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plans. Numerous reports are to the effect that mine development and plant construction lack the desired efficiency. In any event, the U. S. S. R. still must import large quantities of copper to supply home requirements. A development of possible significance was the sudden shipment of large quantities of refined copper from the United States to the U. S. S. R. In the first 10 months of 1939 no such exports were reported, but in November 5,200 metric tons of refined copper were shipped there, December 15,500 tons, January (1940) 24,100 tons, February 5,800 tons, March 5,100 tons, and April none. Rumor stated that much of this copper was ultimately for German consumption, and in the early months of 1940 the Allies are reported to have interrupted shipments destined for Vladivostok. Further rumors claimed that the U. S. S. R. later had copper up for resale in the United States market.

A recent report⁶ states that the Moscow "Pravda" of November 17, 1939, contains an article describing the construction of the Sredural-medzavod (Central Ural copper-refining plant), near Sverdlovsk. The following quotation is of possible interest:

The ore, ground first coarse then fine in crushers and ball mills, passes into the flotation baths, from which it comes in a moist mass, where the copper is mixed only with pyrites tailings. Here the drier takes up the task of eliminating the 10 to 12 percent of moisture, which at present increases the weight of concentrates shipped to the refineries. The drier conveyors and drums are now installed and ready to operate; a start is scheduled for January next.

The complete working of the recovery process is still, it is felt, hampered by the lack of facilities to recover the sulfur gases released in roasting. At the present a chimney 150 meters high is supposed to release these gases so high up as to prevent injury to vegetation in the vicinity. But it would be much more profitable if the authorities erected a chemical factory to recover and utilize the sulfur, estimated at 100 metric tons daily under full operation of the refinery, instead of wasting them.

The output of concentrate has been steadily rising, and for 10 months of this year was 61 percent higher than for all of 1938; the proportion of metal recovered from the ore has also risen, from about 75 percent to 82 to 84 percent.

The present management of this plant is weak, and much engaged in futile paper work. In 10 months of 1939 a total of 729 orders were issued by the chief engineer's office, ranging from the purchase of a pair of pliers to some important production process. The engineers attempt to limit their efforts to actual production, but are constantly assigned to other work. There must be a change of system here, to secure greater efficiency when the plant is in full operation.

Yugoslavia.—This country has been successful in sharply increasing its mine output in recent years. For 1939 a record production of 63,000 metric tons was reported compared with 49,500 in 1938, 42,300 in 1937, and an annual average of 35,000 metric tons for 1932-36. Smelter production totaled 41,658 tons in 1939, 41,993 in 1938, and 39,410 in 1937; the average annual smelter output for 1932-36 was 38,700 tons. The Mines de Bor, operated under French control, is responsible for virtually the entire production. In January 1940 it was reported⁷ that this company had arranged with the Government to sell part of its output to the State and to have the remainder available for its free disposal. Naturally, efforts were being made to prevent shipments of any Bor copper to Germany. An electrolytic refinery was completed and opened on July 2, 1938. Exports of crude copper began to fall when the new refinery was assured. Imports into the United States of unrefined copper from Yugoslavia fell from 17,300 tons in 1936 to 14,600 in 1937, 9,600 in 1938, and 8,600 in 1939.

⁶ Russian Economic Notes, vol. 2, No. 3, February 15, 1940, pp. 6-7.

⁷ The Metal Bulletin (London), No. 2454, January 9, 1940, p. 4.

LEAD¹

By E. W. PEHRSON AND H.

SUMMARY OUTLINE

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Conditions that affected the lead industry improved in 1939; production and consumption were higher, and stocks were reduced. Production from domestic ores increased 27 percent in 1939, the highest on record since 1937, the highest on record since 1937. Foreign ores and base bullion increased 22 percent, but there was a marked decrease in lead ore decreased, but there was a marked increase in base bullion. Exports of refined pig lead were higher, but domestic shipments were lower. Production exceeded demand during the first half of the year, but domestic shipments increased slightly, but domestic shipments were lower. July and by the end of the year stocks had increased slightly, but domestic shipments were lower. year-end inventory since 1929. Prices rose 1.80 cents per pound at New York from January 1939, during the third quarter of the year raised 1.80 cents per pound, which held for the remainder of the year was 5.05 cents a pound compared with 3.25 in 1937. Quotations on the London Metal Exchange rose 1.80 cents per pound in September; for the first 8 months of 1939 the difference between New York and London prices was 1.80 cents per pound.

¹ This report deals primarily with the smelting, refining, and casting of lead. For full details of mining operations see separate reports issued for the various countries.

Salient statistics of the lead industry in the United States, 1925-29 (average) and 1935-39, in short tons

	1925-29 (average)	1935	1936	1937	1938	1939
Production of refined primary lead:						
From domestic ores	660,525	310,505	387,698	443,142	331,964	420,967
From foreign ores and base bullion	123,104	14,056	11,458	24,176	51,705	63,068
	783,629	324,560	399,156	467,317	383,669	484,035
Recovery of secondary lead:						
As pig lead	128,600	156,800	137,500	154,500	119,400	(¹)
In alloys	153,400	113,600	125,400	120,600	105,500	(¹)
	280,000	270,400	262,900	275,100	224,900	(¹)
Total production of pig lead (primary and secondary)	910,229	481,300	530,056	621,817	503,099	(¹)
Imports:						
Lead in base bullion	95,747	2,692	312	1,800	15,296	48,902
Lead in ore	40,096	20,025	20,713	34,103	45,370	30,842
Exports of refined pig lead	98,048	6,082	18,313	20,091	45,806	74,302
Refined primary lead available for consumption	690,916	318,000	383,433	449,464	339,708	415,031
Estimated consumption of primary and secondary lead	900,260	538,900	633,550	678,700	546,000	667,000
Prices:						
New York:						
Average for year						
cents per pound	7.47	4.06	4.71	6.01	4.74	5.05
Quotation at end of year	6.25	4.50	6.03	4.75	4.85	5.60
London average	6.87	3.12	3.91	5.15	3.33	3.09
Mine production of recoverable lead	664,230	331,103	372,919	464,802	369,720	413,979
World smelter production of lead	1,850,000	1,524,000	1,620,000	1,861,000	1,874,000	1,874,000

¹ Data not yet available.

² Data include lead imported for immediate consumption plus material entering the country under bond.

³ Average for 8 months; London Metal Exchange dealings suspended in September.

