.....do.....	1,109,345	3,264,239	2,160,776	8,042,323	1,991,796	11,927,625
Metals Reserve Company mine contracts.....dollars.....			10,127		60,394	
Total overceiling payments.....do.....	1,109,345	3,264,239	2,176,903	8,042,323	1,758,190	11,987,625
Average prices per pound of lead: ⁴						
Average premium production.....cents.....	0.252	0.323	0.797	10.018	9.806	9.822
Metals Reserve Company mine contracts.....cents.....			10.651		11.307	
Total overceiling production.....do.....	0.282	0.323	9.802	10.018	9.905	9.822
Total production.....do.....	8.304	6.802	9.625	7.490	9.530	8.077

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

² Production of Tri-State lead from Metals Reserve Company agency, Joplin, Mo., all other from Bureau of Mines monthly reports. These data are preliminary and do not exactly equal final annual totals for the United States.

³ Data on premium payments and Metals Reserve Company mine contract payments from Metals Reserve Company. All payments shown are subject to correction due to additional payments as a result of retrospective quota adjustments, late reports by smelters and custom mills, etc.

⁴ All average prices shown include Office of Price Administration ceiling price of 6.50 cents a pound for lead.

LEAD

The official London maximum price of lead for Empire and foreign lead, remained unchanged.

Average monthly and yearly quoted prices of lead, London, 1942-44, in cents per pound

Month	1942				St. Louis
	St. Louis	New York	London	St. Louis	
January.....	6.12	6.27		6.35	
February.....	6.35	6.50		6.35	
March.....	6.35	6.50		6.35	
April.....	6.35	6.50		6.35	
May.....	6.35	6.50		6.35	
June.....	6.35	6.50		6.35	
July.....	6.35	6.50	(¹)	6.35	
August.....	6.35	6.50		6.35	
September.....	6.35	6.50		6.35	
October.....	6.35	6.50		6.35	
November.....	6.35	6.50		6.35	
December.....	6.35	6.50		6.35	
Average.....	6.33	6.48	(¹)	6.35	

¹ St. Louis: Metal Statistics, 1944, p. 477. New York: Metal Statistics, 1944, p. 477. London: London Metal Exchange dealings suspended for duration of war. British Ministry of Supply at £26 in December 1939.

FOREIGN TRADE

Imports.—During 1944 imports of lead were virtually the same as in 1943—but considerably less than in 1942. The greater part of the total imports of 1942, as usual, but a substantial tonnage marked drop in the quantity from Mexico in that country due to the strike against the railways from June 8 to August 11 and to the closing of the railroads and rolling stock, which prevented the flow of lead from the mines to the smelters. Receipts from Mexico, which constituted 30 percent of the total imports in 1942, were higher than in 1943 owing largely to a marked decline from Australia, Newfoundland, and Peru. A substantial decline from Africa and Bolivia. Imports from the United States dropped to only a few tons, owing to the receipts of this material from Australia. Imports from Mexico 53 percent, Peru 20, New Zealand 10, compared with 68, 7, 4, and 10 percent in 1943.

¹ Figures on imports and exports compiled by M. B. Price, of the U. S. Department of Commerce.

Total lead imported into the United States in ore, matte, base bullion, pigs, bars, and reclaimed, 1940-44, by countries, in short tons¹

Country	1940	1941	1942	1943	1944
In ore and matte:					
Africa.....	7,586	575	3,879	10,438	3,48
Argentina.....	10,400	13,374	4,582		
Australia.....	17,472	22,634	20,997	19,743	28,7
Bolivia.....	2,707	7,314	1,382	7,012	1,0
Canada.....	8,696	6,725	7,487	6,828	10,4
Chile.....	0,271	1,384	3,100		4,2
Mexico.....	1,804	5,770	2,358	2,931	3,8
Newfoundland.....	27,503	17,669	23,051	13,473	32,2
Peru.....	18,383	6,665	11,168	3,420	11,2
United Kingdom.....	3,498	175		172	
Other countries.....	881	930	302		
	111,300	82,115	70,302	70,023	95,2
In base bullion:					
Australia.....		835	42,900	3,846	
Mexico.....	19,009	23,726	56	639	
Peru.....	179	58	16	94	
Other countries.....	436	85	883	4	
	19,624	24,704	43,855	4,683	
In pigs and bars:					
Australia.....	4,200	43,031	83,362	8,904	
Canada.....	50	89,835	60,210	10	
Mexico.....	128,680	99,950	192,044	214,865	167,7
Peru.....	18,452	40,773	21,891	20,158	54,4
Other countries.....	100				
	151,548	274,189	366,407	244,033	222,7
In reclaimed, scrap, etc.:					
Australia.....			1,390		2,5
Canada.....	4	52	1,292	348	
Panama, Republic of.....	1	4	5	128	
Peru.....	15	95	57	1	
Other countries.....		55	7		
	20	206	2,757	477	3,0
	282,402	381,214	492,471	310,115	321,2

¹ Data include lead imported for immediate consumption plus material entering the country under bond for export.
² United Kingdom of Great Britain and Northern Ireland.

Lead¹ imported for consumption in the United States, 1940-44, by forms in which imported

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		
1940.....	70,027	\$4,650,445	9,992	\$920,046	30,882	\$2,200,075	201	\$36,444	\$12,046	\$7,910
1941.....	82,345	5,343,577	17,570	1,743,350	325,999	23,403,290	47	15,812	19,389	30,682
1942.....	87,377	5,715,251	48,589	4,285,425	387,603	32,328,330	20	7,000	4,690	42,475
1943.....	83,153	5,590,218	4,511	557,545	244,033	20,903,382	25	20,208	5,219	27,131
1944.....	100,723	6,741,418	262	29,346	223,379	22,793,430	40	39,572	547	29,902

¹ In addition to quantities shown (values included in total values), "reclaimed, scrap, etc.," imported follows—1940: 24 tons, \$3,917; 1941: 1,331 tons, \$57,353; 1942: 1,305 tons, \$137,393; 1943: 496 tons, \$56,158; 1944: 3,313 tons, \$208,458. Figures for 1942, 1943, and 1944 include foreign lead received by the Government held in stock piles.

Miscellaneous products, containing lead, imported into the United States, 1940-44

Year	Babbitt metal, solder, white metal, and other combinations containing lead		
	Gross weight (short tons)	Lead content (short tons)	Value
1940.....	1,368	429	\$1,020
1941.....	702	241	711
1942.....	971	274	80
1943.....	230	69	330
1944.....	26	18	17

Exports.—Under the restrictions of the War Relocation Authority, exports of pig lead in 1944 continued to total 15,523 tons exported, 92 percent went to the Republics. Reexports of foreign refined lead amounted to less than 1 ton.

Lead exported from the United States, 1940-44

Year	Pigs and bars		Foreign lead exported in manufactures with benefit of draw-back	Year
	Short tons	Value		
1940.....	23,755	\$1,794,590	15,604	1943.....
1941.....	14,359	1,169,148	21,953	1944.....
1942.....	1,940	285,354	20,248	

Data not available.

Lead exported from the United States, 1940-44

Destination	1940 ¹
Countries:	
Brazil.....	1,555
Chile.....	49
China.....	51
Colombia.....	18
Cuba.....	27
Finland.....	11
France.....	1,120
Hungary.....	43
Japan.....	11,955
Kwantung.....	33
Netherlands.....	2,35
Panama.....	53
Philippine Islands.....	45
Portugal.....	63
Sweden.....	30
U. S. S. R.....	
United Kingdom.....	
Uruguay.....	35
Venezuela.....	24
Other countries.....	1,88
Total.....	23,75

Continents:	
North America.....	86
South America.....	3,07
Europe.....	6,40
Asia.....	13,38
Africa and Oceania.....	2

In addition, 25,324 tons of foreign lead were reexported, according to figures not available.

In addition, 8,874 tons of foreign lead were reexported in 1944 to the United Kingdom of Great Britain and Northern Ireland.

WORLD ASPECTS OF THE LEAD INDUSTRY

The rapid succession of events in 1944 and early 1945, culminating in the unconditional surrender of Germany in May 1945, opened the door to revealing greater detail regarding the lead industry in foreign countries than had been available since 1939. Censorship restrictions—imposed for reasons of security—have been removed by the governments of most of the lead-producing countries, and unrestricted information regarding European countries formerly under Axis control is beginning to flow by way of official channels. Nevertheless, it is not yet possible to present a complete picture of world production and consumption of lead during the years of the European phase of the war. The lead position of the United Nations was satisfactory in 1944, and, although consumption probably did gain somewhat, this increase was accomplished at the expense of accumulated stocks owing to an indicated over-all decline in production.

