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LEAD

By T. H. MILLER AND

SUMMARY OF

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GENERAL SU

Record-breaking receipts of foreign lead, a fairly steady rate of domestic production, and low costs, eased the supply situation which had been tight with other strategic materials and in a position relative to supply versus demand. The position of lead under Government control measures; this allowed for the use of lead as a substitute for more critical materials such as zinc, that have a more direct military application.

The production of refined primary lead ores decreased less than 1 percent in 1942, sources being only 4,128 tons less than in 1941. Consumption of refined soft lead was less than production but permitted most of the increase in the Government stock pile which was as large as at the beginning. Year-end inventories were 22 percent lower owing to foreign metal to balance the deficient supply.

Total imports of lead in all forms were records largely because of a 35-percent increase over 1941; more than half of the increase was the balance almost entirely from Australia.

The established price of 5.85 cents per pound at the beginning of 1942 advanced to 6.75 cents, which level it remained during the balance of the year increased from 5.75 cents in 1942.

¹ This report deals primarily with the smelting, refining and details of mining operations see separate reports issued for

Salient statistics of the lead industry in the United States, 1925-29 (average) and 1938-42, in short tons

	1925-29 (average)	1938	1939	1940	1941	1942
Production of refined primary lead:						
From domestic ores and base bullion...	660,525	331,964	420,967	433,065	470,517	467,367
From foreign ores and base bullion...	123,104	51,705	63,068	100,114	100,460	99,472
Recovery of secondary lead.....	783,629	382,669	484,035	533,179	570,967	506,839
Imports: ¹	280,000	224,900	241,500	260,346	397,416	323,001
Lead in pigs, bars, and old.....	4,592	3,235	7,139	151,568	274,395	369,254
Lead in base bullion.....	95,747	15,296	48,902	19,624	24,704	37,244
Lead in ores and matte.....	40,068	45,370	30,842	111,300	82,115	81,836
Exports of refined pig lead.....	98,048	48,866	74,392	49,079	14,359	5,814
Lead remaining in bonded warehouse at end of period.....	136,969	87,811	79,215	211,876	156,286	(²)
Refined primary lead available for consumption.....	690,916	339,708	415,031	633,989	830,797	927,522
Estimated consumption of primary and secondary lead.....	900,260	546,000	667,000	782,000	1,050,000	(³)
Prices:						
New York:						
Average for year, cents per pound...	7.47	4.74	5.05	5.18	5.79	6.48
Quotation at end of year.....do.....	6.25	4.85	5.50	5.50	5.85	6.50
London average.....do.....	5.87	3.33	3.09	(⁴)	(⁵)	(⁶)
Mine production of recoverable lead.....	664,230	369,726	413,978	457,392	461,426	496,239
World smelter production of lead.....	1,850,000	1,874,000	1,911,000	(⁷)	(⁸)	(⁹)

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

² Includes 25,324 tons of foreign refined lead re-exported, according to American Bureau of Metal Statistics; official figures not available.

³ Includes 2,874 tons of foreign lead re-exported, according to records of the Department of Commerce.

⁴ Data not available.

⁵ Average for 8 months; London Metal Exchange dealings suspended for duration of war.

⁶ Official maximum price fixed by British Ministry of Supply at £25 per long ton.

Figure 1 shows trends in the domestic lead industry since 1900.

War agency regulations.—Throughout 1942 lead remained under full priority control according to General Preference Order M-38 originally announced in October 1941 and later extended beyond the March 1942 termination date. The order provided for a system of allocation that previously had been restricted to releases of foreign lead purchased and held by the Metals Reserve Co., and a "pooling" arrangement was set up whereby primary producers set aside 15 percent of current output each month for allocation to meet special needs. The subsequent easing of the lead situation eliminated the need for this plan later in 1942, and the emergency 15-percent "pool" was dropped after July until further notice, according to Supplementary Order M-38-j effective July 4.

Under Conservation Order M-38-c, issued January 10, 1942, uses of lead were divided into three classes: A prohibited list, an unlimited list, and all other uses limited to 90 percent of the 1941 consumption in each. In September 1942 when the shortage was less acute industry requested some modification of the conservation order, but not until November 11, 1942, and again on January 1, and again on February 2, 1943, were amendments to the order issued that somewhat liberalized the use of lead for construction purposes and as a substitute for more critical materials, such as tin, brass, and bronze. Likewise, Limitation Order L-180, affecting storage batteries, was amended January 5, 1943, to balance consumption with available production of antimonial lead. Despite the continued requests for freer use of lead, further liberalization of the conservation program is limited by the orders and conservation measures that affect other more critical metals.

In an effort to stimulate domestic Production Management, jointly with the War Relocation Authority, on January 13, 1942, announced a plan whereby producers (miners) included in the plan) received, through a cents a pound for lead produced in output as against the ceiling price established on the same date. This covered a period of 2½ years. In 1942 the price was \$39.60 (later adjusted to \$41.80).

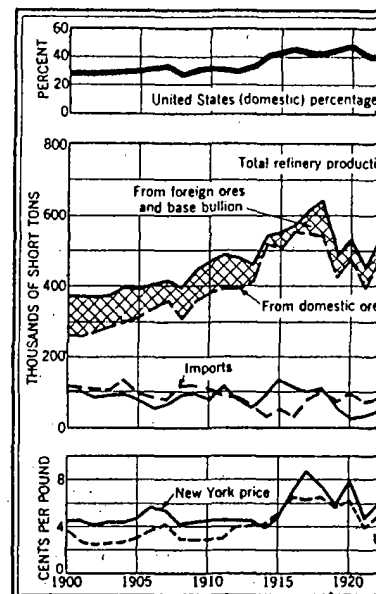


FIGURE 1.—Trends in the lead industry in the United States, 1900-1942. Base bullion, pig lead, and scrap; exports include pig lead.

concentrates was established for equivalent to 2.75 cents per pound per pound of scrap and at secondary plants. On January 18, 1943, the scope of the Metals Reserve Act was extended to include an additional premium of five time limit was extended to July 1, 1943, the highest possible payment for each cent a pound, New York basis, due to the particular mine.

DOMESTIC PRODUCTION

Pig lead is produced at primary plants and at secondary plants. Both types of plants may produce pig lead. Because of the large quantity of b

smelters, their output is essentially antimonial-lead alloys. Figures for production of refined lead at secondary plants are given in the section on Secondary Lead.

The following table shows production of refined lead and antimonial lead at primary refineries from 1938 through 1942.

Refined lead and antimonial lead produced at primary refineries in the United States, 1938-42, in short tons

Year	Refined lead				Antimonial lead
	From domestic ores and base bullion	From foreign ores and base bullion	From scrap	Total	
1938.....	331,964	51,705	24,800	408,469	24,123
1939.....	420,967	63,968	29,011	513,946	21,995
1940.....	433,065	100,114	16,588	549,767	29,762
1941.....	470,517	100,450	13,454	584,421	40,237
1942.....	467,367	99,472	12,856	579,695	51,702

PRIMARY LEAD

Refinery production.—Production of refined primary lead decreased less than 1 percent in 1942.

Refined primary lead produced in the United States, 1938-42, by classes and sources

Year	Production (short tons) by—						Total production ¹		
	Class			Source			Short tons	Value	
	Desilverized lead ²	Soft lead ³		From domestic ores and base bullion	From foreign ores	From foreign base bullion		Average sales price per pound	Total calculated value
		Desilverized	Undesilverized						
1938.....	243,891	31,986	107,792	331,964	32,862	18,843	383,669	\$9.040	\$35,298,000
1939.....	280,366	65,349	138,330	420,967	24,982	38,416	484,035	.047	45,499,000
1940.....	336,466	43,400	153,323	433,066	83,663	16,561	533,179	.050	63,318,000
1941.....	366,386	39,872	164,710	470,517	74,166	28,284	570,967	.057	65,000,000
1942.....	343,971	42,094	180,774	467,367	51,465	17,987	566,839	.063	71,422,000

¹ Lead content of antimonial lead excluded.

² Desilverized soft lead excluded.

³ Includes lead derived from Missouri ores and other nonargentiferous ores.

Sources of primary lead.—Of the total refined primary lead produced in 1942, 82 percent was derived from domestic ores and base bullion and 18 percent from foreign, the same ratio as in 1941. Production from foreign ores increased 10 percent to within 2 percent of the record established in 1940, but lead refined from foreign base bullion was 32 percent less. The marked drop in output of lead from Mexican base bullion is due to larger quantities of bullion being refined in Mexico and does not indicate a corresponding decrease in total Mexican output of lead. This loss was offset in part by a marked increase in base bullion from Australia. Details of the sources of lead from domestic ores are given in the section on Mine Production.

Refined primary lead produced in the United States, 1938-42, by classes and sources

Source	1938
Domestic ore and base bullion.....	331,964
Foreign ore:	
Australia.....	51,705
Canada.....	24,800
Europe.....	16,588
Mexico.....	100,450
South America.....	13,454
Other foreign.....	12,856
Foreign base bullion:	
Australia.....	18,843
Mexico.....	38,416
South America.....	16,561
Other foreign.....	28,284
Total foreign.....	179,872
Grand total.....	579,695

Antimonial lead.—Antimonial product of the refining of base bullion this source is only a small part. The greater part is obtained from scrap, and some is produced by molten soft lead.

Production data from lead-silver materials exclusively are summarized and discussed in detail in the chapter on A large quantity of hard-lead scrap and refineries; the production of soft lead is shown in the following table. Soft lead steadily, but in general the percentage declined correspondingly.

Antimonial lead produced at primary refineries in the United States, 1938-42, in short tons

Year	Production (short tons)	Antimony content	
		Short tons	Percent
1938.....	24,123	2,809	11.6
1939.....	21,995	2,031	9.2
1940.....	29,762	2,944	9.9
1941.....	40,237	3,510	8.7
1942.....	51,702	3,524	6.8

SECONDARY LEAD

Although some scrap lead is refined at a large number of secondary plants, the greater portion is refined at a large number of secondary plants. Secondary refined lead, antimonial lead, other lead at primary and other plants in 1942 is shown in the following table. Secondary lead recovered in 1941 and was equivalent to 69 per

lead output. Further details appear in the chapter on Secondary Metals—Nonferrous.

Secondary lead recovered in the United States, 1941-42, in short tons

	1941	1942
As refined metal:		
At primary plants.....	13,454	12,856
At other plants.....	61,810	55,746
	75,264	68,602
In antimonial lead:		
At primary plants.....	13,862	11,561
At other plants.....	192,660	158,998
	206,522	170,559
In other alloys¹:	115,630	83,840
Grand total:		
Short tons.....	397,416	323,001
Value.....	\$46,305,400	\$40,698,100

¹ Includes some lead in chemical compounds.

LEAD PIGMENTS

Lead pigments manufactured in 1942 contained 223,338 tons of lead—an 18-percent decrease from 1941. Of the 206,680 tons of lead in pigments derived from refined pig lead, litharge contained 42 percent, white lead 36 percent, red lead 22 percent, and sublimed lead, leaded zinc oxide, and orange mineral less than 1 percent. Leaded zinc oxide and sublimed lead are the principal pigments of which the lead content is derived from ores. Details of production and consumption of lead pigments are given in the chapter on Lead and Zinc Pigments and Zinc Salts.

Lead in pigments produced in the United States, 1938-42, by sources, in short tons¹

Year	Lead in pigments from—				Year	Lead in pigments from—			
	Ore		Metal	Total		Ore		Metal	Total
	Domes- tic	Foreign				Domes- tic	Foreign		
1938.....	12,025	-----	163,815	175,840	1941.....	23,951	280	248,674	* 272,615
1939.....	18,171	-----	200,390	218,561	1942.....	15,949	707	206,680	* 223,338
1940.....	16,869	-----	196,235	213,104					

¹ Includes also lead recovered in leaded zinc oxide.