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

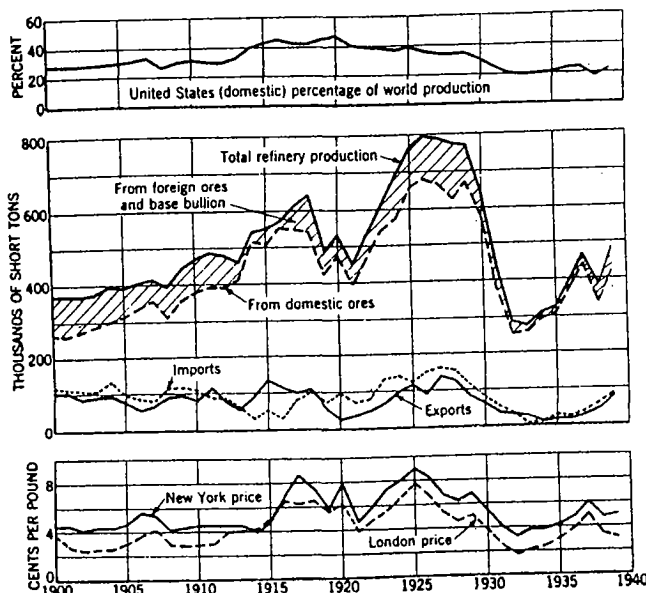


FIGURE 1.—Trends in the lead industry in the United States, 1900-1939. Imports include lead in ore, base bullion, pig lead, and scrap; exports include pigs, bars, and scrap lead exported in manufactures with benefit of draw-back.

World smelter production of lead was 1,874,000 short tons in 1939 as in 1938. Production outside the United States increased 22 percent in contrast to the 22-percent increase in domestic output. Output decreased in Mexico, Canada, Belgium, and Spain. Australia increased its output, and the United States was virtually unchanged. Data on world consumption is not available. Some foreign producers operated on a 10-percent reduction program agreed to in 1938. An outbreak of war in September lead prices were fixed by the British Ministry of Supply and the United States Government contracted for Empire supplies.

DOMESTIC PRODUCTION

Refined pig lead produced in the United States from 1935 to 1939. The following table lists the sources of refined pig lead from these sources from 1935 to 1939:

Total pig lead produced in the United States

Year	From domestic ores and base bullion
1935	310,505
1936	387,698
1937	443,142
1938	331,964
1939	420,967

¹ Data not yet available.

PRIMARY LEAD

Refinery production.—Production of refined primary lead increased 26 percent but was only 62 percent of the total output of refined primary lead. Production from domestic ores increased 26 percent, but from foreign ores and base bullion increased 62 percent. The largest increase in production from foreign materials was the largest increase in production from foreign materials, only 51 percent of the 1925-29 average; it was only 51 percent of the total output of refined primary lead.

Refined primary lead produced in the United States

Year	Production by—				Source
	Classes (short tons)			Total production ¹	
	Desilverized lead ²	Soft lead ³			
		Desilverized	Undesilverized		
1935.....	192,544	35,233	96,783	324,560	310,505
1936.....	239,944	47,462	111,750	399,156	387,698
1937.....	272,051	55,317	139,949	467,317	443,142
1938.....	243,891	31,986	107,792	383,669	331,964
1939.....	280,356	65,349	138,330	484,035	420,967

¹ The lead content of antimonial lead is excluded.

² Includes lead derived from Missouri ores and other nonargentic.

Source of primary lead.—Of the total refined lead produced in 1939, 87 percent was derived from domestic ores and 13 percent from foreign ores and base bullion, the same proportion as in 1933. Production from foreign ores decreased 25 percent in 1939. Refining of foreign bullion was resumed on a large scale in 1938, chiefly because of the closing of one Mexican refinery during the latter part of the year, which diverted bullion to domestic plants. Output of lead from this source more than doubled in 1939, amounting to 38,416 tons, or the largest quantity since 1929. 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, 1935-39, by sources, in short tons

Source	1935	1936	1937	1938	1939
Domestic ore.....	310,505	387,698	443,142	331,964	420,067
Foreign ore:					
Australia.....		172	3,088	7,320	7,580
Canada.....	1,030	2,277	6,343	3,502	4,703
Europe.....	1,080	1,133	3,888	14	188
Mexico.....	5,800	1,486	3,636	9,745	227
South America.....	2,872	3,883	8,497	9,887	8,800
Other foreign.....	2,853	2,460	2,241	2,334	3,025
	13,559	11,401	23,393	32,802	24,652
Foreign base bullion:					
Mexico.....	390	57	782	18,268	37,403
South America.....				676	944
Other foreign.....					
	390	57	782	18,943	38,410
Total foreign.....	14,055	11,458	24,175	51,705	63,068
Grand total.....	324,560	399,156	467,317	383,669	484,035

Antimonial lead.—Antimonial or hard lead is an important by-product of the refining of base bullion, but the quantity derived from this source is only a small part of the country's yearly production. The major part is obtained from the smelting of antimonial-lead scrap, and some is produced by mixing metallic antimony with refined soft lead.

Several lead-smelting plants handle scrap materials exclusively. A large quantity of hard-lead scrap also is treated at primary smelters and refineries, and the production of antimonial lead at these plants is shown in the table that follows. Further information in secondary antimonial lead in 1939 is given in the chapter in this volume on Secondary Metals—Nonferrous.

Antimonial lead produced at primary lead refineries, 1935-39

Year	Production (short tons)	Antimony content		Lead content by difference (short tons)			
		Short tons	Percent	From domestic ore	From foreign ore	From scrap	Total
1935.....	16,384	1,729	10.6	4,685	491	9,479	14,655
1936.....	23,230	2,102	9.3	7,442	896	12,930	21,068
1937.....	27,524	2,679	9.4	7,833	1,721	15,391	24,945
1938.....	24,123	2,809	11.6	6,759	3,385	11,170	21,314
1939.....	21,995	2,031	9.2	4,117	3,189	12,658	19,964

LEAD

SECONDARY LEAD

A large number of plants operate exclusively for the production of secondary materials. The following table shows the production of secondary lead at such plants during the year 1939. The work of Bureau of Mines work on secondary materials was considerably in 1939; as a result, completion of the work was necessarily delayed. Statistics for 1939 were not available at the time this report was written. Further details will appear in the chapter on Secondary Metals—Nonferrous.

Secondary lead recovered in the United States, 1935-39, by sources, in short tons

[Compiled by J. P. Dunlop]

Year	Pig lead (short tons)			Lead in alloys (short tons)
	At primary plants	At secondary plants	Total	
1934.....	33,557	90,943	124,500	83,909
1935.....	44,748	112,032	156,800	113,000
1936.....	34,556	102,944	137,500	125,400
1937.....	29,988	124,514	154,500	120,600
1938.....	24,800	94,600	119,400	105,600

LEAD PIGMENTS

Lead pigments manufactured in 1939 consisted of 23 percent white lead, a 23-percent increase from 1938. Other pigments were derived from refined pig lead; litharge, white lead 39 percent, red lead 18 percent, orange mineral 1 percent. Lead pigments are the principal pigments in which the lead content is high. Details of production and consumption of lead pigments will appear in the chapter in this volume on Lead and Zinc.