World production of lead, 1938-44, in metric tons¹
(Compiled by D. B. Waldbauer)

Country	1938	1939	1940	1941	1942	1943	1944
Argentina.....	10,200	14,000	12,864	18,021	20,760	23,800	18,161
Australia.....	226,155	269,590	275,000	(?)	(?)	(?)	(?)
Belgium.....	94,170	82,000	85,000	20,000	(?)	(?)	(?)
Burma.....	80,166	77,220	83,000	(?)	(?)	(?)	(?)
Canada.....	181,783	172,880	189,662	201,976	220,726	203,656	130,400
China.....	2,000	(?)	(?)	(?)	1,315	1,179	(?)
Chosen.....	10,000	(?)	(?)	(?)	(?)	(?)	(?)
Czechoslovakia.....	5,000	(?)	(?)	(?)	(?)	(?)	(?)
France.....	41,753	42,000	20,000	10,000	(?)	13,724	4,000
Germany.....	171,700	181,400	200,000	225,000	(?)	(?)	(?)
Austria.....	9,280	4,925	(?)	(?)	(?)	(?)	(?)
Greece.....	6,050	(?)	(?)	(?)	(?)	(?)	(?)
Hungary.....	150	(?)	(?)	(?)	(?)	(?)	(?)
Indochina.....	10	5	(?)	(?)	(?)	(?)	(?)
Italy.....	43,287	38,102	35,000	(?)	(?)	(?)	(?)
Japan.....	12,000	12,000	15,000	17,000	(?)	(?)	(?)
Mexico.....	273,529	213,675	191,980	151,167	192,989	212,452	178,200
Northern Rhodesia.....	277	163	263	378	(?)	(?)	(?)
Norway.....	323	321	(?)	(?)	(?)	(?)	(?)
Peru.....	28,478	24,310	31,131	32,871	37,915	43,171	38,000
Poland.....	19,073	(?)	23,000	25,000	(?)	(?)	(?)
Romania.....	5,655	6,100	(?)	(?)	(?)	(?)	(?)
South-West Africa.....	3,214	4,283	600	(?)	(?)	(?)	(?)
Spain.....	31,809	25,991	45,991	46,865	41,149	36,760	34,700
Tunisia.....	23,916	23,421	(?)	(?)	(?)	(?)	(?)
Union of South Africa.....	19	11	(?)	(?)	(?)	(?)	(?)
U. S. S. R.....	68,490	74,800	75,000	(?)	100,000	125,700	(?)
United Kingdom.....	10,000	(?)	(?)	(?)	(?)	(?)	(?)
United States (refined) ²	330,963	404,257	408,675	494,123	497,908	425,003	421,000
Yugoslavia.....	8,646	10,652	(?)	(?)	(?)	(?)	(?)
	1,700,000	1,734,000	(?)	(?)	(?)	(?)	(?)

¹ By countries where smelted, but not necessarily refined.

² Data not yet available; estimate included in total in 1939.

³ Approximate production.

⁴ Unoccupied China.

⁵ Exclusive of secondary material (Metallgesellschaft, Frankfurt on the Main).

⁶ Includes small tonnage of lead contained in exported ore and concentrates. Separate figures not available.

⁷ Figures cover lead refined from domestic and foreign ores; refined lead produced from foreign base bullion not included.

REVIEW BY COUNTRIES

Argentina.—The Aguilar mine of the Compañía Minera Aguilar S. A., subsidiary of the St. Joseph Lead Co., continued to be the leading producer in 1944. Lead concentrates totaling 37,887 metric tons, containing 75 percent lead, were produced in Argentina in 1944, of which approximately 35,000 tons were from Aguilar.

Australia.—A shortage of manpower in the lead industry during 1944. A reduction of the amount of ore treated by the Zinc Corporation—labor—was counter-balanced to some extent by the grade. Although normal exploration was sacrificed to meet production requirements, production remained at roughly 4,000,000 tons, averaging 14.3 percent lead. The problem of maintaining production caused much concern. The lead content of the 1944 was reported to total 75,834 short tons in 1943.

Mount Isa Mines, Ltd., is reported to have lead-zinc ore in reserve averaging 8.6 percent lead. This total excludes a much larger tonnage of low as 4 percent lead, which is not of commercial conditions.

Production data are being released but official figures had not been received in 1945. Data from an unofficial source indicate production of lead in Australia was 197,000 tons in 1943).

Bolivia.—Mine production of lead in 1943 totaled 130,400 metric tons (lead content) in 1943 to 1944, and concentrates are exported, some going to the United States. Again because of an increase in prices of metals, the difficulty of transporting ores from the mines near Lake Titicaca, owned by Compañía Boliviana, has as of 1944—some 4,000,000 metric tons containing an average of 18.7 percent lead, 1.75 ounces of silver, and 1.75 ounces of copper.

Brazil.—A new lead smelter was built at Panelas, State of Paraná. The plant has a sintering hearth, a No. 4 Mace process refinery with a capacity of 20 metric tons per day. This smelter is the second to be constructed. The Apiai plant, which had a capacity of 100,000 metric tons of refined lead, shut down in October 1944. Although a new refinery is reported under construction.

Burma.—The famous Bawdwin lead mine, before the war produced 80,000 tons of lead, was recaptured from the Japanese early in 1945. Of the mine the property was bombed and the reserves last reported before the war are remaining to this centuries-old mine, due to its reopening if damage is found to be serious.

Canada.—Mine production of lead in 1944 totaled 222,030 short tons (revised) in 1943 to 1944. The output of refined lead in 1944 was 224,493 tons in 1943. The production of lead was from the United Mining & Smelting Co., which operates a smelter and electrolytic lead refinery at Columbia.

In 1943 a 250-ton mill was reportedly to be built at the Sherbrooke, Quebec, property of the Aldermac Mining Corp. Production was begun at the completed mill in July 1944, on ore averaging 7 percent zinc, 2.5 percent copper, 2 percent lead, and containing some gold and silver.

In July 1944 the Department of Munitions and Supply announced suspension of operations at four high-cost lead-zinc properties which had been producing for the Metals Reserve Company, an agency of the United States Government. The labor and materials formerly utilized at these properties, the Twin "J" mines, Duncan, British Columbia, Kootenay-Florence mine, Ainsworth, British Columbia, Lake Geneva mine at Benny Siding, Ontario, and Tetreault mines, Notre Dame des Anges, Quebec, have been released for more urgent needs.

France.—The lead-smelting industry in France depends largely on imported ores, but in recent years new mines have been developed, and the output of lead concentrates has shown an increase. Production of lead (content of lead in ores and concentrates) from 1938 through 1944, in metric tons, was as follows:

Year	1938	1939	1940	1941	1942	1943	1944
Production.....	4,220	5,410	2,440	3,870	5,770	5,471	3,320

In 1943 Germany ordered France to increase mine production up to 1,000 tons a month, but the policy of the French was to reduce output when possible and divert labor for development, thereby producing less lead for export to Germany. The lead smelter at Ceilhes was taken over by Société Minière et Métallurgique de Penarroya and reopened at the end of 1944, but operation of the plant will depend upon the obtaining of imported lead concentrates and the availability of coke.

French Morocco.—Production of lead from 1940 through 1944 was as follows, in metric tons:

Year	1940	1941	1942	1943	1944
Ore and concentrates.....	30,739	13,918	9,000	9,570	13,400
Lead content.....	22,132	10,020	6,500	6,800	9,200

Mexico.—Production of lead in Mexico declined from 218,126 metric tons (lead content in ore) in 1943 to 185,282 tons in 1944 due to circumstances unfavorable to mining. A general labor strike against some 140 mining and smelting companies was called on June 8 and was not completely settled until August 11. The Labor Minister announced that, with the strike settled, a general increase in mine production at most of the properties was expected. However, severe floods in the fall of 1944 interfered with mining operations and shipment of ore to smelters. The shortage of railway cars and the generally run-down condition of the railway system further complicated an already critical situation.