² Includes 400 tons from scrap.

³ Includes 2 tons from scrap.

MINE PRODUCTION

Mine production of lead (including that made into lead pigments) in the United States and Alaska increased 8 percent in 1942, the advance being credited to an over-all gain of 4 percent in the Western States and Alaska and 12 percent in the Central States, which more than compensated for a decline of 19 percent in the Eastern States. Production of lead from southeastern Missouri increased 33,090 tons to a total of 197,432 tons, or about 40 percent of the entire United

States production. The output fell to 34,341 tons, a drop of 6,739 tons. A gain in southwestern Missouri made the greater productive States of Colorado continued to be the leading producer, a 10-percent increase, followed by Utah and 6-percent loss, respectively. The production of recoverable lead was made up of nearly all the zinc-lead mines of at Butte in favor of maintaining labor shortages. Arizona produced a record year of 1941, largely because of lead ore from the Tennessee-Schuyler mine. In Colorado and Washington, the lead content of lead continued to gain, but the the Pioche district, and from Missouri. Details of production by mines, and in the State chapters.

Mine production of recoverable lead in the United States, 1938-42, by States

State	1925-29 (average)	1938
Western States and Alaska:		
Alaska.....	982	10,000
Arizona.....	9,743	10,000
California.....	2,070	10,000
Colorado.....	30,112	10,000
Idaho.....	141,610	10,000
Montana.....	18,871	10,000
Nevada.....	9,807	10,000
New Mexico.....	6,730	10,000
Oregon.....	6	10,000
South Dakota.....	21	10,000
Texas.....	213	10,000
Utah.....	149,609	10,000
Washington.....	1,323	10,000
Wyoming.....		10,000
	370,997	202,000
Central States:		
Arkansas.....	38	10,000
Illinois.....	552	10,000
Kansas.....	26,121	10,000
Kentucky.....	135	10,000
Missouri.....	202,240	10,000
Oklahoma.....	58,306	10,000
Wisconsin.....	1,745	10,000
	289,137	168,000
Eastern States:		
New York.....		10,000
Tennessee.....	250	10,000
Virginia.....	3,546	10,000
North Carolina.....		10,000
	4,096	7,000
	664,230	369,000

Mine production of recoverable lead in the United States, by districts that produced 1,000 tons or more during any year from 1938 to 1942, in short tons

District	State	1938	1939	1940	1941	1942
Southeastern Missouri region.	Missouri	118,870	153,522	169,893	164,342	197,291
Oceur d'Alene region.	Idaho	82,274	81,099	95,099	95,520	106,474
Bingham.	Utah	41,334	36,842	37,857	34,512	39,990
Joplin region.	Kansas, Southwestern Missouri, Oklahoma.	30,400	44,170	35,311	41,080	34,341
Park City region.	Utah	7,258	11,631	19,749	19,094	15,278
Tintic.	do.	9,005	8,618	6,535	9,424	10,176
Butte.	Montana	204	4,708	8,859	8,630	7,206
Harshaw.	Arizona	149	2,287	4,581	8,541	6,132
Metaline.	Washington	4,009	3,509	2,495	3,819	4,553
Resting Springs.	California			870	2,581	4,044
Rush Valley.	Utah	4,619	3,422	4,760	4,168	3,988
Warm Springs.	Idaho	7,370	5,555	5,050	5,334	3,783
Leadville.	Colorado	1,222	1,088	794	1,112	3,348
Central.	New Mexico	340	2,941	3,245	3,902	3,206
Floche.	Nevada	3,214	2,964	5,520	6,822	2,764
St. Lawrence County.	New York	2,005	2,387	1,973	2,100	2,434
Heddlerton.	Montana		7	80	997	2,290
Plover (Blow).	Colorado	29	752	1,925	2,525	2,282
Red Cliff.	do.	933	1,137	1,412	1,710	2,240
Animas.	do.	998	958	2,471	3,045	2,124
Eagle.	Montana	4,301	3,252	4,108	3,294	1,999
Smelter.	do.	710	1,256	1,363	1,527	1,988
Old Hat.	Arizona	1,919	1,861	1,908	2,172	1,801
Upper San Miguel.	Colorado	885	1,489	1,278	1,408	1,716
Barker.	Montana	283	780	131	22	1,704
Austinville.	Virginia	5,338	3,380	2,285	3,390	1,661
Wallapai.	Arizona	4,004	703	2,304	2,408	1,656
Bayhorse.	Idaho	915	999	935	1,437	1,623
Ophir.	Utah	2,013	6,080	5,354	1,537	1,044
Port Hill.	Idaho	291	1,111	1,837	1,601	1,025
Montana.	Montana	212	293	955	1,846	614
Upper Mississippi Valley.	Iowa, Northern Illinois, and Wisconsin.	320	388	453		26
Hog Heaven.	Montana	1,214	2,767	3,588	2,824	6
Cateract.	do.	1,326	1,672	1,904	355	
Oro Blanco.	Arizona	4,150	3,568		1	
Willow Creek.	New Mexico	4,277	1,800			

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 most refiners of secondary material who produce common soft lead. Foreign lead refined in the United States and entered for domestic consumption is included.

Lead stocks at end of year at smelters and refineries in the United States, 1938-42, in short tons

	1938	1939	1940	1941	1942
Refined pig lead.	102,489	82,783	32,458	15,973	28,815
Antimonial lead.	13,413	5,094	8,468	4,212	6,122
	115,902	87,877	40,926	20,185	34,937
Lead in base bullion—					
At smelters and refineries.	15,693	10,337	9,166	8,594	7,359
In transit to refineries.	2,359	3,521	3,457	2,215	1,706
In process at refineries.	16,690	15,956	18,141	17,709	13,925
Lead in ore and matte and in process at smelters.	37,722	29,816	30,764	28,518	22,990
	55,332	50,486	71,722	51,446	50,247
	208,956	143,079	143,412	100,149	117,174

In contrast with 1941 the export of refined and antimonial lead in 1942 resulted in an over-all gain of approximately 20,200 tons at the end of the year by the end of April, followed by the end of August. During the year more than balanced nearly constant to 35,600 tons by the end of November. A slight decrease in output in December reduced inventories to about a net gain of 73 percent over the year. Stocks of lead in ore and matte at smelters and refineries were 3 percent higher in 1942.

Consumers' stocks.—The data at the beginning and end of 1942 are similar to results, as obtained from a comparison estimated to represent 85 to 90 percent of the basis of lead consumed, but they do not necessarily hold as regards inventory of antimonial lead decreased slightly, but there was an over-all decline of 22 percent.

Consumers' stocks of refined soft lead at the end of 1942

	Dec. 31, 1941 ¹	Dec. 31, 1942
Consumers' stocks of refined soft lead at the end of 1942		

¹ Based upon a survey of 500 respondents.
² Revised figures.

DOMESTIC SUPPLY

New supply.—The calculated new supply available for consumption in 1942 was 34 percent above the 1925-29 average. In the following table do not indicate the true trend of the greater part of the large tonnage of the supply in 1942 is still held in inventory.

Refined primary pig lead available for consumption

	Supply:	Imports:	Production:	Withdrawn:	Exports:
Supply available for consumption					

¹ Includes small quantity of "sheets and pipes" refined from refined lead.

Consumption.—Although figures showing the total consumption of lead, primary and secondary (including antimonial lead), are not available for 1942 the total probably was somewhat less than the record 1,050,000 tons consumed in 1941 as reported by the American Bureau of Metal Statistics. Owing to the return of large quantities of secondary lead in discarded and obsolete articles and from the lead-consuming industries, the total consumption of pig lead greatly exceeds the supply of new lead. The supply of new lead was greater in 1942, but the actual tonnage released to consumers was considerably less because of use restrictions, and the proportion of secondary and scrap lead to primary material was probably even higher than normal.

Consumption of refined soft lead in the United States, 1941-42, by grades and uses, in short tons¹

	1941	1942		1941	1942
By grades:			By uses—Continued.		
Domestic:			Collapsible tubes.....	3,720	9,986
Corroding.....	289,679	227,207	Foil.....	51,616	9,375
Chemical.....	150,206	142,213	Pipes, traps, and bends.....	32,948	21,395
Common.....	287,113	134,101	Sheet lead.....	35,480	31,774
Foreign: All grades.....	115,649	92,568	Solder.....	35,630	34,764
Total consumed.....	812,647	596,089	Storage batteries.....	78,982	41,135
			Terneplate.....	2,069	2,337
By uses:			Type metals.....	2,975	943
Ammunition.....	32,959	48,025	White lead.....	83,230	58,372
Bearing metals.....	10,180	12,648	Red lead and litharge.....	143,496	98,667
Cable covering.....	141,161	113,374	Chemicals and insecticides.....	8,861	6,298
Calking lead.....	32,380	9,038	Other uses ²	112,833	94,904
Casting metals.....	9,243	3,074	Total consumed.....	812,647	596,089

¹ Based upon survey of 500 respondents; 1941 figures are revised, but 1942 figures are preliminary and subject to revision.

² Includes consumption of lead in manufacture of tetraethyl lead, lead used for ships' ballast, annealing, galvanizing, brass and bronze, and other miscellaneous uses.

A consumer survey conducted by the Bureau of Mines for the second consecutive year disclosed that the consumption of refined soft lead at 500 plants decreased 27 percent in 1942. Judging from available data as regards supply, shipments, and producers' stocks, receipts of 607,431 tons of refined soft lead by those consumers canvassed indicate that the 1942 coverage was probably 85 to 90 percent. Antimonial lead, unrefined scrap lead, and lead in alloys are not included. The accompanying table presents a 2-year comparison by grades and by uses of soft lead. Consumption of all three grades of domestically refined lead and foreign lead declined, common lead showing the greatest drop (48 percent). Of the total amount used in 1942 (comparative 1941 percentages in parentheses), corroding accounted for 38 (36) percent, chemical 24 (18) percent, common 23 (32) percent, and all grades of foreign 15 (14) percent. Consumption of lead by uses decreased during 1942 except that consumed in making ammunition, bearing metals, collapsible tubes, and terneplate. Use in solder remained virtually unchanged. Cable covering was the largest of the principal uses of soft lead in 1942, followed in order by red lead, litharge, white lead, ammunition, and storage batteries. The effect of conservation measures, use restrictions, and the general industrial change-over from peacetime to wartime economy is particularly apparent with respect to some of the principal uses of lead. The cessation of automobile manufacturing largely was respon-

sible for the drop in the consumption and, to some extent, the decline in lead prices. White lead, the most widely used lead product, experienced a considerable decline, and foil dropped markedly because of restrictions placed on the consumption of lead in packaging.

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 at prices normally based upon quotations from the London Metal Exchange. Since the suspension of the London Metal Exchange in 1939 for the duration of the war the actual influence on New York quotations of the London Metal Exchange has been considerable. St. Louis and New York prices have remained at an amount approximating the freight charge from London. At the beginning of the year prices for lead in New York were 5.85 cents at New York, since March 26, 1941. Effective January 1, 1942, the Price Administration established the ceiling price for lead at 5.85 cents, St. Louis, and 6.50 cents, New York for the remainder of 1942.

The official London maximum price for lead, paid, for Empire and foreign lead, as fixed by the Ministry of Supply in December 1939, remained unchanged.