Lead in pigments, 1935-39, by sources, in short tons

Year	Lead in pigments from—				Year
	Domestic ore ¹	Metal	Scrap	Total	
1935.....	12,109	185,151	144	197,404	1938.....
1936.....	15,082	204,997	37	220,096	1939.....
1937.....	17,363	204,981	127	222,451	

¹ Includes also lead recovered in zinc oxide and leaded zinc oxide.
² No pigments from foreign ore.

MINE PRODUCTION

The output of recoverable lead from domestic mines increased 12 percent over that in 1938 but was less than in 1937. Lead from the Central States increased 1939 and that from the Western States 6,266 tons. Eastern States decreased 1,616 tons. Lead from the Missouri rose 34,652 tons (29 percent) in 1939, compared with 26,986 tons in 1938.

during the last quarter of the year. Lead from Oklahoma also was greater than in 1938, but that from Kansas declined. Idaho was again the leading lead producer in the Western States group, followed in 1939 by Utah and Montana. Lead from Idaho decreased slightly in 1939, as there were decreases in output in both the Coeur d'Alene region in Shoshone County and in the Warm Springs district in Blaine County. Lead from Utah increased about 2,000 tons as gains in the Park City region (owing to reopening in May of the Silver King Coalition and Park Utah Consolidated mines) and in the Ophir district more than offset losses in the Bingham and Tintic districts. Lead from Montana increased 7,228 tons in 1939. Most of the gain was in the Butte district and was due to reopening of the zinc-lead properties of the Anaconda Copper Mining Co., but gains also were reported at the slag-burning plant at East Helena, at the Flathead mine in the Hog Heaven district, and at the Comet mine in Jefferson County. Lead in Arizona was about the same as in 1938, but that from Colorado decreased, as the Sunnyside property in San Juan County was idle throughout 1939. Lead from New Mexico increased slightly, as gains in Grant County more than offset the loss in San Miguel County owing to the closing of the Pecos mine in May 1939. Decreases in lead were also noted in the Pioche district, Nevada, and in the Metaline district, Washington. Additional details of production by mines, districts, and States can be found in the State chapters in this volume.

Mine production of recoverable lead in the United States, 1926-29 (average) and 1935-39, in short tons

State	1925-29 (average)	1935	1936	1937	1938	1939
Western States and Alaska:						
Alaska.....	982	470	941	823	994	937
Arizona.....	9,743	7,783	10,698	12,354	10,571	10,771
California.....	2,070	567	482	1,186	495	526
Colorado.....	30,112	5,673	7,267	9,780	9,485	8,222
Idaho.....	141,610	79,026	91,339	103,711	92,177	90,981
Montana.....	18,871	15,849	19,059	17,957	9,327	16,555
Nevada.....	9,807	12,676	10,712	9,347	4,679	4,236
New Mexico.....	6,730	7,289	6,620	6,512	4,040	5,392
Oregon.....	6	30	79	109	23	16
South Dakota.....	21	4				
Texas.....	213	522	468	395	342	227
Utah.....	149,509	63,510	69,886	89,458	65,657	67,634
Washington.....	1,323	103	840	2,830	4,284	3,718
Wyoming.....		3				
	370,997	103,439	218,387	254,468	202,953	209,214
Central States:						
Arkansas.....	38	38	24	40	7	
Illinois.....	552	436	294	180	175	308
Kansas.....	20,121	10,892	11,400	16,008	15,239	13,697
Kentucky.....	135	132	60	89	101	87
Missouri.....	202,240	97,493	110,428	157,631	122,027	156,281
Oklahoma.....	58,306	23,405	25,427	29,840	21,004	27,720
Wisconsin.....	1,745	286	904	1,091	320	868
	280,137	132,682	148,636	204,885	158,873	198,481
Eastern States:						
New York.....		4,982	5,996	5,539	7,896	6,284
Tennessee.....	4,066					
Virginia.....					4	
North Carolina.....						
	4,066	4,982	5,996	5,539	7,900	6,284
	604,230	331,103	372,919	464,892	360,726	413,979

LEAD

Mine production of recoverable lead in the principal lead producing States, 1935-39, in short tons

District	State	1935
Southeastern Missouri region.....	Missouri.....	96,941
Coeur d'Alene region.....	Idaho.....	78,290
Joplin region.....	Kansas, Missouri, Oklahoma.....	34,849
Bingham.....	Utah.....	30,293
Park City region.....	Idaho.....	13,180
Tintic.....	Idaho.....	6,833
Ophir.....	Idaho.....	2,392
Warm Springs.....	Idaho.....	32
Butte.....	Montana.....	10,302
San Juan Mountains.....	Colorado.....	2,428
Oro Blanco.....	Arizona.....	4,717
Metaline.....	Washington.....	4,907
Rush Valley.....	Utah.....	1,121
Eagle.....	Montana.....	4,955
Pioche.....	Nevada.....	1,891
Central.....	New Mexico.....	
Hog Heaven.....	Montana.....	7
Harshaw.....	Arizona.....	292
Old Hat.....	Idaho.....	5,162
Willow Creek.....	New Mexico.....	1,227
Cataract.....	Montana.....	1,239
Smelter.....	Idaho.....	165
Red Cliff.....	Colorado.....	1,288
Port Hill.....	Idaho.....	70
Leadville.....	Colorado.....	285
Wallapai.....	Arizona.....	
Upper Mississippi Valley.....	Iowa, northern Illinois, Wisconsin.....	1,081
Tombstone.....	Arizona.....	988
Flint Creek.....	Montana.....	200
Blasbee (Warren).....	Arizona.....	5,819
Tybo.....	Nevada.....	867
Banner.....	Arizona.....	(2)
Austinville.....	Virginia.....	(2)
St. Lawrence County.....	New York.....	(2)

¹ Not listed according to rank.

² Bureau of Mines not at liberty to disclose.

STOCKS

Lead stocks, as reported by the American Bureau of Mines, are shown in the following table. Stocks of antimonial lead include metal held by all primary refiners of secondary material who produce commercial lead refined in the United States and entered for domestic consumption.