Newfoundland.—The mine production, in terms of lead content of all concentrates produced, amounted to 29,661 short tons in 1944,

compared with 32,940 tons in 1943. The bulk of the concentrates continued to go to the United States. *Peru.*—The lead content of concentrates produced in 1944 was estimated to be 52,501 metric tons, compared with 52,501 metric tons in 1943. This estimate is based upon reports from producing companies. Exports of lead from Peru in 1944 were largely to the United States—amounted to 56,000 and 11,195 tons of lead contained in ore, concentrates, respectively. Comparable totals for 1943 were 20,600 and 11,195 tons, respectively.

The greatest part of the lead produced in Peru is from complex gold-silver-lead-zinc ores mined by the Cerro de Pasco Copper Corp., Department of Junin. Cia Minera, an important producer of lead, reported that in 1944, averaging 13.5 percent zinc.

The Over-All Metals Agreement between the United States Government and the United States Commercial Company, effective as of July 1, 1944, was renewed on August 8, 1944, effective as of July 1, 1944, when the previous agreement expired. The latest agreement provides for the purchase by the United States Commercial Company of lead concentrates and electrolytic lead at the same price as established. The Peruvian Government was authorized in 1944, that 3 months after this date lead concentrates would be purchased at the rate of 10,000 metric tons. The Oroya lead smelter—which constitutes the progress of the mining industry in the country—produced 906 metric tons of lead in 1944 (43,171 tons of lead content). The percent of the lead produced at Oroya is derived from the Cerro de Pasco.

Spain.—Production of lead concentrates in 1944 amounted to 43,000 metric tons (47,913 tons of lead content). Output was 32,000 metric tons compared with 32,000 metric tons in 1943. The drop in output was due in part to interference from Germany. Owing to the great decline in lead production in the past decades, smelter capacity is about five times capacity. Changes are made in the internal economy of the country to continue to supply its own needs for lead, but this is of minor importance.

Sweden.—The completion of a new lead smelter in 1944 brings to four the number of plants in Sweden, with a total capacity amounting to a production of approximately 100,000 metric tons of lead annually. A new plant uses ore obtained from mines in the northern Province of Västerbotten. Lead concentrates were formerly shipped to Germany, but that before the war lead was not smelted in Sweden. S. S. R.—Official data from Russia have not been available for the past several years, but recent reports indicate that 10,000 tons of lead were produced in 1943.

LEAD AND ZINC PIGMENTS AND ZINC SALTS

By HELENA M. MEYER AND ALETHEA W. MITCHELL

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GENERAL SUMMARY

Further improvement in sales of lead and zinc pigments was evident in 1944 over the generally low performance of this group in 1942. Conditions that applied to the earlier war years continued in 1944. In large part these conditions included outstanding war requirements for many items and shortages of essential crude materials and of manpower. For several years sales of the various pigments have not indicated actual demands for any of the items, because all the pigments have been influenced by manpower shortages and all have been affected in varying degree by shortages of necessary primary and subsidiary crude materials. The crude materials used for certain pigments have been in more abundant supply than for others; as a result, during the war some pigments have benefited—temporarily at least—at the expense of others. In 1944 war needs took a preponderant share of total sales of pigments, with the proportion increasing over the earlier war years. Pigments manufacturers continued to be hampered by restrictions on supplies of linseed and other drying oils and of slab zinc, and by limitations on containers. At the end of the year consumers of lead for the manufacture of pigments for civilian requirements faced sharp cuts in the quantities of this metal that could be used. Late in 1944 it was announced that, effective January 1, 1945, the quantities of fats and oils for use in the manufacture of protective coatings, coated fabrics, and floor coverings for civilian consumption were to be reduced from 70 to 60 percent of the average quantities for 1940 and 1941. For over a year, producers had been trying to build their civilian accounts as a safeguard against prospective cancellation of war orders, but these efforts did not come to fruition in 1944. Late in the year supplies of paint, varnish, and lacquer materials were bolstered by limited releases of surplus stock

by some branches of the Government. As war demands as a whole did not indicate the maximum.

As in 1943, paint, varnish, and lacquer record rate; the 1944 total was 9 percent. These data, compiled by the United States, cover 680 establishments that contributed of the total value of the industry as reported for 1939. The value of sales totaled \$568,620,999 in 1943.

Trends in the supply-requirements position indicated in the chapter of this series for 1943. These trends were toward larger supplies for zinc and toward more stringent supplies for lead. Explained, in part, by the fact that lead is more expensive than zinc. As a consequence, more generous allowances had been made available for civilian use, and a movement had been given in the early part of the year for lead for some metals in relatively smaller quantities. The zinc situation continued into the third quarter, accompanied by a tendency toward zinc. Meanwhile, despite the fact that in 1944, ample supplies of metal were available for makers until late in the year. The four quarters brought military disappointments, caused by Government viewpoint regarding war requirements along many lines, and removed allowances of zinc discontinued, but controls were markedly by a revision of War Production Administration order and other orders that affect the situation are discussed later.

Record-breaking production and sales of lead and zinc pigments formally compete for markets supplied by the Government in 1944, but even the increase in production fell far short of supplying all requirements for civilian needs. The Bureau of Mines is the subject throughout 1944 to the restrictions on the feature of sales of lead and zinc pigments. The quantities of litharge and red lead sold in 1944, a consequence of this outstanding consumption of lead established new high rates of sale for 1943, and continued upward to 28,000 tons in 1943, and continued upward to 28,000 tons in 1944, plus smaller gains for lithopone and zinc sulfide more than offset the declines in red lead and zinc chloride purpose and reflected the record sales of raw materials in that year. Agricultural purposes high level in 1944 for the second year

it is possible to ascertain, sales of zinc sulfate for agricultural purposes were also at a new record rate in 1944. For the most part, sales of pigments for the manufacture of ceramics rebounded somewhat from the low rates that prevailed in 1942 and 1943, but white lead did not share in the gains. Use of zinc oxide in the manufacture of rubber receded in 1944 from the relatively favorable rate that prevailed in 1943; distribution of litharge for this purpose, which had been gaining in recent years, also declined.

Two articles¹ concerning experiments in connection with war uses of paints were recently published. The Bureau of Standards² issued a report which is the third and last of the series covering the investigation of pretreatments and paints for protecting plain and galvanized steel surfaces against corrosion.

Salient statistics of the lead and zinc pigments industry of the United States, 1939-44

	1939	1940	1941	1942	1943	1944
Production (sales) of principal pigments:						
White lead (dry and in oil).....short tons.....	98,429	80,562	113,000	83,639	76,167	85,726
Litharge.....do.....	80,518	80,841	122,280	91,513	113,091	138,203
Red lead.....do.....	39,976	42,200	53,838	48,869	63,378	63,972
Zinc oxide.....do.....	114,562	113,213	148,833	99,677	143,402	140,678
Lead zinc oxide.....do.....	42,684	45,362	68,920	48,128	43,828	64,398
Lithopone.....do.....	142,769	151,802	170,642	137,320	136,723	142,905
Value of products:						
All lead pigments.....	\$35,485,000	\$32,628,000	\$46,572,000	\$39,393,000	\$41,897,000	\$46,601,000
All zinc pigments.....	28,794,000	28,747,000	39,210,000	30,785,000	36,260,000	39,288,000
Total.....	64,279,000	61,375,000	85,782,000	70,178,000	78,157,000	85,889,000
Value per ton received by producers:						
White lead (dry).....	\$138	\$137	\$147	\$160	\$163	\$165
Litharge.....	123	126	134	150	162	146
Red lead.....	140	141	161	171	171	164
Zinc oxide.....	117	118	125	138	137	139
Lead zinc oxide.....	114	114	118	129	132	132
Lithopone.....	73	67	71	79	79	78
Foreign trade:						
Lead pigments:						
Value of exports.....	\$715,000	\$604,000	\$1,228,000	\$967,000	\$1,439,000	\$1,387,000
Value of imports.....	10,000	14,000	12,000	4,000	3,000	6,000
Zinc pigments:						
Value of exports.....	925,000	1,685,000	3,625,000	2,741,000	2,737,000	2,016,000
Value of imports.....	280,000	46,000	22,000	8,000	5,000	1,600
Export balance.....	1,360,000	2,119,000	4,719,000	3,686,000	4,168,000	3,395,500

WAR AGENCY REGULATIONS

Lead was subject throughout the year to the limitations imposed by War Production Board Order M-38. This order was strengthened markedly in December by revisions that were expected to reduce civilian consumption to about 60 percent of the 1944 rate. A further revision on January 15, 1945, placed the lead pigments covered by this report (except litharge for storage-battery manufacture which remained under Order M-38) under a new chemicals order, M-384.