Average monthly and yearly quoted prices of lead in London, 1938-42, in cents

Month	1940			1941	1942
	St. Louis	New York	London	St. Louis	New York
January.....	5.32	5.47		5.35	5.45
February.....	4.93	5.08		5.45	5.55
March.....	5.04	5.19		5.61	5.70
April.....	4.92	5.07		5.70	5.70
May.....	4.87	5.02		5.70	5.70
June.....	4.85	5.00		5.70	5.70
July.....	4.85	5.00	(¹)	5.70	5.70
August.....	4.70	4.85		5.70	5.70
September.....	4.78	4.93		5.70	5.70
October.....	5.18	5.31		5.70	5.70
November.....	5.58	5.73		5.70	5.70
December.....	5.35	5.50		5.70	5.70
Average.....	5.03	5.18	(¹)	5.64	5.70

¹ St. Louis: Metal Statistics, 1943, p. 465. New York: Metal Statistics, 1943, p. 465. London: Metal Statistics, 1943, p. 465.

² London Metal Exchange dealings suspended for duration of war. British Ministry of Supply at £26 in December 1939.

FOREIGN TRADE

The continued upward trend in imports of lead in 1942. The total receipts of foreign metal but also as lead in ore, matte, and concentrates, not only to supplement the domestic refined lead but also to allow reserve stock piling of a large tonnage.

¹ Figures on imports and exports compiled by M. B. Pries, Department of Commerce.

of this increased supply, coupled with Government control, was to place lead in the position of a substitute metal.

Imports.—Total imports of lead in 1942 again broke all records largely on account of a 35-percent increase in receipts of foreign refined lead over 1941. In this category Mexico furnished 52 percent, Australia nearly 23 percent, Canada 19 percent, and Peru 6 percent as compared with 36, 16, 33, and 15 percent, respectively, in 1941. Nearly all imports of base bullion (97 percent) in 1942 came from Australia, which heretofore has furnished little or no material of this class. Since the war, however, lead bullion in excess of that which could be refined in Australia has been shipped to the United States rather than to other metallurgical centers barred by wartime restrictions. Lead in ores and matte came from many countries but principally from Newfoundland, Australia, Peru, and Canada, which together supplied 81 percent of the total imports of this material.

*Total lead imported into the United States, 1938-42, by forms in which imported, in short tons*¹

Year	Lead in ore and matte	Lead in base bullion	Pigs, bars, and old	Total lead content
1938.....	45,370	15,290	3,236	63,901
1939.....	30,842	48,902	7,139	86,883
1940.....	111,300	19,624	161,568	282,492
1941.....	82,115	24,704	274,395	381,214
1942.....	81,936	37,244	360,264	459,444

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

*Total lead imported into the United States, in ore, base bullion, and refined, 1938-42, by countries, in short tons*¹

Year	Canada	Mexico	Newfoundland	South America	Europe	Other countries	Total
1938.....	3,174	38,467	—	13,426	680	8,154	63,901
1939.....	5,641	52,059	1	16,527	1,971	10,684	86,883
1940.....	8,721	149,493	27,563	63,120	3,891	29,704	282,492
1941.....	95,686	129,446	17,509	69,820	175	98,512	381,214
1942.....	77,677	194,820	26,649	42,263	52	147,073	459,444

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

² Includes imports from Argentina as follows—1938: 4 tons; 1939: 3,302 tons; 1940: 16,469 tons; 1941: 13,374 tons; and 1942: 4,582 tons.

*Total lead imported into the United States in ore, matte, base bullion, pigs, bars, and old, 1938-42, by countries, in short tons*¹

Country	1938	1939	1940	1941	1942
In ore and matte:					
Africa.....	—	7	7,588	575	3,871
Argentina.....	4	3,362	16,469	13,374	4,582
Australia.....	6,434	7,612	17,472	22,634	20,997
Bolivia.....	—	7	2,707	7,314	1,383
Canada.....	3,173	5,624	8,666	5,725	7,468
Chile.....	2,107	1,844	6,271	1,384	3,166
Mexico.....	24,023	3,846	1,804	5,770	2,358
Newfoundland.....	—	—	27,563	17,509	26,649
Peru.....	9,317	7,174	18,383	6,665	11,168
United Kingdom.....	2	1,058	3,498	175	2
Other countries.....	310	308	881	930	392
Total.....	45,370	30,842	111,300	82,115	81,936

See footnote at end of table.

Total lead imported into the United States, old, 1938-42, by countries,

Country	1938
In base bullion:	
Australia.....	14,400
Mexico.....	1,000
Peru.....	1,000
Other countries.....	16,200
In pigs, bars, and old:	
Australia.....	1,000
Canada.....	1,000
Mexico.....	1,000
Peru.....	1,000
Other countries.....	3,200
Total.....	63,901

¹ Data include lead imported for immediate consumption.

Lead imported for consumption in the United States, in short tons

Year	Lead in ores, flue dust, and mattes, n. e. p. f.		Lead in base bullion	
	Short tons	Value	Short tons	Value
1938.....	6,722	\$543,164	304	\$31,147
1939.....	12,317	1,063,612	1,764	196,298
1940.....	70,027	4,659,445	9,902	929,946
1941.....	82,345	5,343,577	17,570	1,743,350
1942.....	90,633	5,685,692	41,977	3,603,028

¹ In addition to quantities shown (values included as follows—1938: 189 tons, valued at \$20,374; 1939: 3,302 tons, valued at \$37,353; and 1942: 1,305 tons, \$137,393. Figures for 1941 and held in stock piles.

Miscellaneous products, containing lead, States

Year	Babbitt metal, solder, white other combinations containing lead	
	Gross weight (short tons)	Lead content (short tons)
1938.....	390	77
1939.....	136	46
1940.....	1,368	429
1941.....	702	241
1942.....	972	274

Exports.—Total exports (excluding lead in 1942 were much less than the high level of 1939 resulted from the Export Control Act of 1940.

Lead exported from the United States, 1938-42

Year	Pigs and bars		Foreign lead exported in manufactures with benefit of draw-back (short tons)	Year	Pigs and bars		Foreign lead exported in manufactures with benefit of draw-back (short tons)
	Short tons	Value			Short tons	Value	
1938	145,866	\$3,354,616	9,061	1941	14,359	\$1,159,148	21,953
1939	74,392	4,547,219	10,379	1942	1,940	286,354	20,248
1940	23,755	1,704,590	15,604				

¹ Includes sheets and pipes; figures not separable.

Pig lead exported from the United States, 1938-42, by destinations, in short tons

Destination	1938 ¹	1939	1940 ²	1941	1942 ³
Countries:					
Belgium	28	588	644		
Brazil	111	647	1,559	764	51
Canada	101	5	34	12	1
Chile	8	323	492	822	18
Cuba		224	517	2,335	
Denmark		1,569			
Finland	560	616	112		
France	(⁴)	840	1,120		
Germany	1,092	8,333			
Hungary		560	437		
Japan	30,203	34,790	11,958	8,154	
Kwantung	314	99	336		
Mexico	11,408	2,922	15	14	7
Netherlands		2,101	2,862		
Norway		1,091			
Panama	87	238	538	379	
Philippine Islands	1,037	974	450	628	
Sweden	23	7,340	301	112	224
United Kingdom	78	9,411	2	407	1,379
Uruguay			350		
Other countries	821	2,021	2,538	732	186
	45,866	74,392	23,755	14,359	1,940
Continents:					
North America	12,002	3,345	865	574	124
South America	803	1,317	3,078	2,334	192
Europe	1,850	32,152	6,400	228	1,608
Asia	31,606	36,122	13,384	11,132	4
Africa and Oceania	5	456	28	91	2

¹ Includes sheets and pipes; figures not separable.

² In addition, 25,324 tons of foreign lead were re-exported, according to American Bureau of Metal Statistics; official figures not available.

³ In addition, 3,874 tons of foreign lead were re-exported, according to records of the Department of Commerce.

⁴ Less than 1 ton.

WORLD ASPECTS OF THE LEAD INDUSTRY

Since 1939 the lack of production data from many of the important lead-producing countries has precluded any official statement of world output. According to estimates published by the Metal Bulletin, London, world smelter production of lead in 1941 reached 1,770,000 metric tons, a slight gain over the 1940 estimate of 1,700,000 tons from the same source. Although no figures are available for 1942, it is doubtful if total smelter production has increased appreciably, if at all. The Bureau of Mines estimated that in 1942 the world mine production of lead (recoverable lead content) amounted to roughly 1,835,000 metric tons, an indication that production did not increase. Based on estimates by countries, about 80 percent of the world's supply of lead ore by the end of 1942 was controlled by, or available to, the United Nations.

World production of lead, 1937-1942

[Compiled by B. B.]

Country	1937	1938
Argentina	9,900	10,200
Australia	232,198	226,155
Belgium	93,310	94,170
Burma	77,728	80,166
Canada	181,162	181,783
China	1,500	(¹)
Czechoslovakia	5,850	(¹)
France	4,300	(¹)
Germany	37,168	41,753
Greece	162,400	171,700
Hungary	10,836	8,280
India	5,890	6,080
Indochina	147	(¹)
Italy	8	10
Japan	38,938	43,287
Mexico	10,200	12,000
Northern Rhodesia	214,653	273,529
Norway	568	277
Peru	236	323
Poland	19,053	28,478
Rumania	17,587	19,973
South Africa	6,725	5,655
Spain	1,855	3,214
Tunisia	31,973	31,509
Union of South Africa	24,758	23,916
U. S. S. R.	55,000	(¹)
United Kingdom	10,313	10,000
United States (refined)	423,232	330,963
Yugoslavia	4,038	8,646
	1,681,000	1,700,000

¹ By countries where smelted, but not necessarily refined.

² Data not yet available.

³ Approximate production.

⁴ Estimate included in total.

⁵ Exclusive of secondary material (Metallgesellschaft, Frankfurt).

⁶ Includes small tonnage of lead contained in exported or imported concentrates.

⁷ Figures cover lead refined from domestic and foreign ores.

⁸ Not included.

REVIEW BY COUNTRY

Argentina.—Production from the lead mine of Jujuy came principally from the Mina Aguilar S. A., subsidiary of the Argentine Republic. Output in 1942 was curtailed owing to the monthly production rate in January 1942 of 1,950 metric tons of lead concentrates. Total production during January 1942 aggregated 1,950 metric tons of the year no further shipments were received from the mine and the port of Santa Fé on January 1942.

Australia.—Mining activities in Australia have been hampered with many adversities such as higher costs of labor, the armed services, and flow of minerals to the armed services. The Minerals Production Board of the Federal Government to expedite the production of strategic minerals by furnishing financial aid and helping to alleviate manpower shortage on its own account.

Production of lead concentrates was maintained by the Zinc Corporation, Ltd., which produced 3,800,000 tons at the beginning of 1942.

Bolivia.—Mine production of lead in Bolivia, largely from small mines in the La Quiaca region, decreased from 15,653 metric tons (lead content in ore) in 1941 to 12,360 tons in 1942. All ore and concentrates are exported. No further information has been received regarding the erection of a lead smelter in the province of Sud Chichos. It was reported that such a plant would be built through the use of funds allotted by the Bolivian Banco Minero.

Brazil.—The Furnas mine in the Iporanga district continued to be the principal lead producer in 1942. Four additional deposits on the Iporanga River, operated by another company, are reported to have estimated reserves of 20,000 metric tons of galena. The State of São Paulo is having the mineral resources of this entire zone explored. The small lead smelter at Apiai, São Paulo, produced 10 tons of lead during the year, all of which was consumed in Brazil.

Burma.—The Bawdwin lead-zinc mines of the Burma Corporation were seized by the Japanese near the end of April 1942. Assuming that the Japanese successfully repair the reported damage to mines, mill, and smelter, the potential peacetime annual output of about 80,000 tons of lead would become available to them.