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

	1935	1936
Refined pig lead.....	215,595	165,159
Antimonial lead.....	6,711	6,697
	222,306	171,856
Lead in base bullion:		
At smelters and refineries.....	15,072	9,187
In transit to refineries.....	1,860	1,070
In process at refineries.....	16,233	14,100
Lead in ore and matte and in process at smelters.....	33,105	24,367
	58,562	50,096
	314,033	240,311

In the first half of 1939 the excess of output over shipments for virtually every month resulted in increasing inventories. Stocks of refined and antimonial lead at refineries totaled 115,900 tons at the end of 1938 and had reached 129,600 tons by the end of June. Accelerated demand as a result of industrial improvement, in anticipation of war, and more largely because of actual opening of hostilities in September, caused a reversal of early conditions in the latter half of the year, and stocks declined monthly from June until they reached the lowest level of the year at the end of November, when they stood at 58,100 tons. A slight excess of production in December carried stocks to 58,800 tons at the end of the year. These were the smallest year-end inventories on hand since the end of 1929 and only a little more than half the amount on hand as the year began. Stocks of lead in ore and matte and in process at smelters, and base bullion at smelters and refineries, in transit to refineries, and in process at refineries, were 5 percent lower at the end than at the beginning of the year.

DOMESTIC CONSUMPTION

New supply.—The following table shows the refined primary lead available for consumption from 1935 to 1939. The figures do not consider variations in producers' stocks, and as these have changed considerably during the past 5 years the quantities stated do not indicate the true trend in actual consumption of new lead. The supply available for consumption in 1939 was 22 percent higher than in 1938 but was equivalent to only 60 percent of the 1925-29 average. The total consumption of lead, as indicated by the second table following, also rose 22 percent in 1939.

Refined primary pig lead available for consumption in the United States, 1935-39, in short tons

	1935	1936	1937	1938	1939
Supply:					
Imports.....	1,322	2,600	2,238	1,005	5,388
Production.....	324,560	399,156	467,317	383,669	484,035
	325,882	401,746	469,555	385,574	489,423
Withdrawn: Exports.....	6,982	18,313	20,091	45,866	74,392
Supply available for consumption.....	318,900	383,433	449,464	339,708	415,031

¹ Includes small quantities of old, reclaimed, and scrap lead.

² Includes small quantities of foreign lead reexported.

³ Includes a small quantity, not separable, of "sheets."

Consumption by uses.—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 available. The following table gives the American Bureau of Metal Statistics estimate of the total consumption of lead by industries, 1935-39.

LEAD

Lead consumed in the United States, 1935-

Purpose	1935	1936
White lead.....	80,000	85,500
Red lead and litharge.....	47,500	54,000
Storage batteries.....	175,000	191,000
Cable covering.....	38,800	61,400
Building.....	32,000	40,000
Automobiles.....	10,000	11,100
Ammunition.....	29,200	32,500
Terneplate.....	4,700	6,200
Foil.....	15,900	28,500
Bearing metal.....	13,000	16,500
Solder.....	20,000	22,000
Type metal.....	15,000	17,000
Calking.....	12,000	13,500
Castings.....	5,000	5,750
Other uses.....	40,700	46,000
	638,900	633,550

¹ American Bureau of Metal Statistics. These estimates are for the purpose of whether its origin is primary or secondary. Antimonial lead is included.

The principal use of lead is in the manufacture of storage batteries and in most recent years 30 percent or more of the total consumption has been for that purpose. Consumption during 1939 was 19 percent higher than in 1938, showing in relation to the record year, having increased from 1929. As pointed out in Minerals Yearbook, 1939, in storage batteries returns quickly to the trade and therefore noticeably curtails the need for new lead. White lead is regularly the second-largest use for lead and for this purpose is welcomed by producers because it has increased 6 percent over 1938 but lagged 37 percent behind 1929, the year of record consumption, and again ranked as the largest use for lead. Since 1929 that purpose has dropped 66 percent, although it was 11 percent above 1938. It required 23 percent of the total consumption in 1929 and 27 percent in 1930 but fell to 11 percent in 1939. The failure of the utility industry to purchase its share of total lead requirements of the country has had a considerable influence on the lead industry. The building industry has been one of the largest consumers of lead in recent years and has been on the upgrade in recent years and in 1939 than in 1938, but it was 48 percent lower than in 1929. Lead and litharge—exclusive of quantities used in storage batteries—took nearly 9 percent of the total lead used in 1939, three times the proportion for that purpose in 1938 and 33 percent more lead than in 1938 and 1929. Among the smaller uses for lead, ammunition was 19 percent more in 1939 than in 1938. It was one of the smaller uses by the foregoing table to have been higher than in 1938, 3 percent larger than in that year.

PRICES

The two major markets for lead in the United States are New York and St. Louis; much of the lead produced in the United States is sold at prices based upon quotations in these markets. The New York quotations are influenced to some extent by the lower prices usually prevailing on the London market, so that the New York price seldom exceeds the St. Louis price by as much as the freight differential, which normally is 0.35 cent a pound.

In view of the startling world events in 1939, prices for lead were remarkably steady, fluctuating less than those for other common nonferrous metals. The average monthly quoted price for pig lead at New York, outside market, was 4.83 cents a pound in January. In the first half of the year the monthly average varied only 0.1 cent a pound. The average for July was 4.85 cents. In the first half of the year monthly refined production exceeded shipments, except in March, when a virtual balance was temporarily established. After June, however, the situation was reversed and, as a result of improving demand, shipments began to rise while output held at former levels. The declaration of war between Germany and France and Great Britain in September was the signal for sharply increased demands. Shipments, which averaged 40,000 tons for the first 8 months of the year, rose to 60,000 tons in September and 66,000 in October, then declined slightly to 64,000 in November and 45,000 in December. Weekly domestic sales of lead reached a new high record in the week ended September 9, when they amounted to more than 42,000 tons. In all of September transactions aggregated 104,000 tons, the largest monthly total on record. In an endeavor to discourage excessive purchases, producers assured consumers that no shortage was likely, but with little apparent success. They maintained a conservative price policy in the face of spectacular sales during the latter part of the year, and price advances were proportionately far less than requirement gains. Production trended upward in the final quarter but failed to equal shipments until an approximate balance was attained in December. The average price at New York for August was 5.04 cents; it rose to 5.45 cents in September and was at the highest levels of the year—5.50 cents a pound—throughout the final quarter.

LEAD

Average monthly and yearly quoted prices of lead at St. Louis and New York, 1937-39, in cents per pound

Month	1937			1938	
	St. Louis	New York	London	St. Louis	New York
January.....	5.85	6.03	5.97	4.72	4.8
February.....	6.09	6.20	6.19	4.48	4.6
March.....	7.05	7.20	7.20	4.35	4.5
April.....	6.03	6.18	6.71	4.35	4.5
May.....	5.85	6.00	5.28	4.25	4.4
June.....	5.85	6.00	5.03	4.00	4.1
July.....	6.85	6.00	5.30	4.73	4.8
August.....	6.30	6.46	5.02	4.75	4.9
September.....	6.23	6.39	4.63	4.85	5.0
October.....	5.56	5.71	4.03	4.95	5.1
November.....	4.88	5.03	3.72	4.94	5.0
December.....	4.72	4.86	3.64	4.09	4.8
Average.....	5.86	6.01	* 5.15	4.50	4.7

¹ St. Louis: Metal Statistics, 1940, p. 465. Average daily quotation for lead (open market), as reported daily in the American Metal Market.