¹Journal of the Franklin Institute, Exterior Paint on Temporary Army Buildings: Vol. 238, No. 1, December 1944, p. 455.

²The Paint Industry Magazine, Paint, Its Durability and Use Under Field Conditions: Vol. 60, No. 1, January 1945, pp. 18 and 20.

³National Bureau of Standards, Building Materials and Structures, Painting Steel: Rept. BM810, Oct. 16, 1944.

The sweeping M-384 order restricted the amount of white lead that could be put into process in any calendar quarter to not more than 25 percent of the white lead (not lead carbonate) of the first 6 months of 1944. Lead used in various pigments, was similarly affected. The red lead used in any calendar quarter in the production of primers, paints, and lacquers (including paste red lead) was limited to not more than 30 percent of the amount of red lead (not lead carbonate) similarly used in the first 6 months of 1944. That could be put into process in any calendar quarter for going purposes (including paste white lead) was limited to 25 percent of the quantity of white lead (not lead carbonate) of the base period. Ceramics manufacture for the first 6 months of 1944 consumed 25 percent of the amounts of lead consumed in each case there was the option to use 1,000,000 pounds of lead if the quantity were greater than the stated maximum. Inventory restrictions on white-lead consumption were in effect.

White lead is defined in the order as mean white lead or basic sulfate of white lead. Zinc metal is controlled by War Production Board Order M-11-b. Consumption restrictions on zinc metal were in effect in the summer of 1944, as was indicated in the summary of the tendency to ease the covering order. Military disappointments in the fall of 1944, subject to Order M-11-a, which was amended to restrict the use of reagent chemicals, cellulose nitrate, and toilet soap to the list of permitted uses. The type of paint in which lead-free zinc oxide, which had escaped control, was used was restricted by Order M-11-a in an amendment dated June 1, 1944. Order M-128, which referred to zinc sulfide pigments, was revoked in June 1944. Order M-353, was amended to include zinc metal in the list of permitted uses. July 1, 1944. Thus priority ratings of zinc metal for the purchase of all of these pigments were established, with the exception of material needed for the production of services, in which case such orders had no effect. Certification set forth in M-353. The order was amended in November to provide that only those ratings established by military certification would be given preference in the order.

POSTWAR OUTLOOK

The inability of pigments manufacturers to share of their business in 1943 and 1944, and the amounts of these products that will have to be produced, stated that deferred maintenance work, have been estimated as high as 100 percent. It is felt justified in predicting a rapidly expanding paint, and lacquer industry because:

Ernest T., After War—What?: Paint Industry Magazine

In the first place, we have no reconversion problems. With reasonably speedy victory over Germany already assured and with victory over Japan in much clearer prospect than seemed likely before Germany's impending collapse, we are fully equipped for a head start without necessity of awaiting the final victory in the Pacific theater of war, while many other industries will have to reconvert their factory operations and cannot get started in new production for a considerable time to come. However, no matter what other industries do, they will need our products for practically any activities in which they engage.

As civilian production gains headway in catching up with the great backlog of deferred civilian needs, the demands upon the paint industry may be expected to surpass the records achieved in the peak war years.

The expected gain in postwar production of automobiles until pent-up requirements are filled was outlined in the report of this series for 1943. This gain and increases in production of other civilian equipment retarded by the war will call for pigments for finishes, storage batteries, rubber, and other items that are large pigment users. Railroads will need large supplies of pigments, as pointed out by Trigg in the article already cited, to rehabilitate rolling stock, stations, bridges, and other properties and equipment. He indicated also that a large merchant marine and the biggest Navy in the world will provide a large postwar market for pigments. The pigments export market for the purposes itemized could provide a postwar outlet for very large tonnages.

There seems to be little question regarding the size of postwar requirements for pigments. The main question concerns the proportions of the market that different pigments will supply. In this connection, the prewar shifts from certain pigments to others are expected to continue in postwar years.

Lead pigments sold by domestic manufactu

Pigment	1943	
	Short tons	Value (in- clusive of
		Total
Basic lead sulfate or sublimed lead:		
White.....	4,762	\$700,560
Blue.....	845	128,100
Red lead.....	53,378	9,136,010
Orange mineral.....	79	19,730
Litharge.....	113,091	17,146,670
White lead:		
Dry.....	39,525	6,441,900
In oil.....	36,042	8,326,450

*1 Weight of white lead only but value of paste.

Lead pigments sold by domestic manufacturer
short tons

Year	White lead		Base or W
	Dry	In oil	Wh
1940.....	30, 115	50, 447	5,
1941.....	54, 680	58, 311	8,
1942.....	25, 865	47, 774	7,
1943.....	39, 626	30, 642	4,
1944.....	46, 466	39, 260	5,

Leaded zinc oxide registered the largest increase among the pigments covered by this report, except for the orange mineral; sales of leaded zinc oxide increased 10 percent. Sales of leaded zinc oxide in 1944 were \$10,000,000 and failed to equal that recorded in 1943. Zinc oxide (lead-free) sold had the largest increase (4 percent), but it declined 2 percent in 1944. This pigment during much of the war was used primarily by painters to other pigments. Lithopone sales were \$10,000,000 in 1944, but the rate was not high as compared with 1943.

Previous reports of this series have indicated that sales are a better guide to activity in the pigments industry than production because complete data are not available on stocks and materials classified as production of one item are sometimes disposed of under another classification. Moreover, pigments produced under one classification at a plant are sometimes employed at a plant of another company for blending into another pigment in the lead and zinc group. The Bureau of Mines attempts to eliminate all possible duplication and to tabulate products only in the form in which they enter final use as pigments. Thus the quantities of basic lead sulfate and zinc oxide that are blended to make leaded zinc oxide are omitted, except as leaded zinc oxide. Duplication caused by other blending, which is on a considerably smaller scale, is also avoided insofar as possible. Pigments consumed by the producing companies, however, to make products beyond those covered by this report—that is, paint, storage batteries, and other articles—are considered as sales.

The value of lead and zinc pigments in 1944 totaled \$85,889,000, a gain of 10 percent over 1943; it was the largest since 1929 and exceeded 1941 by a narrow margin.

As in 1943, litharge and red lead made the best showings of the pigments covered by this report; sales of both items were at higher levels than ever before, being 22 and 1 percent, respectively, larger than

1925 and 1941. Producers' average prices showed some variation in 1944 from 1943 levels, but these changes do not reflect revisions in average quoted prices.

Zinc pigments and salts sold by domestic manufacturers in the United States, 1943-44

Pigment or salt	1943			1944		
	Short tons	Value (at plant, exclusive of container)		Short tons	Value (at plant, exclusive of container)	
		Total	Average		Total	Average
Zinc oxide ¹	143,402	\$19,712,413	\$137	140,675	\$19,582,487	\$139
Leaded zinc oxide ²	43,828	5,801,840	132	64,395	8,496,579	132
Lithopone.....	135,723	10,745,305	79	142,905	11,208,891	78
Zinc chloride, 50° B.....	53,707	2,777,998	62	(³)	(³)	(³)
Zinc sulfate.....	16,649	1,261,801	81	17,156	1,431,487	82

¹ Zinc oxide containing 5 percent or more lead is classed as leaded zinc oxide.

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

³ Revised figures. ⁴ Satisfactory data not available.

Zinc pigments and salts sold by domestic manufacturers in the United States, 1940-44, in short tons

Year	Zinc oxide	Leaded zinc oxide	Lithopone	Zinc chloride (50° B.)	Zinc sulfate
1940.....	113,213	45,362	151,802	(¹)	11,337
1941.....	148,833	68,920	176,042	(¹)	19,201
1942.....	99,677	48,128	137,320	52,374	14,331
1943.....	143,402	43,828	135,723	53,707	16,649
1944.....	140,675	64,395	142,905	(²)	17,156

¹ Data not available.

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

³ Satisfactory data not available.

Figures covering zinc chloride for 1944 are not available because of the refusal of one company, believed to be large, to give reliable data.