Canada.—Production of lead in Canada increased from 230,084 short tons in 1941 to 255,751 short tons in 1942. These figures include smelter production plus lead contained in exported ore. Well over 95 percent of the lead is mined in British Columbia almost entirely from the Sullivan mine of the Consolidated Mining & Smelting Co. Sales of primary lead in Canada were placed under a system of control in 1942 whereby no producer could sell or supply primary or secondary lead or lead-base alloys in pig or ingot form without written approval of the Metals Controller of Canada; lead-base type metal, babbitt, and solder were excepted. Extensive exploratory drilling for new deposits was done in an effort to replace the heavy drain on existing reserves. Gulf Lead Mines, Ltd., was organized to continue the development of lead-zinc deposits on the east coast of Hudson Bay. Ore supplies are being supplemented by numerous efforts to recover lead from residues. The slag dumps at the gold mines of the Kirkland Lake and Larder Lake areas of Ontario yielded considerable lead, and the Western Exploration mill produced lead concentrates from tailings dredged from Slocan Lake. The New Calumet was expected to have its new 300-ton zinc-lead concentrator in operation before the end of 1942.

Mexico.—Mine production of lead in Mexico increased 27 percent from 155,259 metric tons (lead content of ore) in 1941 to 197,019 tons during 1942. The most important event in 1942 was the Bateman-Juarez-Telloz agreement between the Metals Reserve Co., the State Department, and the Mexican Government, under which the Metals Reserve Co. contracted to buy 250,000 tons of lead at 5.40 cents a pound each year for the duration of the war; the contract could be extended by mutual agreement after the war. Mexico agreed to stabilize taxes on lead, freeze freight rates, and hold in abeyance certain clauses in the labor laws. In spite of the agreement labor difficulties arose, and at the end of the year the miners were threatening to strike for a 25-percent wage increase. On December 23, a reciprocal trade pact with the United States reduced the duty on lead and lead in ore to 50 percent of the amount set by the United States in 1930. It will remain at this level until 30 days after

the termination of the national emergency, established at 20 percent below the rate of duty in 1930.

In 1942 the Avalos lead smelter of the Financiera Minera del Norte de Mexico Co. at Chihuahua treated 466,549 tons of lead, compared with 311,841 tons of lead in 1941. Production in the Chihuahua district increased in 1942. The Potosí Mining Co. exhausted its main ore body and is in a state of liquidation. Nearly all the cooperative mines in the Taxco district have been turned over to private ownership and operation in 1942. The El Bote Cooperativa Minera "El Bote", S. de R. L., produced 10 tons of lead a day (content in concentrates).

Newfoundland.—The mine production of all concentrates produced amounted to 33,166 tons in 1942 as compared with 33,166 tons in 1941.

North Africa.—The North African mines, which have aroused interest in raw materials since the United Nations. The largest lead producer is the Midelt mine, 15 miles northeast of Midelt. Reserves have been estimated at 60,000 tons on the basis of the concentrates. The concentrating plant has a capacity of about 25,000 tons a year.

The lead-mining industry in Tunisia is based on scattered deposits in the northern part of the country (concentrates?) reportedly averaging normal times about 90 percent of the Tunisian output. At the smelter owned by the Pénarroya, which has a capacity of about 25,000 tons a year, 3,700 tons of lead were produced during the period January 1 to May 1, 1942, producing 3,700 tons of lead in Morocco, Algeria, and Tunisia totaled 3,700 tons.

Peru.—The lead content of concentrates in 1942 was estimated to be about 55,830 tons, compared with 54,822 tons in 1941. This estimate is based on the output of the companies producing 80 percent of the total output. Exports for 1942 included 3,117 metric tons of concentrates, and 36,979 metric tons of refined lead, estimated 8,000, 12,000, and 38,000 tons. The largest lead producer is the Huaron mine, which produced 180,000 tons of positive ore and 500,000 tons of concentrates, averaging 6.89 percent lead, 8.73 percent zinc, and 0.18 percent silver. The Oroya lead smelter, with a capacity of 42,240 tons of refined lead a month, recovered 42,240 tons of refined lead in 1941.

Spain.—According to the official figures of the Board of Spain, the 1942 output was 51,728 tons of concentrates, compared with 43,728 tons in 1941. Deposits are in the Sierra Morena and the Sierra de Guadalupe. There are five lead smelters that report a total output of 100,000 tons of lead annually. Domestic consumption leaving a surplus of about 12,000 tons.

Sweden.—The suspension of virtually all lead mining in Sweden during 1942 has resulted in a surplus of about 12,000 tons.

tion to other metals into Sweden due to the conditions of war has forced the Boliden Mining Co. to further intensify its efforts to produce the metal from Swedish deposits. Reportedly by the summer of 1943, the company will start commercial-scale production from the mine at Laisvall. Lead concentrates produced at this property have a lead content of 80 percent and are shipped to the Rönnskär smelter at Skellefteå.

ZINC

By A. L. RANSOME AND

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GENERAL SUMMARY

In 1942, a year of broken records and industrial mobilization of a nation at standing in its ability to more than between supply and demand. With Government regulatory measures, and increased its output 7 percent above the more an all-time high level of production in stocks. Conservation measures essential needs resulted in an over-all 12-percent increase, but consumers' stocks advanced 6 percent. In domestic shipments of zinc by smelters, gain in exports, principally for Lend-Lease, emphasis placed on the use of High-Grade zinc, rise in production of high-purity metal were made by redistillation of the low grade. As a result of this and also because of use of zinc decreased 8 percent. At the close of the year, usable capacity, with additional expected to bring an already enlarged stock of 1943.

Domestic mine output showed only a slight increase of premium prices, and to full capacity smelters continued to use foreign zinc before. Total imports in 1942 were 10 percent of the total production.

The established ceiling price of 8.25 cents for Western zinc was unchanged during the year. The average of 7.48 cents in 1941 and 6.48 cents in 1942.

This report deals primarily with the smelting branch of the zinc industry. Some zinc ore is used in the production of Lead and Zinc Pigments and Zinc Salts.

Peru.—In 1942 the mines in this country produced 51,263 metric tons of 58-percent zinc concentrates, a substantial increase over the 1941 total of 40,800 tons containing 23,700 tons of extractable zinc. Zinc mining continued to be largely controlled by the Cerro de Pasco Copper Corporation which owns a zinc deposit in central Peru containing ore reserves estimated at 10,000,000 tons containing 17 percent zinc, 6 percent lead, and 6 ounces of silver per ton. The output from the Cerro de Pasco Casapalca mine, which decreased from 15,877 tons of concentrates in 1940 to 13,550 tons in 1941, probably was smaller in 1942. This mine has a flotation plant with a daily capacity of 800 tons. The Huaron mine of the Cie de Mines de Huaron is now producing at the rate of nearly 1,270 tons of 60-percent concentrates a month. In 1943 Cerro de Pasco should finish a new 800-ton daily capacity concentrator, under construction. The smelter at Oroya produces about 800 tons of refined zinc annually which is consumed in South America. Peruvian exports in 1942 were 247 metric tons of zinc in ore, 25,220 tons in concentrates, and 942 tons of refined zinc.

Spain.—Three mines and one smelter were reported operating in 1941. Output of zinc concentrates in 1941 was estimated at 73,000 metric tons. The monthly production rate of zinc concentrates early in 1943 was between 5,500 and 6,000 tons, and the stocks on hand available for export were about 15,000 tons containing 58 percent zinc and 7,000 tons containing 52 percent zinc. The Cie Royale Asturienne des Mines enlarged its plant and installed a special furnace to produce high-grade zinc.

LEAD AND ZINC PIGMENTS

By H. M. MEYER AND

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GENERAL SUMMARY

Activity in the pigments industry advanced in 1942 from the rate that prevailed in 1941 due not to failure of demand but rather to the use of metal, scrap, and ores early in the year. The shipping drums, cans and other containers, and other materials, as the year advanced, revolutionized whole industries, such as the paint industry, one of the principal users of pigments. The regulation of the Office of Defense Production that all shipments by rail be in full compliance with the marked capacity of freight cars.

Supplies of zinc and lead metal were abundant in 1942, but as increasing amounts of metal were used, a record rate of importation, limitation was placed on imports in November. Large-scale production of zinc in New York in August, greatly changing the market for zinc of crude materials for the competitive market. As a result, restrictions on titanium pigments were imposed. The restrictions, nonetheless, had but a temporary effect. Probably the only noteworthy set-back in the production of this group of pigments.

Consumption of the lead oxides for pigments in 1942 was considerably below the rate of 1941, but except for that year it was higher than in 1940. Zinc oxide and lithopone used in the paint industry sharply. The outlook for future need for pigments by inability to gage requirements for pigments in rubber. The use of pigments in paint and varnish, except for red lead, which established a new high rate. Curtailment in the use of lead sulfate for paints and varnish processes. The industry was marked. On the other hand, lead sulfate established a new high record in 1942.

According to the F. W. Dodge Corporation, production in 1942 attained a new high record.

record by 25 percent. The Lumber and Lumber Products Division of the War Production Board anticipates a noteworthy reduction in the number of board feet required by the Nation in 1943 as compared with 1942, or 31,100,000,000 compared with 40,300,000,000. The peak of war construction at army cantonments, drydocks, airports, and shipyards obviously has passed. In 1942 paint materials were largely used to fill Government needs. In its January 11, 1943, issue the Oil, Paint and Drug Reporter estimated that by fall of 1942 the Government was taking approximately 60 percent of total paint materials compared with 25 percent in 1941 and 5 percent in 1940. The large proportion of steel-construction paint requirements is indicated in part by the new high-record use of red lead in paint in 1942. This pigment is the only one in the group covered by this report that showed increased use for paint manufacture; it is well-known for its use in steel-construction paints.

During and after World War I the chemical industry in the United States made great progress. Dr. J. S. Long¹ says that the American paint industry will emerge from World War II independent of the importation of basic commodities from foreign countries. Many of the new products and processes developed since the start of the war have advantages over those used before that time.

The flexibility of the paint-mixing industry will be tested further by the recent (April 1943) amendment to War Production Board Order M-71 of the Fats and Oils Section of the Department of Agriculture, which reduced this trade's quota of linseed oil and of all other drying oils not required immediately for direct war effort and not already embraced in the edible and potential food categories from 60 to 50 percent of the average 1940-41 usage for the second quarter of 1943. Original Order M-71 (effective October 1942) cut chemical and vegetable oils to 70 percent. In a mimeographed release on conservation in the use of linseed oil in paint, Hickson² pointed out that linseed oil is the most widely used drying oil in the paint industry and that about 79 million gallons were consumed in 1940 and about 109 million in 1941, of which 75 to 80 percent was used in the paint and varnish industry. Consumption in 1942 was considered to have been higher than in 1940. Hickson said:

Nearly all the linseed oil used in the United States is manufactured there, but in 1940 more than one-third of the 31 million bushels of flaxseed required was imported, mainly from Argentina. Under present conditions practically no flaxseed is imported from South America. At the same time there have been new demands for the oil, in part to meet the needs of our Allies, and in part to replace other imported oils such as tung (China wood oil) and perilla oils that were used previously.

Adding to the list of paint components whose need as food material is considered greater than their desirability for paint and other industrial uses, the War Production Board has placed processed industrial casein under allocation control under Order M-307.

In connection with the container problems that developed during the year, an article by Lahay³ probably will be of interest. Several papers on packaging problems were read at the 14th Annual Pack-

¹ Long, J. S., War Jogs Us Out of Our Complacency: Paint Industry Magazine, vol. 35, No. 4, April 1943, p. 128.

² Hickson, Eugene F., Conservation of Linseed Oil in Paint: Department of Commerce, Nat. Bureau of Standards Letter Circ. LC-717, February 10, 1943, 8 pp.

³ Lahay, Richard W., Chemical Containers for the Duration: Chem. Ind., vol. 52, No. 3, March 1943, pp. 351-362.

LEAD AND ZINC PIGMENTS

aging Conference in New York early in the April 1943 issue of Chemical Industry.

The increasing use of fiber drums, wood boxes, as well as the expenditure of money already in use in the industry, presents difficulties.