² New York: American Metal Market, daily issues. Pig lead, New York, outside market.

³ London: Metal Statistics, 1940, p. 460. Average price of foreign lead in Metal Statistics, converted to cents per pound at average exchange rate.

⁴ London Metal Exchange dealings suspended for duration of the war.

⁵ London quotations in pounds sterling per long ton, as follows: (8 months), £14.7083.

⁶ Average for 8 months: Comparable average for New York was 4.83

There were narrow movements in the London market. In January the average price (United States outside market) was 3.00 cents; it rose to 3.20 cents in February and then to the low point for the year—3.00 cents. A slow rise to 3.30 cents in August. Quotations on the London market were discontinued at the outbreak of war in September. The differential between selling prices in New York and London was higher in 1939 than in 1938, continuing the general trend of the year. The differential in 1939 ranged from 0.94 cent to 1.77 cents higher than in 1938. The low point occurring in February and the high point in August for 8 months was 1.74 cents. In 1938 New York prices ranged from 0.94 cent to 1.77 cents higher than London and the average for the year was 1.41 cents. The average difference was 0.86 cent, and in 1936 it was 0.74 cent.

In September 1939 it was announced that the United States Supply had established the maximum price of lead at \$1.00 per long ton ex ship and of foreign lead at \$1.00 per long ton. December control prices for Empire and foreign lead at £25 per long ton, duty paid, delivered.

FOREIGN TRADE²

Although imports of lead in ore, matte, and bullion increased 31 percent in 1939 compared with 1938 and exports of pig lead showed a 62-percent increase for the same period, the total of pig lead exported in 1939 approximated the lead in ore, matte, and bullion imported; domestic exports of pig lead for some years have comprised principally crude material imported for smelting and refining in bond and earmarked for export.

Imports.—Aside from the significant increase in total imports of unrefined lead in 1939, a noticeable feature was the 84-percent decrease in imports from Mexico of lead in ore and matte and a compensating 232-percent increase in imports of lead bullion from the same country. Although Mexico, for years the principal source of unrefined lead imports, contributed 65 percent of the total tonnage imported in 1939, Canada's imports of ore and matte increased 77 percent in 1939 compared with 1938; however, Chile and Peru supplied less unrefined lead in 1939 than in 1938, the total decrease for both countries being 22 percent.

Total lead imported into the United States, 1935-39, by classes, in short tons¹

Year	Lead in ore and matte	Lead in base bullion	Pigs, bars, and old	Total lead content
1935.....	20,025	2,802	1,322	24,039
1936.....	20,713	312	2,590	23,615
1937.....	34,103	1,800	4,903	40,806
1938.....	45,370	16,290	3,235	64,901
1939.....	30,842	48,902	7,139	86,883

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

Total lead imported into the United States, in ore, base bullion, and refined, 1935-39, by countries, in short tons¹

Year	Canada	Mexico	Newfoundland	South America	Europe	Other countries	Total
1935.....	236	9,786	6,837	6,643	512	25	24,039
1936.....	1,692	10,501	3,956	6,861	341	265	23,615
1937.....	5,749	17,098	—	13,229	535	4,225	40,806
1938.....	3,174	38,467	—	13,428	880	3,154	64,901
1939.....	5,641	52,039	1	16,527	1,971	10,684	86,883

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

Total lead imported into the United States in ore, matte, and base bullion, 1935-39, by countries, in short tons¹

Country	1935	1936	1937	1938	1939
In ore and matte:					
Canada.....	58	1,419	5,211	3,173	5,624
Chile.....	1,102	574	474	2,107	1,844
Mexico.....	7,986	10,452	15,970	24,023	3,846
Newfoundland.....	6,818	3,956	—	—	—
Peru.....	3,718	4,007	10,132	9,317	7,174
Other countries.....	346	296	2,316	6,760	12,364
	20,025	20,713	34,103	45,370	30,842
In base bullion:					
Mexico.....	1,746	39	1,067	14,444	47,916
Peru.....	784	52	239	198	84
Other countries.....	162	221	404	654	903
	2,692	312	1,800	15,296	48,902

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

² Figures on imports and exports compiled by M. B. Price, of the Bureau of Mines, from records of the Department of Revenue and Domestic Commerce.

LEAD

Lead remaining in warehouses in the United States,

(Stated in the form in which the material was entered)

Year	Lead in ore and matte	Lead in base bullion ¹	Year
1935.....	22,598	2,173	1938.....
1936.....	33,401	1,930	1939.....
1937.....	57,509	2,622	

¹ Pigs, bars, sheets, and old lead included with base bullion.

Lead¹ imported for consumption in the United States, 1935-39, by classes, in short tons

Year	Lead in ores, fluo dust, and mattes, n. s. p. f.		Lead in base bullion		Pigs and bars	
	Short tons	Value	Short tons	Value	Short tons	Value
1935.....	8,273	\$258,954	1,154	\$66,559	1,308	\$33,841
1936.....	6,836	225,568	763	45,340	1,979	97,611
1937.....	5,613	507,946	188	12,788	2,355	174,071
1938.....	6,722	543,164	304	31,147	2,001	84,109
1939.....	12,317	1,063,612	1,764	166,298	4,772	176,431

¹ In addition 285 tons valued at \$10,678 of "reclaimed, scrap, etc." in 1935; 342 tons, \$23,534 in 1936; 249 tons, \$30,810 in 1937; 189 tons, \$20,000 in 1938; and 189 tons, \$20,000 in 1939.

Miscellaneous products containing lead imported for consumption in the United States, 1935-39, by countries, in short tons

Year	Babbitt metal, solder, white metal, and other combinations containing lead		
	Gross weight (short tons)	Lead content (short tons)	Value
1935.....	128	24	\$44,269
1936.....	334	67	112,205
1937.....	618	178	213,734
1938.....	390	77	128,660
1939.....	136	45	96,492

Exports.—Most significant during 1939 was in pig-lead exports to Europe, which rose from 1938 to 33,152 in 1939. There was a sharp increase in purchases by Germany, but of note also is the increase in exports to Belgium, Denmark, Hungary, and Sweden jumped from 51 tons in 1938 to 13,152 in 1939. There was a fourfold increase in exports to Japan with 1937, purchases by that country in 1937 were 1,000 tons over those in the preceding year. Exports of lead increased noticeably from 78 short tons in 1938 to 1,000 tons in 1939. The decrease of importance during the year was due possibly to refining of bullion in that country and to the movement of the material to the United States for

Lead exported from the United States, 1935-39

Year	Pigs, bars, and old		Foreign lead exported in manufactures with benefit of draw-back (short tons)	Year	Pigs, bars, and old		Foreign lead exported in manufactures with benefit of draw-back (short tons)
	Short tons	Value			Short tons	Value	
1935.....	16,982	\$472,017	8,995	1938.....	46,806	\$3,354,616	9,081
1936.....	18,313	1,390,454	8,312	1939.....	74,392	4,547,219	10,359
1937.....	20,091	1,838,262	8,679				

¹ Includes small quantities of foreign lead reexported.
² Contains sheets and pipes; figures not separable.