Sales of zinc sulfate failed by 11 percent to equal the rate for 1941 but except for that year they were the highest on record.

CONSUMPTION BY INDUSTRIES

WHITE LEAD

Sales of this pigment, which declined in 1943, returned virtually to the 1942 level in 1944. Total sales for the dry and "in oil" varieties increased 13 percent in 1944, but amounted to only 84 percent of the annual average for the prewar 5-year period, 1935-39; they were not much more than half of the average for the period of high industrial activity in 1925-29. The dry class gained 18 percent compared with 7 for the "in oil" grade, and it has fared much better, on the whole, for many years.

By far the largest part of white lead sales is for consumption in the manufacture of paints, ordinarily over 90 percent entering this use. 93 percent was reported as having gone into paints in 1944. It is believed that a break-down of the Other class would raise the paint total. Sales of white lead for the manufacture of ceramics declined in 1944 against the trend for other pigments used for that purpose.

Production of white lead totaled 76,191 tons in 1944.

LEAD AND ZINC PIGMENTS AND SALTS

Distribution of white lead (dry and in oil) sales, 1940-44

Industry	1940	1941
Paint.....	73,137	100,064
Ceramics.....	3,029	3,700
Other.....	4,396	8,030
	80,562	111,800

The Eagle-Picher Lead Co. commented on conditions in its report to stockholders, as follows:

The White Lead Division continues to face almost identical conditions. Recent drastic reduction in the allocation of paint pigments, coupled with a long-standing limitation on oil, has reduced the permitted production of this division. This definitely precludes any hope of profitable operation.

BASIC LEAD SULFATE

The chief use of this pigment is also in the manufacture of paints. Large quantities, likewise, are used annually in the manufacture of leaded zinc oxide. It is counted as finished basic lead sulfate but is included under the figures for leaded zinc oxide. A small quantity of zinc oxide also it goes chiefly into paints. In 1944, basic lead sulfate were sold for use in the manufacture of paint compared with 6,100 tons in 1943. Lead reported having used 5,600 tons of basic lead sulfate in 1944 are not available.

Production of basic lead sulfate totaled 4,396 tons in 1944.

Distribution of basic lead sulfate sales, 1940-44

Industry	1940	1941
Paints.....	5,593	9,280
Rubber.....	128	200
Storage batteries.....	4	8
Other.....	475	87
	6,200	10,375

RED LEAD

Trade in red lead was heavy in 1944, and for sales was established by a narrow margin. It has enjoyed great activity in the war years, especially as a construction paint. The percentage of red lead in 1944 was less than in 1943—it is used in storage-battery manufacture, which regularly takes its turn at establishing a new record in red lead. Total red lead sales were less than the previous record in 1941, but sales for storage batteries were 10 percent above the 1941 peak.

Production of red lead totaled 53,398 tons in 1944.

LEAD AND ZINC PIGMENTS

Distribution of red lead sales, 1940-44, by industries, in short tons

Distribution of litharge sales, 1940-44.

Industry	1940	1941	1942	1943	1944
Storage batteries.....	26,718	27,405	23,545	26,616	30,211
Paints.....	11,949	20,130	21,017	22,271	18,060
Ceramics.....	1,117	1,593	639	622	810
Other.....	2,416	4,710	2,868	3,869	4,860
	42,200	53,838	48,369	53,378	53,941

ORANGE MINERAL

There was a noteworthy gain in sales of this small-tonnage pigment in 1944. With the increase, the principal use changed from the manufacture of ink to the manufacture of color pigments. The advance in 1944 was made over the smallest annual total since 1880.

Production of orange mineral amounted to 280 tons in 1944 contrasted with only 3 in 1943.

Distribution of orange mineral sales, 1940-44, by industries, in short tons

Industry	1940	1941	1942	1943	1944
Color pigments.....	18	26	7	8	
Ink manufacture.....	51	98	93	49	
Other.....	68	122	28	22	
	137	246	128	79	

LITHARGE

A new peak rate of sales of litharge for storage-battery manufacture in 1944 carried total sales of litharge to record heights; they were 2 percent higher than in 1943 and 13 percent above the previous peak in 1941, and they thus made the best showing of the pigments covered by this report. Battery manufacture took more than half of the total a condition that has existed only once before, in 1932, since the Bureau of Mines began to collect data on distribution of sales; in 1932 too sales of litharge were only 80 percent of the amount sold for battery manufacture in 1944. In addition to the litharge used to make batteries, the storage-battery manufacturers themselves produced black or suboxide of lead which they use as a substitute for litharge. The amount so used in 1944—61,000 tons—equaled the record tonnage for 1941 and was 1,000 tons above 1943. In 1944, 58,000 tons of pig lead were required to manufacture the suboxide, compared with 57,000 in 1943. Black oxide figures are not included in the Bureau of Mines totals for litharge. Insecticidal use of litharge also made a new high record for the second successive year in 1944, surpassing the previous peak of 1943 by 28 percent. Ceramics took 25 percent more litharge than in 1943. Other of the larger users of litharge, except oil refining, took less of the pigment in 1944 than in 1943, the decline for rubber contrasting with the uptrend of recent years. The drop in use in chrome chemicals is explained more by restricted allowances of chrome than of lead.

Production of litharge amounted to 146,900 tons in 1944 compared with 112,037 tons in 1943.

Industry	1940
Large batteries	38,303
Acidolides	16,041
Amics	12,072
Some pigments	8,466
Refining	6,876
Glycer	1,590
Alkyl	3,003
Alcohol	418
Other	3,082
	89,841

ZINC OXIDE

Sales of this pigment receded slightly at a favorable rate that prevailed in 1943, but the amount of sales in neither year met the consumption requirements. Consumption of pigments gained 27 percent over 1943. In paints, the other principal classes of pigments, as the second most important output, the manufacture of rubber declined 12 percent and the use of zinc oxide declined 16 percent. The decrease for the smaller percentage use of zinc oxide for rubber. Lead-free grade would have been specified thereon.

Production of lead-free oxide amounted to only 123,913 tons in 1943.

Distribution of zinc oxide sales, 1940-44.

Industry	1940	1941
Chemical warfare	70,979	9
Shells	23,268	3
For coverings and textiles	4,752	
Shells	6,352	
Shells	7,862	1
	113,213	14

LEADED ZINC OX

of leaded zinc oxide rose more sharply than any other pigment covered by this act and were second only to the record of 1944 in that year. The preparation of paints. This pigment was not used in 1944 as was the lead-free class, in instances where the lead-free class was used. It will be noted that sales of this pigment in the manufacture of paints declined 16 percent in 1944. Zinc oxide include basic lead sulfide, sold under Basic Lead Sulfate.

Leaded zinc oxide production totaled 64,432 tons in 1944 compared with 39,515 tons in 1943. The totals are broken down as follows (1943 revised data in parentheses): Over 5-35 percent lead, 52,022 (33,144) tons; over 35-50 percent, 8,364 (5,908) tons; and most of the remainder in both years, 5 percent or less.

Distribution of leaded zinc oxide sales, 1940-44, by industries, in short tons

Industry	1940	1941	1942	1943	1944
Paints.....	44,341	67,472	47,052	42,303	62,223
Rubber.....		1		42	119
Other.....	1,021	1,447	1,076	1,483	2,053
	45,362	68,920	48,128	43,828	64,395

LITHOPONE

The lithopone statistics in this report are given on the basis of ordinary lithopone sold as such plus the ordinary lithopone content of the high-strength product. This method of publication is used to conceal the operations of one company which always dominates the output of the high-strength product and is the only producer in some years. In 1944 three companies, operating four plants, produced high-strength lithopone, but one company made a negligible contribution to the total. Lithopone sales in 1944 were influenced by the historic peak in total sales of all paint, varnish, and lacquer materials, over three-quarters of the sales of this product regularly going into paint, varnish, and lacquer channels. It is significant that lithopone sales for paints rose somewhat less than total sales of paints, varnish, and lacquer materials, inasmuch as lithopone would naturally benefit from restrictions on sales of other pigments, such as zinc oxide and titanium dioxide. Floor coverings and textiles take the next-most important amounts of lithopone, and sales for this purpose dropped 8 percent in 1944. A separation of the quantities for 1944, based on somewhat incomplete data, indicate that 9,578 tons were for floor coverings and 5,168 for coated fabrics and textiles. Use of lithopone for the manufacture of paper has been gaining and amounted to 6,488 tons in 1944, compared with 4,043 tons in 1943, 3,423 in 1942, and 5,559 in 1941. The 1944 total is a peak rate since 1937, the first year for which separate figures for this use are available. The consumption of titanium dioxide for paper manufacture was also at a high rate in 1944, the gross weight of titanium pigments showing a peak rate since before 1935 (the first year for which separation is available) but the TiO_2 content lagging behind that for 1943 and the even higher total for 1941. Printing ink took a large amount of lithopone (1,216 tons) in relation to most other years since before 1936 (the period for which data are available); the total for 1941 (2,301 tons), however, was considerably above all other years since before 1936. Exports are included mainly under Other, but one company at least classifies part of its exports according to the end use.