Recently released data on the 1941 show that in that year the United States consumed 41,314 short tons as well as in the United States. The short tons used in manufacturing should be of interest: White lead oil 714 (648), basic sulfate white lead 648 (597), zinc oxide (pure) and zinc leads 2,255 (2,087), and lithopone 177,745 (125).

Through the Reciprocal Trade Information Act, December 1, 1942, the rate of duty on zinc oxide containing not more than 25 percent of lead is 10 cents a pound for oxide in dry form and 15 cents a pound with oil or water. The duty on zinc

Salient statistics of the lead and zinc pigments (average)

	1925-29 (average)	1938
Production (sales) of principal pigments:		
White lead (dry and in oil).....short tons.....	164,483	100,000
Litharge.....do.....	84,845	68,000
Red lead.....do.....	41,382	30,000
Zinc oxide.....do.....	184,208	79,000
Leaded zinc oxide.....do.....	26,809	38,000
Lithopone.....do.....	177,745	125,000
Value of products:		
All lead pigments.....	\$60,092,000	\$28,351,000
All zinc pigments.....	41,314,000	23,301,000
Total.....	101,406,000	51,652,000
Value per ton received by producers:		
White lead (dry).....	178	178
Litharge.....	178	178
Red lead.....	193	193
Zinc oxide.....	133	133
Leaded zinc oxide.....	124	124
Lithopone.....	98	98
Foreign trade:		
Lead pigments:		
Value of exports.....	1,346,000	610,000
Value of imports.....	30,000	10,000
Zinc pigments:		
Value of exports.....	2,150,000	339,000
Value of imports.....	931,000	285,000
Export balance.....	2,535,000	654,000

PRODUCTION

In this report, sales are used as a measure of production, particularly in the case of inventories at the beginning of the year. At times materials classified as "stockpiled" under another description may be a more accurate measure of pigments.

channels. Moreover, pigments produced under one classification at a plant are sometimes employed at the plant of another company for blending into another product covered by the lead and zinc pigments canvass. To prevent duplication, the Bureau of Mines attempts to count the product only in the form in which it enters actual use. Basic lead sulfate used in the manufacture of leaded zinc oxide presents the principal problem in this connection. It is included in the statistics in this report at the leaded zinc oxide stage, at which point it enters use in paints. Some other blending is done; but it does not affect large amounts, and—insofar as possible—the duplication involved is eliminated. Production figures are employed in this report in calculating the metal content of pigments and salts in the section on Raw Materials Used in Manufacture of Lead and Zinc Pigments and Zinc Salts. Pigments used by producers in manufacturing products at their own plants are considered here as sales.

The total value of sales of lead and zinc pigments in 1942 was 18 percent below 1941, falling from \$85,782,000 to \$70,178,000. It was, however, higher than in the 11 years before 1941. The higher average prices generally received for the commodities covered by this report were responsible for the smaller drop in total value as compared with that in the total quantity of the products.

Lead pigments.—In 1941 litharge, red lead, and white lead (dry) had reached new all-time peaks. The declines in these pigments, as well as in others in the lead group, in 1942 may be ascribed, in part at least, to artificial factors—those other than the actual demand. Under the influence of the heavy Government construction program red lead made the best showing of any pigment covered by this report; total sales fell only 10 percent compared with a 34-percent decline for dry white lead, the other extreme in activity among the important pigments. Sales of both red lead and litharge in 1942 exceeded those in all other years except 1941 and were 17 and 8 percent over the averages for 1925–29. White lead in oil decreased 18 percent from 1941, making a better showing than other lead pigments except red lead, but it continued below all others in its relation to other earlier years. Average values received by producers for all lead pigments showed gains in 1942 that ranged, except for the small-tonnage orange mineral, from \$9 a ton for white lead in oil to \$32 for blue lead sulfate. The lead-pigment group decreased 23 percent in total quantity and 15 percent in total value from 1941.

Lead pigments sold by domestic manufacturers in the United States, 1941–42

Pigment	1941			1942		
	Short tons	Value (at plant, exclusive of container)		Short tons	Value (at plant, exclusive of container)	
		Total	Average		Total	Average
Basic lead sulfate or sublimed lead:						
White.....	8,739	\$1,122,822	\$128	7,229	\$1,107,187	\$152
Blue.....	1,631	211,816	130	1,181	191,811	162
Red lead.....	58,838	8,667,409	161	48,369	8,284,230	\$172
Orange mineral.....	246	57,516	234	128	30,843	239
Litharge.....	122,380	18,416,507	134	91,513	13,756,868	150
White lead:						
Dry.....	54,689	8,012,421	147	25,865	5,742,747	222
In oil.....	58,311	12,062,378	207	47,774	10,308,863	216

LEAD AND ZINC PIGMENT

Lead pigments sold by domestic manufacturers in the United States, 1938–42, in short tons

Year	White lead		Barium sulfate
	Dry	In oil	
1938.....	29,813	70,400	
1939.....	30,509	67,920	
1940.....	30,115	50,447	
1941.....	54,689	58,311	
1942.....	35,865	47,774	

Zinc pigments and salts.—In the zinc oxide established a new high record in 1942 but remained above all previous years. Zinc metal and salts have been increasingly popular in 1942 that permitted a better than average showing. Zinc oxide, which is made almost entirely from ores, supplies of either metal or scrap (other sources of zinc oxide) sales were down 33 percent in 1942. Zinc oxide (lead-free) sales were down 33 percent in 1942, supplies of zinc metal and scrap have been reduced in this pigment. Sales of litharge in 1941, having fallen 22 percent. Altogether, zinc pigments and salts were down 28 percent in total quantity in 1942, but in total value because producers of all pigments received higher average prices.

Zinc pigments and salts sold by domestic manufacturers in the United States, 1941–42

Pigment or salt	1941	
	Short tons	Value exclusive of container
		Total
Zinc oxide ¹	148,833	\$18,558,400
Leaded zinc oxide ¹	68,920	8,101,700
Lithopone.....	176,842	12,550,000
Zinc chloride, 50° B.....	(1)	(1)
Zinc sulfate.....	19,201	1,424,400

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

² Data not available.

Zinc pigments and salts sold by domestic manufacturers in the United States, 1938–42, in short tons

Year	Zinc oxide	Zinc metal and salts
1938.....	79,120	
1939.....	114,532	
1940.....	113,213	
1941.....	148,833	
1942.....	99,677	

¹ Data not available.

Sales of zinc chloride totaled 52,374 tons (50° B.) in 1942. Comparable data for a number of earlier years are not available. The figures for 1942 include the equivalent zinc chloride content of chromated zinc chloride and zinc ammonium chloride sold.

Except for the high record quantity for 1941, sales of zinc sulfate were at peak levels in 1942. The total for 1942 lagged 25 percent behind 1941 which, however, was 61 percent above the previous record, attained in 1940.

CONSUMPTION BY INDUSTRIES

White lead.—Sales of dry white lead declined 34 percent from 1941, and the "in oil" variety fell 18 percent; the total was 26 percent below 1941 and 46 percent less than the 1925-29 average. The predominant use of both classes of product is in the manufacture of paints, and 92 percent was so used in 1942.

Distribution of white lead (dry and in oil) sales, 1938-42, by industries, in short tons

Industry	1938	1939	1940	1941	1942
Paint.....	95,018	92,380	73,137	100,665	76,837
Ceramics.....	1,918	1,767	8,029	3,704	1,812
Other.....	3,277	4,282	4,396	8,631	4,980
	100,213	98,429	85,562	113,000	83,639

Basic lead sulfate.—Basic lead sulfate also goes mainly into paints, either directly or as a component of leaded zinc oxide. The statistics for basic lead sulfate do not include the quantity used for blending into leaded zinc oxide, the amount so used being accounted for under the latter pigment. In 1941 the use of basic sulfate in the manufacture of leaded zinc oxide reached a peak total of 12,000 tons; in 1942 it amounted to 6,000 tons.

Distribution of basic lead sulfate sales, 1938-42, by industries, in short tons

Industry	1938	1939	1940	1941	1942
Paints.....	5,024	5,170	5,593	9,285	7,733
Rubber.....	91	140	128	200	89
Storage batteries.....	8	4	4	8	—
Other.....	683	224	475	877	588
	5,801	5,538	6,200	10,370	8,410

Red lead.—This pigment receded from its peak performance in 1941 but maintained a high rate of activity in the face of more serious declines all along the line. Sales in 1942 were 10 percent below 1941 but, except for that year, were the highest ever recorded, surpassing even the heavy construction period in the prosperous twenties. An important reason for the favorable record is the performance of this pigment in construction paints. Red lead is used principally in the manufacture of storage batteries. Its use for this purpose was below the amounts so consumed in 1939, 1940, and 1941, whereas sales for paint manufacture were at new high record levels in 1942. In 1939-40 paint manufacture took 28 percent of the total red lead sold, whereas in 1941 and 1942 it took 37 and 43 percent.

LEAD AND ZINC PIGMENTS

Distribution of red lead sales, 1938-42, by industries, in short tons

Industry	1938
Storage batteries.....	19,812
Paints.....	8,631
Ceramics.....	1,812
Other.....	3,277

Orange mineral.—This pigment is used in the manufacture of ink. The manufacture of ink has been restricted by War Production Board, limiting of 1942 to 70 percent of that used in 1941. The order was withdrawn in August.

Distribution of orange mineral sales, 1938-42, by industries, in short tons

Industry	1938
Ink manufacture.....	—
Color pigments.....	—
Other.....	—

Litharge.—Although sales of litharge were less than in 1941, they were the largest since 1929. Over a period of years the use of litharge has shown an up-trend. Its use for insecticides was 24 percent less than in 1941 but above all earlier years. Its use in ceramics dropped 48 percent in that year probably had not been exceeded in every year since 1929. In that year pigments fell 47, oil refining 29, and litharge in oil refining with 13,615 tons in 1929. In the manufacture of batteries, the storage batteries themselves make a black or suboxide of lead for litharge. Whereas the quantity of litharge (in short tons) was below the peak quantity in 1941, the former record level established in 1941 was not included in the Bureau of Mines statistics.

Distribution of litharge sales, 1938-42, by industries, in short tons

Industry	1938
Storage batteries.....	32,000
Insecticides.....	11,000
Ceramics.....	5,000
Chrome pigments.....	5,000
Oil refining.....	9,000
Rubber.....	—
Varnish.....	2,000
Linoleum.....	—
Other.....	3,000

Zinc oxide.—Zinc oxide production was affected adversely by the scarcity of zinc metal and scrap. Metal and scrap supplies have been restricted for several years; as a result, the proportion of zinc oxide made from ores has advanced sharply. Zinc oxide produced by the American process (from ore) accounted for 58 percent in 1936; it was 64 percent in 1940, 76 in 1941, and 84 in 1942. French process (from metal and scrap) meanwhile accounted for 42, 36, 24, and 16 percent respectively, in those years. The proportion of French-process oxide made from scrap has also been on the up-trend. It amounted to 22 percent in 1936 and 45 in 1940 and 1941 but dropped back to 40 in 1942.

Total zinc oxide sales declined 33 percent in 1942, the amounts sold for use in rubber and ceramics showing the most severe drops. The paint class performed better than all others.

Supplementary Order M-11-a was amended in May 1942 (effective June 1) to read that each producer of zinc oxide shall set aside from his production each month quantities to be determined from time to time by the Director of Industry Operations, the remainder to be distributed so that each customer would receive an equal percentage of the producer's commitments to him. For some time no zinc oxide has been set aside because of an excess already in the pool.