Pig lead exported from the United States, 1935-39, by destinations, in short tons

Destination	1935 ¹	1936	1937	1938 ²	1939
Countries:					
Belgium.....			43	28	588
Brazil.....	338	795	652	111	647
Canada.....	46	46	7	101	5
Denmark.....				560	616
Finland.....				(³)	540
France.....	11	2	568	1,092	8,333
Germany.....					560
Hungary.....	5,324	8,629	7,320	30,203	34,790
Japan.....			56	314	99
Kwangtung.....	38	8,049	8,122	11,403	2,922
Mexico.....	188				2,161
Netherlands.....			112		1,091
Norway.....	217	223	569	1,037	974
Philippine Islands.....		6		23	7,340
Sweden.....	8	123	2,226	78	9,411
United Kingdom.....	813	442	416	916	2,806
Other countries.....					
	6,982	18,313	20,091	45,806	74,392
Continents:					
North America.....	157	8,282	8,337	12,002	3,345
South America.....	668	1,021	784	303	1,317
Europe.....	212	133	2,949	1,950	33,152
Asia.....	5,945	8,865	7,980	31,606	36,122
Africa and Oceania.....	(³)	12	32	5	456

¹ Includes small quantities of foreign lead reexported.
² Includes sheets and pipes; figures not separable.
³ Less than 1 ton.

WORLD ASPECTS OF LEAD INDUSTRY

International cooperation.—The Lead Producers Association, representing 60 to 75 percent of the lead produced outside the United States, agreed on November 1, 1938, to a 10-percent reduction in output; this action represents the first positive step toward control of the lead market since 1932. The output of lead during the first 6 months of 1939, however, was higher than for the same period of 1938.

Early in September, after the outbreak of hostilities in Europe, dealings on the London Metal Exchange were suspended, and metal supplies and prices were placed under supervision of the Nonferrous Metals Control created under the Defense Act.

World production.—Lack of adequate production data precludes any reliable estimate of world lead output during 1939. According to the American Bureau of Metal Statistics, lead in ore production in 1938 was 1,772,012 metric tons. Of this total North America produced 836,702 tons (47 percent); in 1939 the American Bureau of

Metal Statistics reported North American output at 836,702 metric tons. In 1938 South American output was 5 percent of the total; in 1939 it was 10 percent. The mine production of lead in the world in 1938 was slightly over half of the total world output and may indicate a lower world production in 1939. Smelter production of lead in 1939 is estimated at 1,000,000 tons. Output of the United States increased from 1938 to 404,257 tons in 1939, representing an increase in production for the latter year. Australian output was considerably lower, whereas Mexican output showed a slight increase.

World production of lead, 1935-39

(Compiled by R. B. M.)

Country	1935	1936	1937	1938 ¹	1939
Argentina.....	4,112	1,111	1,111	1,111	1,111
Australia.....	221,431	221,431	221,431	221,431	221,431
Belgium.....	68,080	68,080	68,080	68,080	68,080
Burma.....	73,217	73,217	73,217	73,217	73,217
Canada.....	148,558	148,558	148,558	148,558	148,558
China.....	1,800	1,800	1,800	1,800	1,800
Czechoslovakia.....	1,728	1,728	1,728	1,728	1,728
France.....	3,986	3,986	3,986	3,986	3,986
Germany.....	14,575	14,575	14,575	14,575	14,575
Greece.....	122,300	122,300	122,300	122,300	122,300
Hungary.....	8,048	8,048	8,048	8,048	8,048
India.....	4,679	4,679	4,679	4,679	4,679
Indonesia.....	14	14	14	14	14
Italy.....	35,803	35,803	35,803	35,803	35,803
Japan.....	7,442	7,442	7,442	7,442	7,442
Mexico.....	178,923	178,923	178,923	178,923	178,923
Northern Rhodesia.....	185	185	185	185	185
Norway.....	677	677	677	677	677
Peru.....	9,452	9,452	9,452	9,452	9,452
Poland.....	18,819	18,819	18,819	18,819	18,819
Rumania.....	4,557	4,557	4,557	4,557	4,557
South-West Africa.....	62,742	62,742	62,742	62,742	62,742
Spain.....	25,300	25,300	25,300	25,300	25,300
Tunisia.....	44,853	44,853	44,853	44,853	44,853
Union of South Africa.....	22,350	22,350	22,350	22,350	22,350
U. S. S. R.....	204,075	204,075	204,075	204,075	204,075
United Kingdom.....	7,554	7,554	7,554	7,554	7,554
Yugoslavia.....					
Total.....	1,383,000	1,478,000	1,478,000	1,478,000	1,478,000

¹ By countries where smelted but not necessarily refined.
² Data not yet available. Estimate included in total.
³ Exclusive of secondary material (Metallgesellschaft, Frankfurt).
⁴ Figures cover lead refined from domestic and foreign ore; refining not included.

World consumption.—Owing to disturbed conditions, consumption of lead in 1939 cannot be estimated. The Bureau of Metal Statistics reported world consumption in 1938 at 1,638,100 metric tons.

REVIEW BY COUNTRY

Argentina.—The Compania Minera Argentina, the St. Joseph Lead Co., supplied 94 percent of the lead in 1938. During 1938 the flotation plant at 174,445 metric tons of ore contained 11.94 percent zinc, and 32 percent lead. In 1938, 29,836 tons of concentrates were produced. Output of concentrates amounted to 36,700 tons.

the world price of metals to the Yugoslav State or on its behalf for payment in dinars. The geology, development, and history of the Mezica lead-zinc mines in the Karawanken Alps of northern Yugoslavia, now operated by the Central European Mines, Ltd. (British), are well-described by Loch.⁴ The run-of-mine ore averages about 13.5 percent lead and 5 percent zinc, and the zinc content appears to be increasing in depth at the Moreing shaft. The flotation plant produces about 16 tons of zinc concentrates averaging 50 percent zinc in 8 hours.

⁴ Loch, Charles W., A Lead-zinc Enterprise in Yugoslavia: Mining Mag. (London), vol. 611 No. 4, October 1939, pp. 201-216.

LEAD AND ZINC PIGMENTS AND

By H. M. MEYER AND A. W. M.

SUMMARY OUTLINE

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Lead and zinc pigment manufacturers reported in 1939 over 1938, owing to gains by industrial consumers of pigments, namely the paint, covering, paper, and other trades.