Plant capacity for the production of lithopone was reported to total 155,000 tons in 1944 or relatively the same as the 157,000 tons for 1943.

Production of lithopone totaled 133,960 tons compared with 132,600 tons in 1943. Stocks were reduced in both years. The plant of the

Paint and Pigment Department of the United Color & Pigment Co.) and no production is planned there for 1945.

Distribution of lithopone sales, 1940-44, by industries, in short tons

Industry	1940
Paints, etc.....	117,075
Floor coverings and textiles.....	18,738
Rubber.....	3,387
Other.....	12,602
	151,802

¹ Includes a quantity, not separable, used for printing ink.

There was little change in consumption of lithopone in the manufacture of titanated lithopone (about 15 percent TiO_2), as 8,300 tons in 1944, compared with 8,400 in 1943. Production of titanated lithopone was 8,300 tons in both years. The lithopone figure included in the totals for ordinary lithopone.

Titanated lithopone produced in the United States, 1940-44, in short tons

Year	Titanated lithopone produced	Ordinary lithopone used	
1940.....	18,100	15,200	1943
1941.....	16,800	14,100	1944
1942.....	11,700	9,900	

ZINC SULFATE

Only one company produced zinc sulfate in 1942, and the Bureau of Mines is not able to give reliable information on this pigment.

ZINC CHLORIDE

The Bureau of Mines is unable to produce reliable information because of the refusal of one company, large, to give reliable information.

ZINC SULFATE

Sales of zinc sulfate increased 10 percent in 1944, being 11 percent above those for 1941, and usually accounts for the largest part of the total. It stood first in 1944 with what appears to be a record for one year. A more precise comparison for 1941, however, might easily place the 1944 total. The agricultural use of zinc sulfate in 1944 seems likely to have been application in agriculture. Some of the uses are: As a fungicide in a variation

zinc sulfate is used in place of copper sulfate; with lime to spray peach trees for bacterial spots; more extensively with lime as a safener where arsenate of lead is used as a spray; with lime as a spray on various trees to make up for zinc deficiencies in the soil; alone directly in the soil to make up for zinc deficiencies; alone as a spray where the foliage will stand it; and to a certain extent for weed eradication. The sharp rise in sales of zinc sulfate for paint and varnish processing in 1943 was more than counteracted in 1944. The use of zinc sulfate for the manufacture of glue continued its substantial decline in 1944.

Distribution of zinc sulfate sales, 1940-44, by industries, in short tons

Industry	1940	1941	1942	1943	1944
Rayon.....	3,649	5,170	3,149	4,537	5,827
Agriculture.....	2,366	3,038	4,123	3,329	4,707
Chemicals.....	2,151	5,555	2,695	1,642	1,474
Paints and varnish processing.....	1,509	1,422	1,917	2,439	1,712
Flotation reagent.....	241	312	355	1,282	1,117
Glue.....	320	1,203	760	635	212
Electroplating.....	348	502	219	187	177
Textile dyeing and printing.....	54	130	60	213	177
Other.....	1,209	1,809	1,163	1,385	1,712
	11,937	19,201	14,331	15,649	17,117

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

Figures covering the raw materials used in making pigments and salts were not available when the report of this series for 1943 was prepared. Data for 1943 are given below, and those for 1944 will appear in a subsequent report.

Lead pigments and zinc pigments and salts are manufactured from a variety of materials, including ore, refined metal, and such secondary materials as scrap and waste from various industrial processes. In 1943, 93 percent of the lead in pigments was derived from pig lead and 7 percent from ore. Of the lead in ore used to make leaded zinc oxide, about 10 percent was from foreign sources. The proportion for zinc pigments in 1943 was 78 percent from ore, 8 percent from slag, and 14 percent from secondary materials; about 14 percent of the ore used was foreign.

Metal content of lead and zinc pigments produced by domestic manufacturers, 1942-44, by sources, in short tons

Source	1942		1943	
	Lead in pigments ¹	Zinc in pigments	Lead in pigments ¹	Zinc in pigments
Ore:				
Domestic.....	18,185	103,445	14,358	4,118
Foreign.....	707	9,636	1,168	1,168
Metal.....	206,680	8,252	202,783	8,252
Secondary material ²	2	21,663		
	225,574	142,996	218,307	14,148

¹ Includes also lead recovered in leaded zinc oxide.

² Revised figures.

³ Zinc ashes, skimmings, drosses, and old metal.

The following tables give the source of the manufacture of each pigment and salt. Pig lead is either directly or indirectly, in the manufacture of white lead, and orange mineral and is used also as basic lead sulfate. The lead content of leaded zinc oxide, which in turn was made from pig lead in the table. Zinc oxide is the most considerable slab zinc is used. Ore is employed in the manufacture of zinc oxide, leaded zinc oxide, lithopone, zinc sulfate. A substantial proportion of the zinc oxide that in zinc chloride made in the United States is a secondary material. For a number of years prior to World War II there had been a large quantity of secondary zinc used in the manufacture of lithopone. Supplies of both metal and scrap caused the price of zinc oxide made by the French process to drop sharply in 1943, despite the fact that the French process rebounded somewhat in the latter part of 1943.

Lead content of lead and zinc pigments produced by domestic manufacturers, 1942-44, by sources, in short tons

Pigment	1942					Total lead in pigments	Domestic
	Lead in pigments produced from—						
	Ore		Pig lead	Secondary material			
	Domestic	Foreign					
White lead.....			73,757		73,757		
Orange mineral.....			45,228		45,228		
Basic lead sulfate.....			86,667		86,667		
Lead oxide.....	4,760		827		5,587	4,760	
Leaded zinc oxide.....	13,425	707	120	2	14,254	10,118	
	18,185	707	206,680	2	225,574	14,358	

¹ Revised figures.

Lead content of zinc pigments and salts produced by domestic manufacturers, 1942-44, by sources, in short tons

Pigment or salt	1942				Total zinc in pigments and salts	Domestic
	Zinc in pigments and salts produced from—			Secondary material		
	Ore		Slab zinc			
	Domestic	Foreign				
White lead.....	74,289	313	8,247	5,585	88,434	70,000
Orange mineral.....	19,687	5,555		328	25,570	15,600
Basic lead sulfate.....	9,469	3,768	5	15,760	28,992	11,800
Lead oxide.....	(¹)	(¹)			(¹)	(¹)
Leaded zinc oxide.....	671	1,200	86	11,777	11,787	1,700
				2,151	4,108	1,700

¹ Figures are higher than those shown in the report on Secondary materials recovered from byproduct sludges, residues, etc., not at the mines not at liberty to publish.

PRICES

The total and average values reported by producers for lead and zinc pigments and zinc salts are given in the tables in the first part of this report. For most of the products covered there was little change in average prices received, but those for both red lead and litharge declined. The lower values for these two products can be explained only by variation in delivery points of portions of the total sales. Producers' values are reported on an f. o. b. plant basis. The ceiling prices established by the Office of Price Administration for the pigments and salts covered in this report, and likewise those for the metals lead and zinc were unchanged throughout 1944 at the levels that prevailed in 1943.