Distribution of zinc oxide sales, 1938-42, by industries, in short tons

Industry	1938	1939	1940	1941	1942
Rubber.....	46,266	70,187	70,979	90,429	82,111
Paints.....	20,884	28,334	23,268	30,304	28,111
Floor coverings and textiles.....	3,030	5,641	4,752	6,991	5,211
Ceramics.....	4,908	6,572	6,352	8,596	7,211
Other.....	4,041	6,818	7,882	12,513	11,211
	79,129	114,552	113,213	148,833	134,957

Leaded zinc oxide.—Sales of leaded zinc oxide declined 30 percent in 1942, which was almost as severe as the drop in sales of zinc oxide (lead-free). On the basis of long-time trends, however, it has fared far better than the lead-free class. Except for 1941, the leaded group was higher than in any other year and was 81 percent above the annual average for 1925-29. The lead-free class, on the other hand, was 10 percent below the 1925-29 average. Leaded zinc oxide is made entirely from ores, and although these supplies were not abundant they were notably larger than those for metal and scrap. Paint consumes virtually all of the leaded zinc oxide made. The figures for leaded zinc oxide include basic lead sulfate used in blending as indicated under "Basic lead sulfate."

Distribution of leaded zinc oxide sales, 1938-42, by industries, in short tons

Industry	1938	1939	1940	1941	1942
Paints.....	37,348	41,519	44,341	67,472	51,111
Rubber.....	858	1,164	1,021	1,447	1,111
Other.....					
	38,216	42,684	45,362	68,920	52,222

Lithopone.—Lithopone statistics are reported on the basis of regular lithopone content of high-strength lithopone plus normal lithopone sold as such. Lithopone sales in 1942 held up better

than the average for the zinc-pigment group, 1941 sales for the year 1941 were close to 1940. The distribution of lithopone for floor coverings and textiles were 18 percent in 1942 but was 18 percent lower. Based on some comparison of the 1942 quantities shown for floor coverings and textiles indicates that the oil cloth and felt-base floor coverings and textiles (oil cloth, shade cloth, etc.) and other sales in 1942 included (incomplete) for printing ink. Figure for printing ink cannot be separated from the principal item under "other" uses covered by Order M-128 of the War Production Administration. The "other" class is too small to show plant capacity for the production of lithopone, 182,000 tons at the end of 1942, was provided for the establishment of a new plant for the production of lithopone, of which lithopone is the principal product. Order had been completed, however, but no use was made of the power plant. On the books should it be needed.

Distribution of lithopone sales, 1938-42, by industries, in short tons

Industry	1938	1939	1940	1941	1942
Floor coverings and textiles.....	101,924	15,400	3,148	6,274	125,746
Other.....					
	101,924	15,400	3,148	6,274	125,746

a quantity, not separable, used for printing ink, consumption of ordinary-strength lithopone (which usually peaked in 1937, when 19,400 tons were sold, about half of the record amount, is shown in the following table for lithopone in the preceding table.

Lithopone produced in the United States, its manufacture, 1938-42, in short tons

Year	Titanated lithopone produced	Ordinary lithopone used	1941	1942
1938	20,100	17,000		
1939	16,100	13,700		
1940	18,100	15,200		
1941				
1942				

Zinc sulfide.—In recent years as many as 100,000 tons of zinc sulfide, but one company has been producing it. For that reason the Bureau has not reported the figures for this pigment. On

Zinc chloride.—Sales of zinc chloride, in terms of 50° B. solution, totaled 52,374 tons in 1942. These figures include the zinc chloride equivalent of zinc ammonium chloride and chromated zinc chloride produced. Comparable data for recent earlier years are not available.

Zinc sulfate.—Although sales of zinc sulfate declined 25 percent from 1941, they were the highest ever recorded, except for that year. One reason for the recent records for this salt is its increasing use for agricultural purposes. This use made noteworthy gains in 1942 as against the declines in most other uses. Much less zinc sulfate was consumed in the manufacture of rayon, chemicals, and glue in 1942 than in 1941, but the amounts so used compared favorably with other years. Consumption of zinc sulfate in paint and varnish processing has been increasing rapidly in recent years, and it reached new heights in 1942 when it rose 35 percent over 1941. Its use as a flotation reagent has also been gaining.

The large quantity of zinc sulfate produced as an intermediate product in the manufacture of lithopone is excluded from the zinc sulfate statistics.

Distribution of zinc sulfate sales, 1938-42, by industries, in short tons

Industry	1938	1939	1940	1941	1942
Agriculture.....	1,664	2,168	2,366	3,038	11,912
Rayon.....	2,851	3,897	3,649	5,170	1,112
Chemicals.....	947	1,309	2,181	5,585	1,112
Paints and varnish processing.....	658	553	1,509	1,422	1,112
Glue.....	285	172	320	1,203	1,112
Flotation reagent.....	63	268	241	312	1,112
Electroplating.....	284	556	348	502	1,112
Textile dyeing and printing.....	59	172	54	130	1,112
Other.....	948	1,206	1,299	1,869	1,112
	7,757	10,157	11,937	19,201	1,112

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

Lead pigments and zinc pigments and salts are manufactured from a variety of materials, including ore, refined metal, and such miscellaneous secondary materials as scrap and waste from various industrial processes. In 1942, 93 percent of the lead pigments was derived from pig lead and 7 percent from ore. A small part of the ore used was foreign. The proportion for zinc pigments in 1942 was 79 percent from ore, 6 percent from slab zinc, and 15 percent from secondary materials; 9 percent of the ore used was foreign.

Metal content of lead and zinc pigments produced by domestic manufacturers, 1941 and 1942, by sources, in short tons

Source	1941		1942	
	Lead in pigments ¹	Zinc in pigments	Lead in pigments ¹	Zinc in pigments
Ore:				
Domestic.....	23,951	129,520	15,949	707
Foreign.....	290	2,464	707	2
Metal.....	248,674	18,463	208,689	2
Secondary material ²	400	31,703	2	2
	273,315	170,150	223,338	2

¹ Includes also lead recovered in leaded zinc oxide.
² Zinc ashes, skimmings, drosses, and old metal.

LEAD AND ZINC PIGMENTS

The following tables give the source of each pigment and salt. Pigments may be directly or indirectly, in the manufacture of lead and orange mineral and is used in the manufacture of lead sulfate. The lead content of lead sulfate, which in turn was made from the table. Zinc oxide is the most important lead zinc is used. Ore is employed in the manufacture of leaded zinc oxide, lithopone, and zinc chloride made in the United States. A substantial proportion of the secondary zinc consumed in the manufacture of lead pigments in 1933. The scarcity of zinc metal and the proportions of zinc oxide made in 1942.

Metal content of lead and zinc pigments produced by domestic manufacturers, 1941 and 1942, by sources, in short tons

Source	1941		1942	
	Lead in pigments produced from—	Total lead in pigments	Zinc in pigments and salts produced from—	Total zinc in pigments and salts
Ore:				
Domestic.....	86,760	86,760	112,099	112,099
Foreign.....	47,615	47,615	172	172
Metal.....	1,126	1,126	400	400
Secondary material.....	17,820	17,820	2	2
	23,951	23,951	248,674	248,674

Metal content of zinc pigments and salts produced by domestic manufacturers, 1941 and 1942, by sources, in short tons

Source	1941		1942	
	Zinc in pigments and salts produced from—	Total zinc in pigments and salts	Zinc in pigments and salts produced from—	Total zinc in pigments and salts
Ore:				
Domestic.....	87,999	87,999	15,435	15,435
Foreign.....	27,508	27,508	1,469	1,469
Metal.....	14,013	14,013	28	28
Secondary material.....	2,831	2,831	2,840	2,840
	132,350	132,350	17,732	17,732

Figures are higher than those shown in the report on Secondary materials recovered from byproduct sludges, residues, etc., not classified.

PRICES

The total and average values reported by producers for lead and zinc pigments are given in the tables in the first part of this report. For all of the lead pigments average values were \$9 to \$32 a ton higher than in 1941; the small-tonnage orange mineral gained \$5. All of them were at their lowest points for the year in January, which coincided with the highest levels attained in 1941. For each pigment, except basic lead sulfate (white), the gains in 1942 amounted to $\frac{1}{4}$ cent a pound. In general, the high points were reached in the first 2 months, and prices continued at these levels for the remainder of the year and beyond. Litharge did not reach a peak until June. Basic sulfate (white) advanced $\frac{1}{4}$ cent in April and dropped back $\frac{1}{4}$ cent in July.

Pig lead, price changes for which are usually followed closely by those for lead pigments, was under ceiling price limitations beginning January 1942. The ceiling price for common lead, delivered New York, was 6.50 cents a pound. Corroding lead and chemical lead were allowed premiums of 0.10 cent a pound.

Average values reported for all zinc pigments sold were also higher in 1942, the gains ranging from \$13 a ton for zinc oxide to \$8 for lithopone. The average value for zinc sulfate rose \$8 a ton in 1942. The voluntary price ceilings on zinc oxide agreed to by producers, following requests in December 1941 from the Office of Price Administration, were given in the chapter of this series for 1941. On the whole, prices throughout 1942 were $\frac{1}{4}$ cent a pound above those of the previous year. Late in March negotiations were carried on to increase the voluntary ceilings on leaded zinc oxide containing 35 percent or more lead to 7 cents a pound. The proposed increase was caused by advances in the price of basic sulfate, a basic ingredient of leaded zinc oxide. Later in the month the sweeping General Maximum Price Regulation gathered all grades of zinc oxide among other chemicals, oils, paints, and other commodities under its provisions. Prices under the Regulation were not to exceed the highest ones prevailing in March 1942. In June the Office of Price Administration established the maximum price of 7 cents a pound for the leaded grade mentioned above, effective June 22. Later the effective date was moved back to May 11. A premium of $\frac{1}{4}$ cent a pound was permitted for delivery of oxide in barrels, another $\frac{1}{4}$ cent for delivery of less than carlots, and an additional $\frac{1}{4}$ cent for delivery in less than carlots to consumers in California, Oregon, or Washington. Price Schedule 80 of the Office of Price Administration, effective February 2, 1942, set a maximum price of 4.25 cents a pound for the normal grade of lithopone.

LEAD AND ZINC PIGMENTS

Range of quotations on lead pigments and
(or delivered in the East), 1941-1942

Product
Basic lead sulfate, or sublimed lead, less than carlots, barrels
White lead, or basic lead carbonate, dry, carlots, barrels
Litharge, commercial, powdered, barrels
Red lead, dry, 95 percent or less, less than carlots, barrels
Orange mineral, American, small lots, barrels
Zinc oxide:
American process, lead-free, bags, carlots
American process, 5 to 35 percent lead, barrels, carlots
French process, red seal, bags, carlots
French process, green seal, bags, carlots
French process, white seal, barrels, carlots
Lithopone, domestic, 5-ton lots, bags
Zinc sulfide, less than carlots, bags, barrels
Zinc chloride, works:
Solution, tanks
Fused, drums
Zinc sulfate, crystals, barrels

FOREIGN

All of the most important items pigments are in the export classification: lead, litharge, zinc oxide, and lithopone. Exports of all of the important pigments from the previous year but compare immediately preceding 1941. Available data appear in the following tables.

Value of foreign trade of the United States
1941-1942

	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 sulfate	
Other zinc salts and compounds	
Grand total	

¹ Data not available.

² Figures on imports and exports compiled by M. B. Department of Commerce.

Lead pigments and salts imported for consumption in the United States, 1938-42

Year	Short tons					Total value
	Basic carbonate white lead	Red lead	Litharge	Orange mineral	Lead compounds	
1938.....	20	1	1	2	85	\$22,644
1939.....	11	2		1	104	28,248
1940.....	2		(¹)	1		13,989
1941.....	2	3			17	15,307
1942.....		2	2		11	5,841

¹ Includes also—1938: Lead pigments, n. s. p. f., \$198 (2,330 pounds), and suboxide of lead, n. s. p. f., \$5,335 (81,834 pounds); 1939: Lead pigments, n. s. p. f., \$900 (5,270 pounds), and suboxide of lead, n. s. p. f., \$9,620 (40,445 pounds); 1940: Suboxide of lead, n. s. p. f., \$13,571 (71,148 pounds); 1941: Suboxide of lead, n. s. p. f., \$11,694 (65,208 pounds); 1942: Suboxide of lead, n. s. p. f., \$3,221 (13,228 pounds).