In general, activity in pigments, as measured by sales, increased until it reached the highest levels in the first quarter, then receded somewhat in the first half. Quoted prices for white lead were higher than in 1938, unchanged from the levels established in 1937. Producers reported that they received 12 and 2 percent higher values for the two grades of white lead than in 1938. Quotations for the other lead pigments rose, but producers apparently did not receive the increases indicated. Prices for various grades of lead sulfate were stationary throughout the year. Lead and zinc sulfide showed a declining tendency in 1939, but producers' values but seemed to be influenced by the metal.

Although sales of lead pigments increased in 1939, quantity whereas those of zinc pigments in 1938. Lead pigments fared better inasmuch as they gained 25 percent in value compared with 24 percent for zinc pigments. Their 1939 averages, however, zinc pigments represented 70 percent of the total value in 1939, while that for lead pigments was 30 percent. Popularity of lead grades of zinc oxide continued to grow, sales for the year established a new high. Sales of the lead-free grades were 26 percent higher in 1939. It is noteworthy that owing to the white lead paints are now available in 1939. The total value of imports of lead and zinc pigments changed little from 1938 to 1939, but the value of exports in 1939.

Salient statistics of the lead and zinc pigments industry of the United States, 1925-29 (average) and 1935-39

	1925-29 (average)	1935	1936	1937	1938	1939
Production (sales) of principal pigments:						
White lead (dry and in oil) short tons.....	164,483	90,831	118,407	98,213	100,213	98,429
Litharge.....do.....	84,816	70,930	80,240	83,002	88,711	89,518
Red lead.....do.....	41,362	28,776	34,890	33,931	30,183	30,978
Zinc oxide.....do.....	154,208	99,697	120,800	114,652	79,120	114,552
Leaded zinc oxide.....do.....	28,600	20,978	40,512	40,343	38,216	42,684
Lithopone.....do.....	177,745	169,486	168,319	164,771	128,746	142,789
Value of products:						
All lead pigments.....	\$60,002,000	\$28,064,000	\$34,206,000	\$35,676,000	\$28,351,000	\$35,485,000
All zinc pigments.....	41,314,000	28,500,000	27,862,000	28,038,000	23,301,000	28,794,000
Total.....	101,406,000	56,564,000	62,068,000	63,714,000	51,652,000	64,279,000
Value per ton received by producers:						
White lead (dry).....	178	124	128	140	123	138
Litharge.....	176	104	116	143	122	128
Red lead.....	193	121	133	160	137	140
Zinc oxide.....	133	103	90	103	117	117
Leaded zinc oxide.....	124	93	87	104	107	114
Lithopone.....	98	84	82	78	70	78
Foreign trade:						
Lead pigments:						
Value of exports.....	1,340,000	512,000	546,000	586,000	510,000	715,000
Value of imports.....	30,000	2,000	12,000	17,000	10,000	10,000
Zinc pigments:						
Value of exports.....	2,160,000	392,000	420,000	610,000	339,000	925,000
Value of imports.....	931,000	468,000	375,000	414,000	285,000	280,000
Export balance.....	2,835,000	434,000	579,000	765,000	564,000	1,350,000

¹ Revised figures.

Titanium pigments again absorbed a larger share of the market for white pigments than in previous years. It was estimated¹ that production of titanium pigments approached 165,000 tons in 1939. According to this report, one of the largest paint manufacturers completed and put into successful operation a pilot plant using a recently developed process.

PRODUCTION

In this chapter sales are used as being more significant than production, for no account is taken of stocks on hand at the beginning and end of the year. The quantities consumed by the producers in manufacturing products at their own plants are included under sales. Production figures are used only in calculating the metal content of pigments and salts in the section of this report on Raw Materials. Used in the Manufacture of Lead and Zinc Pigments and Zinc Salts.

The total value of sales of lead and zinc pigments rose from \$51,652,000 in 1938 to \$64,279,000 in 1939, which was 63 percent of the average for 1925-29. The increase in 1939 was caused by greater sales of lead oxide pigments and all zinc pigments and by higher average values received by producers for several items.

Lead pigments.—Increased quantities of red lead, orange mineral and litharge were sold in 1939. Sales of white lead (dry) were slightly higher, and sales of white lead in oil and basic lead sulfate declined. Changes in sales from 1938 to 1939 ranged from a decline of 5 percent for basic lead sulfate to increases of 30-32 percent for litharge and red lead. The average values received by producers for all lead pigments

¹ Chemical and Metallurgical Engineering, vol. 47, No. 2, February 1940, p. 76.

LEAD AND ZINC PIGMENTS

except orange mineral were higher in 1939 than in 1938, but those for white lead were stationary in November 1938. The figures given in this report are exclusive of the amounts used in the manufacture of basic sulfate so used is reported under lead. The use of basic lead sulfate has expanded and totaled about 7,700 tons in 1939. Litharge, of which a higher tonnage was sold in 1925-29, the advance being 6 percent.

Lead pigments sold by domestic manufacturers

Pigment	1938	
	Short tons	Value (at exclusive of cost)
		Total
Basic lead sulfate or sublimed lead:		
White.....	5,030	\$655,203
Blue.....	771	88,873
Red lead.....	30,183	4,121,428
Orange mineral.....	127	27,547
Litharge.....	68,711	8,359,629
White lead:		
Dry.....	29,813	3,681,052
In oil.....	70,400	11,617,650

¹ Revised figures.

² Weight of white lead

Lead pigments sold by domestic manufacturers in short tons

Year	White lead		Basic lead sulfate or sublimed lead
	Dry	In oil	
1925.....	27,072	68,869	7,672
1926.....	34,776	83,632	7,531
1927.....	32,661	65,552	7,614
1928.....	29,813	70,400	6,030
1929.....	30,509	67,920	4,088

¹ Revised figures.

Zinc pigments and salts.—Sales of lead pigments were high in 1939, being 6 percent higher than in 1938, and 60 percent higher than in 1925-29. Sales of zinc oxide and litharge were higher than in 1938, but amounted to only 114,552 tons in 1939, as against the 1925-29 averages. Average quotations for lead-free zinc oxide were unchanged in 1939, and the average values reported by producers for the 2 years. Prices of leaded zinc oxide in 1939 were higher than in 1938, and producers reported that the average value they received. On the other hand, quotations were lower in 1939, the top of the range coinciding with the bottom of the range for 1938.

Large quantities of basic lead sulfate now used in making leaded zinc oxide are included as part of the leaded zinc oxide total and, to avoid duplication, are not shown as basic lead sulfate.

Complete data covering the production of zinc chloride in recent years are not available owing to the refusal of one large producer to supply an accurate report.