Range of quotations on lead pigments and zinc pigments and salts at New York (or delivered in the East), 1941-44, in cents per pound

Product	1941	1942	1943	1944
Basic lead sulfate, or sublimed lead, less than carlots, barrels	6.50-7.00	7.00-7.75	7.50-7.75	7.50-7.75
White lead, or basic lead carbonate, dry, carlots, barrels	7.50	7.50-8.25	8.25	8.25
Litharge, commercial, powdered, barrels	7.00-8.25	7.35-9.00	8.00-9.00	8.00-9.00
Red lead, dry, 95 percent or less, less than carlots, barrels	8.50-9.25	8.75-10.00	9.50-10.00	9.50-10.00
Orange mineral, American, small lots, barrels	11.00-11.75	11.25-12.50	12.00-12.50	12.00-12.50
Zinc oxide:				
American process, lead-free, bags, carlots	6.50	7.25	7.25	7.25
American process, 5 to 35 percent lead, barrels, carlots	6.25-6.75	7.00-7.35	7.25-7.35	7.25-7.35
French process, red seal, bags, carlots	7.75	8.50	8.50	8.50
French process, green seal, bags, carlots	8.25	9.00	9.00	9.00
French process, white seal, barrels, carlots	9.00	9.75	9.75	9.75
Lithopone, ordinary, small lots, bags	4.10	4.50	4.50	4.50
Zinc sulfide, less than carlots, bags, barrels	8.00-8.25	8.50-8.75	8.50-8.75	8.50-8.75
Zinc chloride, works:				
Solution, tanks	2.25-2.50	2.50	2.50	2.50
Fused, drums	4.25-6.50	5.00-6.50	5.00-6.50	5.00-6.50
Zinc sulfate, crystals, barrels	3.15-4.40	3.65-4.60	3.85-4.60	3.65-4.60

¹ Quotation was reduced to 3.65-4.40 cents per pound in the September 11 issue, which added "works freight allowed," to the description.

FOREIGN TRADE¹

The average annual value of foreign trade in lead and zinc pigments has remained relatively high during the war as compared with prewar levels. The principal trade is under the export classifications, no import item reaching \$30,000 in value in either 1943 or 1944. Lead pigments export values declined 4 percent in 1944 as compared with 1943 but were 142 percent above the average for the 5-year period 1935-39, whereas zinc export values declined 26 percent and were 275 percent above the prewar average. Total exports of both classes (lead and zinc pigments) in 1944, however, amounted to only 4 percent of the value of total production in the United States.

¹ Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of U. S. Department of Commerce.

LEAD AND ZINC PIGMENT

Value of foreign trade of the United States in
1943-44

	Imports
Lead pigments:	
White lead	
Red lead	
Litharge	
Orange mineral	
Other lead pigments	
Zinc pigments:	
Zinc oxide	
Lithopone	
Zinc sulfide	
Lead and zinc salts:	
Lead arsenate	
Other lead compounds	
Zinc chloride	
Zinc sulfide	
Zinc sulfate	
Other zinc salts and compounds	
Grand total	

¹ Data not available.

Lead pigments and salts.—Imports nonexistent. White lead is the principal heading, with red lead and litharge following among the pigments, and lead arsenate among the salts. Shipments of white lead from the country following a comparatively high rate of increase in 1944, but of all of the other items specified rose less than 10 percent. Lead arsenate did not equal half of the 1941 level.

Lead pigments and salts imported for consumption

Year	Imports		
	Basic carbonate white lead	Red lead	Litharge
1940	2		
1941	2	3	
1942		2	
1943		4	
1944	(1)		

Less than 1 ton.

¹ Includes also suboxide of lead, n. s. p. f., as follows: 1940: \$3,221 (13,228 pounds); 1942: \$3,221 (13,228 pounds); 1943: \$2,283 (9,132 pounds).

THE MINERAL INDUSTRY

(MINE REPORT)

By H. FOSTER BA

SUMMARY OUTLINE

Year	Short tons						Total value
	White lead	Red lead	Litharge	Orange mineral	Sublimed lead	Lead arsenate	
1940.....	1,360	1,336	1,580	(1)	(1)	1,450	\$830,220
1941.....	2,501	2,060	2,802	(1)	(1)	4,797	2,100,338
1942.....	2,249	1,391	1,090	7	05	296	1,030,472
1943.....	4,602	1,635	1,010	7	71	1,627	1,814,615
1944.....	3,652	2,117	2,391	13	82	2,133	1,888,128

¹ Not compiled on an annual basis before 1942.

Zinc pigments and salts.—Zinc sulfate is the principal import item under this class, but it amounted to only 542 tons in 1944, virtually the same as in 1943. Lithopone and zinc oxide are the principal products exported and their individual quantities largely exceed each of the lead classes. Exports were smaller in 1944 by 33 and 8 percent, respectively, and the virtually constant rates for 1943 and 1942 were below those for 1941. Principal zinc salts exported, shown separately, on an annual basis for the first time in 1942, are zinc sulfate and zinc chloride. Available data are covered in the footnote to the second table that follows.

Zinc pigments and salts imported for consumption in the United States, 1940-44

Year	Short tons						Total value
	Zinc oxide		Lithopone	Zinc sulfide	Zinc chloride	Zinc sulfate	
	Dry	In oil					
1940.....	273	45	.....	(1)	10	245	\$54.02
1941.....	122	11	(1)	1	.....	162	29.33
1942.....	13	1	.....	1	.....	362	26.36
1943.....	10	11	.....	.....	.....	640	24.03
1944.....	(1)	6	.....	(1)	.....	642	30.24

¹ Less than 1 ton.

Zinc pigments and salts ¹ exported from the United States, 1940-44

Year	Short tons		Total value	Year	Short tons		Total value
	Zinc oxide	Lithopone			Zinc oxide	Lithopone	
1940.....	3,239	14,298	\$1,584,667	1943.....	6,019	17,320	' \$2,898,800
1941.....	8,264	21,527	3,525,386	1944.....	8,511	11,551	' 2,194,800
1942.....	6,013	17,036	' 2,913,696				

¹ Zinc salts not separately recorded on an annual basis before 1942.

¹ Zinc salts not separately recorded on BB annual basis before 1942.

General conditions.....
Metal production.....
 " Calculation of value.....
Nonmetallic production.....

GENERAL CONDITIONS

The demands for men and materials which caused a major dislocation in Alaskan value of the mineral output dropped to \$700 million. It was at the beginning of this century that Alaska always been the leading mining industry. Over a million ounces, decreased to about the smallest yield since the historic discovery, being at least virtually all of the modern has meant so much to Alaska, was wiped out. Not all of this happened in 1944, but the year. The descent began early in the war. Air bases, roads, and other war facilities, borrowed almost bodily out of the mines and gangs. This was particularly upsetting to mining has long been the leading inland Alaskan industry away from the coast of the mines. It was a war sacrifice no State like degree. It had, naturally, some considerable sums of money to create the new war temporary prosperity, and some of the facilities will be of permanent use. Not the rush that the times demanded much necessary in some places, and some, perhaps, it of it all will have come a very great communication and transportation was the most insistent needs of the Territory. The fact that the whole economy of the region construction period is sure to be difficult and The closing of the great Alaska Juneau world's greatest low-cost producer—where added \$80,489,823 to the world's wealth. This historic event of great magnitude, both

For detailed table on Alaskan mineral production, see chapter
Mineral Production.

Exports.—Almost the entire quantity of titanium concentrates and alloys exported in 1944 went to Canada. Mexico received 90 percent of the pigment exports; Cuba, 3 percent; Brazil, 2 percent; and other countries, 5 percent. Exports of tetrachloride dropped from 694 short tons in 1943 to 372 tons in 1944; 57 percent went to United Kingdom, 30 percent to Australia, and 13 percent to Canada. The total exports of titanium products (including concentrates) in 1944 were valued at 2¼ million dollars.

Exports of titanium products from the United States, 1940-40, by classes

Year	Concentrates		Metal and alloy (including ferro- alloys)		Dioxide and pig- ments		Tetrachloride and other compounds	
	Short tons	Value	Short tons	Value	Short tons	Value	Short tons	Value
1940.....	(1)	(1)	(1)	(1)	4,902	\$867,535	(1)	(1)
1941.....	1,432	\$70,013	1,150	\$35,087	7,821	1,609,071	17	\$3,792
1942.....	618	117,888	422	60,038	8,870	1,707,433	24	13,666
1943.....	576	103,947	700	117,402	9,765	1,830,344	728	442,591
1944.....	290	46,797	793	127,146	10,925	1,851,467	375	215,696

¹ Data not available.

² Data cover last 6 months only.

³ Data cover last 4 months only.