² Less than 1 ton.

Lead pigments and salts exported from the United States, 1938-42

Year	Short tons						Total value
	White lead	Red lead	Litharge	Orange mineral	Sublimed lead	Lead arsenate	
1938.....	1,411	806	1,694	(¹)	(¹)	511	\$605,075
1939.....	2,024	1,324	2,077	(¹)	(¹)	866	875,235
1940.....	1,380	1,335	1,586	(¹)	(¹)	1,450	836,230
1941.....	2,801	2,968	2,892	(¹)	(¹)	4,797	2,100,335
1942.....	2,249	1,391	1,999	7	96	296	1,030,472

¹ Not compiled on an annual basis prior to 1942.

Zinc pigments and salts imported for consumption in the United States, 1938-42

Year	Short tons						Total value
	Zinc oxide		Lithopone	Zinc sulfide	Zinc chloride	Zinc sulfate	
	Dry	In oil					
1938.....	579	66	3,932	12	272	392	\$321,445
1939.....	1,485	66	2,641	7	399	325	317,719
1940.....	273	45		(1)	19	245	64,923
1941.....	122	11	(1)	1		162	29,835
1942.....	13	1		1		362	26,390

¹ Less than 1 ton.

Zinc pigments and salts¹ exported from the United States, 1938-42

Year	Short tons		Total value	Year	Short tons		Total value
	Zinc oxide	Lithopone			Zinc oxide	Lithopone	
1938.....	1,163	1,734	\$339,415	1941.....	8,284	21,527	\$3,525,366
1939.....	3,485	4,845	925,408	1942.....	6,013	17,036	2,912,795
1940.....	8,239	14,298	1,684,667				

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

² Includes also: Zinc sulfide \$5,328 (37,091 pounds); zinc chloride, \$42,574 (648,343 pounds); zinc sulfate, \$53,624 (1,025,554 pounds); other zinc salts and compounds, \$76,023 (692,029 pounds).

GOLD, SILVER, COPPER

(MIN)

By CHAS.

SUMMARY

Summary.....
Calculation of value of metal production.....

SUM

Gold recovered from Alaska 487,621 fine ounces valued at \$24,341,345 in 1941, was 99 percent of the copper, and lead produced. The were byproducts of gold mining mines decreased from 56 in 1941 to 31 in 1942, from 752 to 422.

The outbreak of the war in D enterprises, both large and small, is virtually responsible for the lode and placer mines. The expenditure of hundreds of airfields, pipe lines, Navy bases, construction necessary for the defense offered laborers on these project positions at the mines and closed several of the lode mines, opening in 1942, and forced a handed. Dragline operators who were unable to finish the 1942 their equipment to contractors.

War Production Board Gold coming as it did on October 8, in Alaska in 1942, inasmuch as and dredges and most lode mining full brunt of the order will be Goodnews Bay platinum operation the war. Only three important of 1943, and these were permitted.

All tonnage figures are short do not include moisture.

Yardage figures used in measurements are "bank measure"; the ground before treatment.

The value of metal production at the following prices.

Colombia.—Colombia exported 49,163 ounces of crude platinum in 1942 (37,349 in 1941). The South American Gold & Platinum Co. produced 25,786 ounces of crude platinum metals in 1942 (30,548 in 1941) and 51,974 ounces of gold (72,582 in 1941). The figures for other operators are not available.

Union of South Africa.—Figures on output of platinum metals are not available for all of 1942, but it is reported that production to the full capacity of the plant proceeded uninterruptedly during the year. The output was shipped to England for refining.

World production of platinum and allied metals, 1937-42, in troy ounces

[Compiled by B. B. Waldbauer]

Country and product	1937	1938	1939	1940	1941	1942
Australia:						
New South Wales: Placer platinum.....	46	8	(¹)	(¹)	(¹)	(¹)
Tasmania: Placer osmiridium.....	586	191	283	(¹)	(¹)	(¹)
Belgian Congo: From refineries:						
Palladium.....	12,507	1,575	3,312	(¹)	(¹)	(¹)
Platinum.....	2,122	225	868	(¹)	(¹)	(¹)
Canada:						
Placer platinum.....	22	16	25	24	60	30
From refineries: ²						
Platinum.....	139,355	161,310	148,877	108,464	124,257	238,400
Other platinum metals.....	119,829	130,893	135,402	91,522	97,432	226,600
Colombia: Placer platinum (exports).....	29,315	34,549	39,070	35,859	37,349	49,163
Ethiopia: Placer platinum.....	3,378	3,537	(¹)	(¹)	(¹)	(¹)
Italy: From refineries: Platinum.....	1,286	1,029	(¹)	(¹)	(¹)	(¹)
Japan: Placer platinum.....	(¹)	(¹)	(¹)	(¹)	(¹)	(¹)
Netherlands Indies (probably placer platinum).....	21	28	34	(¹)	(¹)	(¹)
New Zealand: Placer platinum.....	55	1	13	(¹)	35	(¹)
Panama: Placer platinum.....	267	(¹)	(¹)	(¹)	(¹)	(¹)
Papua:³						
Placer platinum.....	20	41	2	(¹)	(¹)	(¹)
Placer osmiridium.....	8	4	4	(¹)	(¹)	(¹)
Sierra Leone: Placer platinum.....	308	180	83	135	(¹)	(¹)
Union of South Africa:						
Platinum (content of platinum metals) ⁴	17,770	18,250	18,008	20,140	* 14,205	* 10,805
Concentrates (content of platinum metals) ⁴	21,849	35,124	41,243	51,835	* 54,790	* 43,825
Osmiridium ⁵	5,790	5,354	7,031	(¹)	(¹)	(¹)
U. S. S. R.: Placer platinum⁶.....	100,000	100,000	100,000	100,000	100,000	100,000
United States:						
Placer platinum.....	10,803	40,032	32,460	33,800	20,221	* 23,213
Ore (content of platinum metals) ⁷	124	90	60	(¹)	15	20
From refineries: ⁸						
Platinum.....	4,761	3,761	5,270	4,470	1,805	4,333
Other platinum metals.....	5,817	3,486	3,364	3,304	4,689	5,472
	11 476,000	11 541,000	11 540,000	11 465,000	11 483,000	11 790,000

¹ Data not available.

² Recovered from nickel-copper mattes.

³ Year ended June 30 of year stated.

⁴ Produced from platinum ores.

⁵ January to November, inclusive.

⁶ January to October, inclusive.

⁷ Produced from treatment of gold ores on the Rand.

⁸ Estimated production.

⁹ Subject to revision.

¹⁰ New platinum metals recovered in gold and copper refining of domestic materials.

¹¹ Estimate.

TITANIUM

By ALLAN F. MASON

SUMMARY OUTLINE

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GENERAL STATEMENT

The fading of summer in the Adirondacks has not yet brought it the first large-scale shipments of ilmenite to New York, which is to render the United States principal ore of titanium. Domestic production in 1942 compared with 1941, but rutile fell below its normal level by a plant-expansion property. Mining of both titanium minerals greatly in 1943. Ilmenite imports, normally slumped in 1942 to a fraction of their former levels, to draw heavily on their stocks while rutile to reach its stride. In contrast, rutile fell in 1942 because of the smaller tonnage of rutile. priority rating, the relative proximity of the availability of cargo space on vessels rendering primary supplies to Australia. White pigment took the bulk of the ilmenite and rutile in 1942, but both minerals also were consumed.

GOVERNMENT CONTROL

Rutile was put under import control by the War Relocation Administration, December 26, 1941 (Order M-4). Restrictions on ilmenite were removed by the War Relocation Administration, June 26, 1942 (Amendment 2, Order M-4). Titanium pigments were directed to set aside a production for allocation by the Office of War Relocation, effective December 1, 1941 (Order M-4). The effective date to January 1, 1942, effective February 1 increased the allocation of the output; and December 9 revoked the verbally requested by the War Production Administration to divert to welding-rod and alloy production normally moving to ceramics manufacture to that effect was promulgated.

Price action on titanium pigments first appeared January 3, 1942, when to stem a proposed advance the Office of Price Administration requested stabilization of prices at levels of October 1, 1941. The request was made mandatory March 1, 1942 (Price Schedule 98). Amendments allowed one producer to sell above the maximum price for 2 months, provided for additional means of enforcement, and after December 2 permitted adjustable pricing for long-term contracts.

DOMESTIC PRODUCTION

Ilmenite production in the United States tripled in 1942 compared with 1941 and set a new record, but rutile output decreased 15 percent. The decline was due primarily to a stoppage of Arkansas production during plant enlargement. Ilmenite concentrates shipped in 1942 contained 42 to 52 percent TiO_2 , and rutile concentrates ranged from 90 to 94 percent TiO_2 . Production and shipments, 1939-42, are shown in the following table. The Bureau of Mines is not at liberty to publish corresponding figures for 1929-38.

Production and mine shipments of titanium concentrates from domestic ores in the United States, 1939-42

Year	Ilmenite			Rutile		
	Production (short tons)	Shipments		Production (short tons)	Shipments	
		Short tons	Value ¹		Short tons	Value
1939.....	14,602	16,872	\$137,042	(²)	(²)	(²)
1940.....	20,668	20,702	183,686	2,888	2,657	\$393,243
1941.....	23,297	21,526	196,522	3,130	3,431	493,782
1942.....	(²)	(²)	(²)	2,648	2,649	410,956

¹ Represents cost of production for some producers whose product is consumed by affiliated companies.
² Bureau of Mines not at liberty to publish figures.

Arkansas.—The Titanium Corporation sold its rutile property at Malvern, Magnet Cove district, Hot Spring County, in March 1942 to the Titanium Alloy Co. of Arkansas, Inc., subsidiary of the Titanium Alloy Manufacturing Co. The property was inactive from January to September, during which time the concentrating plant was enlarged. In its decade (1932-42) of operation the Titanium Corporation produced 3,771 short tons of rutile averaging 93 percent TiO_2 and shipped 3,621 tons valued at \$440,758. In addition, it produced 1,281 tons of rutile averaging 52 percent TiO_2 and shipped 29 tons valued at \$583; the remainder was an inventory sold with the plant and will be brought up to commercial grade by the new operator.

Florida.—For 3 years the Riz Mineral Co. (formerly the Consolidated Operations Corporation) has been recovering rutile, ilmenite, and zircon from beach sands near Melbourne, Brevard County. Unworked since 1927, the beach deposits in Duval and St. Johns Counties near Jacksonville will yield large quantities of rutile in 1943, according to present plans of the Titanium Alloy Manufacturing Co.

New York.—The Sanford Lake titaniferous magnetite deposit near Tahawus, Essex County, was opened in 1942 by the Titanium Division of the National Lead Co., which granted a 25-percent interest in the

project to the Krebs Pigment & Chemical Co., Inc. The mine is known as the Sanford Lake deposit.¹ Production began in August and is well on the way toward a daily output of concentrates (48 percent TiO_2) and 1,800 tons of concentrates (64 percent Fe, low P, 9 percent TiO_2) from 4,500 tons of ore (16 percent TiO_2). The process involves grinding to pass a 20-mesh screen, followed by wet and dry magnetic separators. There are 15 million tons, and probable reserves of 15 million tons, of ore.

North Carolina.—Ilmenite production was reported at Finley, Caldwell County, by the Glidden Co., a subsidiary of the Glidden Co. The feature is a deposit of black sands of Albemarle Sound with ilmenite. The North Carolina State Board of Conservation is studying the deposit. The Pont de Nemours & Co., Inc., Wilmington, is not encouraging. A rutile deposit near Seaford, Delaware, from which some shipments were made in 1941, is being developed in 1941 by the Southern Mineral Products Co. Most of the property was condemned by the Federal authority for its Chatuge Dam project.

Virginia.—Rutile and ilmenite are produced at the American Rutile Co., a subsidiary of the American Metal & Thermit Corporation. Ilmenite is produced by the Southern Mineral Products Co., a subsidiary of the American Metal & Thermit Corporation of America; this property is estimated to have 4 million tons of titanium dioxide.²

FOREIGN TRADE

Imports.—Ilmenite imports in 1942 came from Canada, 2,942³ from Australia, 1,287⁴ from India compared with 1941 entries of 15,000 from Canada, 4,093⁴ from Australia, 3,700 from Portugal. Imports of rutile in 1942 came from Brazil, 4,661⁴ from Australia, 111 from France and 35 from French Cameroun compared with 1941 imports of 2,448 from Australia and 2,448 from Brazil. The rutile is classified as "Zirconium ore" by the Department of Commerce, and the remaining concentrates are ilmenite with some gangue (magnetite, hematite, etc.). The ilmenite content of such concentrates is shown in the preceding figures. After importation the concentrates are separated into their component minerals by the Titanium Alloy Manufacturing Co. (subsidiary of the American Metal & Thermit Co., and Ventures, Ltd.), Carteret, N. J.; (subsidiary of the American Metal & Thermit Co., Pa.); and Titanium Alloy Manufacturing Co. There were no imports of ferrotitanium.

¹ Crockett, R. E., *Eastern Magnetite: Min. and Met.*, vol. 2, No. 12, December 1942, pp. 47-49.
² Hagar, I. D., *Ilmenite and Magnetite Produced in Quantity*, *Min. and Met.*, vol. 23, No. 432, December 1942, pp. 59-60.
³ *Mining and Contracting Review*, MacIntyre Development, July 18, 1942, pp. 7 and 17.
⁴ Bevan, Arthur, *Virginia's War Mineral Resources: Virginia's War Mineral Resources*, Virginia's War Mineral Resources, 1942, pp. 1-10.
⁵ Figures on imports and exports (unless otherwise indicated) are from records of the Department of Commerce.
⁶ Partly estimated. See accompanying table, footnote 2.

Titanium concentrates¹ imported for consumption in the United States, 1938-42

Year	Ilmenite			Rutile		
	Short tons		Value of "As reported" ²	Short tons		Value of "As reported" ²
	As reported	Total ³		As reported	Total ³	
1938.....	234,275	234,141	\$1,018,403	230	364	\$26,533
1939.....	286,676	287,191	1,126,200	442	787	23,170
1940.....	221,641	223,891	750,590	158	2,164	14,840
1941.....	166,846	170,680	620,940	3,114	6,291	308,176
1942.....	7,116	10,389	55,694	6,479	10,465	626,375

¹ Classified as "Ore" by Department of Commerce.² Includes Bureau of Mines estimate of ilmenite and rutile, respectively, contained in Australian zircon-rutile-ilmenite concentrates classified as "Zirconium ore" by Department of Commerce. Data for 1938 are adjusted to apportion Australian zircon-rutile-ilmenite concentrates classified as "Ilmenite" by Department of Commerce.³ Value pertains to "As reported" quantity only. Value of remainder included with "Zirconium ore." (See chapter of this volume on Minor Metals.)

Exports.—Exports in 1942 comprised 617 short tons (\$117,886) of titanium concentrates, 491 tons (\$61,909) of titanium ferro-alloys, 15 tons (\$9,938) of titanium tetrachloride, and 9 tons (\$3,728) of other titanium compounds.

STOCKS

Stocks of ilmenite were cut in half during 1942 as a result of virtual cessation of imports from India and consequent necessity for consumers to draw heavily on inventories. On the other hand, imports of rutile from Australia and Brazil were not only maintained but appreciably augmented in 1942 so that, even in the face of greatly increased consumption, total inventories of rutile climbed 56 percent. Industry stocks of rutile actually declined 3 percent, but that trend was offset by the stock-piling program of Government-owned Metals Reserve Co.

Stocks of titanium concentrates in the United States at end of year, 1941-42, in short tons

Stocks	1941				1942			
	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.....	28,106	12,087	75	53	11,917	5,142	75	53
Distributors ¹	12,867	6,032	2,387	2,238	11,541	5,371	1,702	1,589
Consumers.....	311,087	178,258	1,144	1,072	149,153	81,735	1,707	1,589
Government.....			31	29			2,194	2,002
Total stocks.....	352,060	196,377	3,637	3,392	172,611	92,248	5,678	5,292

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

CONSUMPTION AND USES

Consumption of ilmenite decreased 6 percent and that of rutile increased 67 percent in 1942 compared with 1941. Ilmenite was used

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principally in pigments (95 percent) and in welding-rod coatings (84 percent), alloys (1 percent).

Consumption of ilmenite and rutile in the United States, 1941-42

Product	Ilmenite	
	Gross weight	Estimated TiO ₂ content
1941		
Pigments (manufactured titanium dioxide) ¹	267,944	
Welding-rod coatings ²	58	
Alloys.....	7,104	
Ceramics.....		
Miscellaneous ³		
Total consumption.....	275,106	
1942		
Pigments (manufactured titanium dioxide) ¹	244,465	
Welding-rod coatings ²	58	
Alloys.....	11,802	
Ceramics.....		
Miscellaneous ³	1,212	
Total consumption.....	257,535	

¹ "Pigments" include all manufactured titanium dioxide, except that used in welding-rod coatings. Total was 1,700 short tons in 1941 and 4,900 tons in 1942.² Partly estimated.³ Consists of ilmenite used as a steel flux and rutile used in lacquer.

Titanium pigments.—Manufactured titanium dioxide is used as a white pigment, principally in lacquer but also in paper, linoleum, rubber, printing ink, soap, and cosmetics. Nonmanufactured titanium dioxide include ceramic pigments. Domestic production of titanium pigments reached the high levels of 1941 at about the same time as registered the second-best year to date. Production of 1938 and was more in tonnage and value as any other white pigment. Titanium dioxide is used for a high degree of opacity (covering power), whiteness, and durability.

Welding-rod coatings.—Some 321,000 short tons of welding rods were produced in the United States with 152,000 tons in 1941. According to the Bureau of Mines, all types of welding rods produced in 1941 amounted to 35,000 tons. Of this amount 60 to 70 percent was used in shipbuilding to replace riveting with welding. Requirements for cargo ships by 10 percent arc from oxidation during welding and to protect the cooling weld deposit; it is used in positions as rutile, manufactured titanium dioxide (95 percent Ti, 0.1 percent C max.) is added.

Titanium alloys.—Ferrocabontitanium (99.99 percent Ti, 0.1 percent C max.) is added to steel to produce a powerful deoxidizer in steel making.

¹ Oliver, Frank J., Welding—Given Tremendous Impetus by New Materials, p. 127.

inhibit intergranular corrosion of stainless steels, and to prevent air-hardening of 5-percent chromium steels. Titanium is added to a number of nonferrous alloys, particularly to aluminum to increase strength and ductility, and is a constituent of a number of complex deoxidizers. The use of the pure metal is limited principally to radio tubes.

Other uses of titanium.—One hundred to two hundred short tons of ilmenite are consumed monthly by the Rustless Iron & Steel Corporation, Baltimore, Md., as a replacement for fluorspar (which, according to the company, emits fumes causing illness to workers) in making titanium-bearing stainless steel. Rutile and manufactured titanium dioxide are used in ceramics, principally to improve the acid resistance of porcelain enamels, to impart colors ranging from cream to brown in pottery bodies and glazes, and to make electric insulators. Consumption of rutile in ceramics was curtailed in 1942, and the quantities thus conserved were diverted to welding-rod coatings and alloys. Small quantities of rutile are used in lamp-electrode coatings of street lights and as a deoxidizer (with aluminum) in special alloy steels. Titanium carbide is a constituent of hard cutting alloys used in machine tools. Titanium tetrachloride is an important smoke-screen chemical.

PRICES

Titanium (in all forms) showed no price changes in 1942. Ilmenite, 60 percent TiO_2 , was nominally quoted at \$28-\$30 a long ton, f. o. b. Atlantic seaboard, according to Metal and Mineral Markets. One consumer was paying \$31.50 a ton for Indian material early in the year. Rutile, 94 percent TiO_2 , was listed 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 ferrocarbontitanium, 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 was fixed at 14½-16½ cents a pound by Office of Price Administration Schedule 98, noted under Government Control.

TECHNOLOGY

Titaniferous magnetite analyzing 18 percent TiO_2 , from Poplar Lake, Minn., was crushed to minus-48-mesh and treated by hydraulic classification, tabling, and magnetic concentration to yield a product containing 43 percent TiO_2 .⁶ The effects of titanium in blast-furnace charges and the recovery of vanadium from Sanford Lake ilmenite tailings (titaniferous magnetite) were investigated by the Bureau of Mines, the University of Minnesota, and the National Lead Co.⁷ An improved method of making powdered titanium metal was patented.⁸

⁶ Minnesota Geological Survey, Notes on Titanium and Vanadium (mimeographed): 1942, 4 pp.
⁷ Wood, O. E., Joseph, T. L., and Cole, S. S., Smelting of Vanadium-Bearing Titaniferous Sinter in an Experimental Blast Furnace: Bureau of Mines Rept. of Investigations 3679, 1943, 24 pp.
⁸ Comstock, George F., and Effimoff, Vlastobeslav V. (to Titanium Alloy Manufacturing Co.), Powdered Titanium Metal: U. S. Patent 2,273,834, February 24, 1942.

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WORLD PRODUCTION

The United Nations controlled most deposits of titanium in 1942. The Axis mines in Norway and Malaya, unless in a ore to the Nazis or collaborationist Vichy from Senegal. Cameroun concentrates, using Free French, were shipped to Great Britain. Available data on world production of titanium for the years are shown in the following table.

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

(Compiled by B. D. Walcott)

Country	1937	1938
Ilmenite:		
Australia:		
New South Wales.....	681	(1)
Queensland.....		
Brazil (exports).....	234	317
Canada.....	3,836	188
Egypt.....	317	90
Federated Malay States (exports).....	6,290	6,465
India, British.....	182,142	258,298
Norway.....	84,209	62,720
Portugal.....	1,456	688
Senegal.....	3,075	8,430
United States.....	(1)	(1)
Rutile:		
Australia:		
New South Wales.....	1,141	460
Queensland.....		
South Australia.....		
Brazil (exports).....	377	488
Cameroun (French).....	103	118
Norway.....	187	124
South-West Africa.....	16	
United States.....	(1)	(1)

¹ Data not available.

² Subject to revision.

³ Bureau of Mines not at liberty to publish figures.

⁴ In addition, zircon-rutile-ilmenite concentrates were produced.

⁵ Less than 1 ton.

⁶ Exports.

Algeria.—The Keddaradans mine, Palestrina, produced 100 metric tons of titanium-zirconium concentrates in 1942.

Australia.—Mixed rutile-ilmenite-zirconium concentrates are produced in New South Wales by Porter & Derricott Metal Recoveries Pty., Ltd., at New Brighton, and in Queensland by the Broken Hill Proprietary Ltd., at Byron Bay; and in Queensland by the Broken Hill Proprietary Ltd., at Little Burleigh. Most of the concentrates are shipped to the United States; the output goes to the Titanium Alloy Manufacturing International Titanium Corporation, and to the Orefraction, Inc. A little rutile is also produced in South Australia. Some titanium concentrates are produced in Australia by the Broken Hill Proprietary Ltd.