STOCKS

Although inventories of ilmenite at the end of 1944 were about one-fourth larger than a year earlier in terms of TiO₂ content, they represented only about 5 months' supply at the 1944 consumption rate. Stocks of rutile increased about 12 percent by the year end and were probably more than 6 months' needs in view of the declining welding-rod output.

Stocks of titanium concentrates in the United States at end of year, 1943-44, in short tons

Stocks	1943				1944			
	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.....	3,753	1,771	100	94	1,572	722	252	236
Distributors ¹	5,638	2,492	1,012	941	4,542	2,316	2,532	2,380
Consumers.....	118,263	57,786	1,871	1,745	161,572	72,814	1,720	1,570
Government.....			3,253	3,058			2,500	2,350
Total stocks.....	127,654	62,049	6,236	5,838	167,686	75,852	7,004	6,536

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

² Revised figures.

CONSUMPTION AND USES

The 19-percent increase in use of ilmenite in 1944 over that of the preceding year may be ascribed to the unsatisfied demand for titanium pigments. Consumption for pigments was 97 percent of the total, most of the remainder going into alloys and cemented carbides. The

diminished consumption of rutile was back in welding-rod output; 73 percent welding-rod coatings, and nearly all the

Consumption of ilmenite and rutile in the United States, 1943-44, in short tons

Product	Gross weight
1943	
Pigments (manufactured titanium dioxide).....	290,573
Welding-rod coatings ¹	194
Alloys and carbide.....	10,583
Ceramics.....	
Miscellaneous ²	1,472
Total consumption.....	302,822
1944	
Pigments (manufactured titanium dioxide).....	349,808
Welding-rod coatings ¹	148
Alloys and carbide.....	10,174
Ceramics.....	
Miscellaneous ²	1,114
Total consumption.....	360,941

¹ "Pigments" include all manufactured titanium dioxide, was 5,700 tons in 1943 and 3,900 tons in 1944.

² Consists of ilmenite used as a steel flux and rutile used in la

Titanium pigments.—Both production and consumption continued on an upward trend in 1944. There was no pronounced change in the pattern, which in 1944, according to the 1943 pattern, was 1 percent for paint, varnish, and lacquer, 2 percent for welding-rod coating, 2 percent for textiles, 1 percent for rubber, and 8 percent for pigments continued very strong demand maintained under War Production Board by means of preference ratings. The demand for pigments continued very strong, but was simultaneously replaced by Miscellaneous Chemicals. The use of titanium continued to grow at the expense of both lithium and its exceptionally high hiding power. type in 1941 and the chalk-resistant rutile new pigments with 20 to 40 percent anatase form that was the only titanium pigment available before 1941. Hiding power and chalk resistance have led to the widest use in camouflage or protective coating on ships. United States Government during the year.

Welding-rod coatings.—Production of titanium in 1944 was 382,000 short tons compared with 321,000 tons in 1943 and 321,000 tons in 1942. The

¹ Chemical and Metallurgical Engineering, Report on Titanium, 1944, p. 122.

in use of titanium dioxide mirrored changes in armament- and ship-construction programs and impending further cut-backs.

Titanium alloys.—The titanium ferro-alloys are important additives in the production of rimming and killed steels. The titanium-treated steels are cleaner, give higher ingot yield, and have generally better physical characteristics than untreated steels and some of those treated with other deoxidizers. In these applications there is little or no titanium residual in the finished steel. Titanium is also used as an alloying element, especially in stainless steels where its main effect is through carbide control to inhibit intergranular corrosion and embrittlement. A titanium alloy steel, now in commercial production, has made possible the direct application of white or light pastel vitreous enamels to steel without the use of a ground-coat enamel. This one-coat enameling steel possesses exceptional cold-drawing characteristics and resistance to sagging or bending at enamel firing temperatures and is reported not to age-strain.^{8 9}

Other uses.—Titanium tetrachloride was used as a screening smoke during the First World War and has been employed in substantial volume during the present conflict. At first it was usually prepared by chlorinating rutile in the presence of carbonaceous material. Subsequently and during the current war, titanium cyanonitride—an electric-furnace product—was reacted with chlorine to make the tetrachloride. These were high-temperature processes requiring careful controls, and the product was likely to be contaminated with impurities contained in the raw materials. Later, better results were obtained by substituting pigment titanium dioxide briquetted with finely ground charcoal and a binder in place of the cyanonitride.

PRICES

No price changes affected any form of titanium in 1944. Ilmenite and rutile prices were fixed by the Office of Price Administration February 22, 1943 (Regulation 327), at levels prevailing in March 1942. Ilmenite, 60 percent TiO_2 , was nominally quoted at \$28-\$30 a long ton, f. o. b. Atlantic seaboard, and rutile, 94 percent TiO_2 , at 8-10 cents a pound. Steel quoted ferrotitanium, ton lots, at \$1.23 per pound of contained Ti for 40- to 45-percent grade and \$1.35 for 20- to 25-percent grade; and ferrocantitanium, 15-20 percent Ti, at \$142.50 a short ton for 6- to 8-percent carbon and \$157.50 for 3- to 5-percent carbon. Titanium metal, 96-98 percent, was listed at \$5-\$5.50 a pound. The base price of manufactured titanium dioxide remained fixed at 14½-16½ cents a pound.

TECHNOLOGY

The Bureau of Mines and Geological Survey made field studies on Wyoming titaniferous magnetite. The Bureau conducted laboratory research on metal and alloy production and on ore dressing of various raw materials.

The Humphreys spiral concentrator has efficiently separated heavy minerals from natural sands, with high recoveries. It is reported to be relatively insensitive to changes in pulp density and quantity and

grade of feed, and to particle size or shape. Application—Oregon chromite-bearing beach sand, with a ratio of 2.25 : 1 was obtained, with a recovery of 85 percent. Florida beach-sand spiral feed has 5½ to 6 percent ilmenite. The concentrate ranges from 88 to 96 percent ilmenite and rutile, but was held close to 90 percent. The concentrate exceeds 95 percent.¹¹

WORLD PRODUCTION

Data on world production of ilmenite and rutile are shown in the following table.

World production of titanium concentrates (ilmenite and rutile) in metric tons

[Compiled by B. B. Walden]

Country	1937	1938	1939
ILMENITE			
Australia:			
New South Wales	681	(1)	742
Queensland			
Brazil (exports)	120	155	10
Canada	3,835	188	8,351
Egypt	317	90	(1)
Federated Malay States (exports)	0,290	6,462	11,098
India, British	182,142	258,268	(1)
Norway	84,209	62,724	55,027
Portugal	1,133	668	502
Senegal	3,075	8,436	(1)
Spain			
United States	(1)	(1)	13,247
RUTILE			
Australia:			
New South Wales	1,141	1,460	790
Queensland			
South Australia		8	2
Brazil (exports)	768	377	489
Cameroon (French)	103	118	159
Norway	187	124	166
South-West Africa	16		
United States	(1)	(1)	(1)

¹ Data not available.

² Subject to revision.

³ January to November, inclusive.

⁴ Includes 26 tons of garnet-ilmenite.

⁵ Bureau of Mines not at liberty to publish figures.

⁶ In addition, zircon-rutile-ilmenite concentrates were produced.

⁷ Less than 1 ton.

⁸ Exports.

Australia.—Beach-sand deposits similar to those in New South Wales, which have been worked for a number of years, are being prospected and developed along 60 miles of the Queensland coast. Approximate mineral composition of the usually called "black sands," is as follows: 30 to 35 percent rutile, 30 to 35 percent ilmenite, and 10 to 15 percent monazite concentrate. The product from the deposits is a mixed concentrate, but efforts are being made to separate concentrates of individual minerals, mainly

⁸ Comstock, G. F., and Walner, E., New Titanium Steel for Vitreous Enamelling: Iron Age, vol. 155, No. 7, February 1945, pp. 60-63, 152-153.

⁹ Comstock, G. F., Strain Aging of Killed Low-Carbon Steel, with Particular Reference to the Effect of Titanium: Proc. Am. Soc. Testing Materials, vol. 43, 1943, pp. 521-541.

¹⁰ Gleeson, George W., Why the Humphreys Spiral Works: Engineering and Mining Journal, Queensland: Vol. 145, No. 1, 1945, pp. 85-86.

¹¹ Humphreys, I. B., and Hubbard, Judson S., work cited in Engineering and Mining Journal, Queensland: Vol. 145, No. 1, 1945, pp. 85-86.