Sales of zinc sulfate in 1939 almost equaled the high record established in 1937.

Zinc pigments and salts sold by domestic manufacturers in the United States, 1938-39

Pigment or salt	1938			1939		
	Short tons	Value (at plant, exclusive of container)		Short tons	Value (at plant, exclusive of container)	
		Total	Average		Total	Average
Zinc oxide ¹	79,129	\$9,253,342	\$117	114,552	\$13,446,443	\$117
Leaded zinc oxide ¹	38,216	4,072,422	107	42,084	4,980,471	114
Lithopone.....	126,746	9,975,012	79	142,759	10,461,102	73
Zinc chloride, 50° B.....	(²)	(²)	(²)	(²)	(²)	(²)
Zinc sulfate.....	7,757	439,479	57	10,157	582,831	57

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, 1935-39, in short tons

Year	Zinc oxide	Leaded zinc oxide	Lithopone	Zinc chloride (50° B.)	Zinc sulfate
1935.....	99,697	29,976	159,486	(¹)	7,892
1936.....	126,800	40,512	158,319	(¹)	9,721
1937.....	114,052	40,343	154,771	(¹)	10,121
1938.....	79,129	38,216	126,746	(¹)	7,757
1939.....	114,552	42,084	142,759	(¹)	10,157

¹ Data not available.

CONSUMPTION BY INDUSTRIES

White lead.—Prices received by producers for white lead were higher in 1939 than in 1938, and the increased values per ton were responsible for the improvement in this industry for the year. Tonnage data showed relatively little change in sales of dry white lead and a drop of 4 percent in sales of white lead in oil. Normally 95 percent of the white lead made is used in the manufacture of paint. As stated in Minerals Yearbook, 1939, the Lead Industries Association began a 3-year promotion campaign in 1939 designed to increase the use of white-lead paint. Early in 1940 it was announced that white lead paints were now available in colors. Previously white lead was generally available only in paste form, and it was mixed with linseed oil on the job and tinted to taste or specification.

Late in 1939 a Canadian article called attention of the lead industry to the thousands of gallons of white paint being used on the roads and curbs of England in preparation for "black-outs." A market summary on page 7 of the Metal Bulletin, London, January 16, 1940, pointed out that paint makers—at any rate, those of the lead-paint section—had suffered a sharp decline in business. The summary stated that it might have been expected that Government construction

work and camouflaging would have of that most camouflage and road paints.

In March it was stated that the lead would be revised, and a preliminary in the year, however, the Technical that no change should be made. The TT-W-251A-White Lead, Basic Carbon Semi-paste containing Turpentine, was and the latest amendment (Amendment

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

Industry	1935
Paint.....	91,297
Ceramics.....	1,834
Other.....	3,700
Total	96,831

¹ Revised figures.

Basic lead sulfate.—The outstanding the manufacture of paint, 93 percent being for that purpose. Increasing quantity being used annually in making leaded used are included in the totals for leaded the totals for basic lead sulfate to avoid tonnages. In 1939, 7,700 tons of basic making leaded zinc oxide compared with in 1937.

Distribution of basic lead sulfate sales, 1935-

Industry	1935
Paints.....	7,770
Rubber.....	156
Storage batteries.....	374
Other.....	
Total	8,299

Red lead.—Total sales of red lead gaining better in relation to that year than the principal use of red lead is in the market and 62 percent of the 1939 total was consumed the second largest quantity of outlet gained in the same proportion as

Distribution of red lead sales, 1935-39,

Industry	1935
Storage batteries.....	17,657
Paints.....	8,721
Ceramics.....	867
Other.....	1,531
Total	28,776

Orange mineral.—Ink manufacture and color pigments have alternated as leading consumers of orange mineral. Ink manufacture led in 1939 and used 49 percent of the total sales reported.

Distribution of orange mineral sales, 1935-39, by industries, in short tons

Industry	1935	1936	1937	1938	1939
Ink manufacture.....	85	71	76	20	64
Color pigments.....	125	77	51	94	40
Other.....	42	100	79	13	27
	252	248	206	127	131

Litharge.—Sales of litharge made a good showing in 1939; they were 30 percent higher than in 1938 and 6 percent higher than the annual average for 1925-29. Leaded zinc oxide was the only other pigment covered in this report that exceeded its 1925-29 average in 1939. All uses of litharge showed noteworthy increases in 1939 except varnish and linoleum, which remained virtually stationary. Storage batteries, the principal use, took 44 percent of the total in 1939. Black oxide or suboxide of lead used by battery manufacturers reached a new peak of 45,000 tons compared with the previous record of 42,000 tons in 1937. Sales of black oxide are not included in Bureau of Mines totals for litharge. The preparation of lead oxide for use in storage batteries was the subject of a new patent issued in December (U. S. Patent 2,182,479). Since 1931 insecticides have been the second most important use of litharge. Sales for this purpose rose 40 percent in 1939 but were 10 percent below the record tonnage in 1937. The ceramics industry attained third place as a consumer of litharge in 1939, having displaced the oil-refining industry.

Distribution of litharge sales, 1935-39, by industries, in short tons

Industry	1935	1936	1937	1938	1939
Storage batteries.....	36,067	38,700	32,228	32,514	39,754
Insecticides.....	14,665	14,662	18,242	11,736	16,458
Ceramics.....	6,761	7,762	7,577	6,889	8,600
Chrome pigments.....	6,617	6,662	7,330	4,590	7,311
Oil refining.....	7,890	7,269	8,311	6,411	7,633
Varnish.....	1,610	4,247	3,366	2,449	2,448
Rubber.....	3,171	2,147	1,650	880	1,425
Linoleum.....	220	254	264	231	225
Other.....	2,960	4,553	4,925	4,011	4,111
	79,030	86,246	83,002	68,711	88,111

Zinc oxide.—Sales of zinc oxide advanced 45 percent in 1939—the greatest percentage gain of any of the lead and zinc pigments. Sales of this product, however, were only 74 percent of the annual average for 1925-29. The rubber industry takes most of the zinc oxide sold and this use comprised 61 percent of the total in 1939. Consumption of zinc oxide in rubber rose 52 percent compared with increases of 2 and 34 percent, respectively, in paints and ceramics. Floor coverings and textiles regained part of the ground lost in 1938, when sales fell 66 percent, as consumption advanced 86 percent in 1939. Of the zinc oxide produced in 1939, 59 percent was made by the American process and 41 percent by the French process compared with 62 and 38 percent, respectively, in 1938. The proportion of French-pro-

oxide made from scrap zinc rose sharply in 1939, the total compared with 32 percent in 1938 and a large quantity of zinc oxide is used in the rubber industry. This tonnage is included in the total zinc oxide and is excluded from zinc oxide totals to avoid duplication in reporting metal tonnages. The rubber and ceramic industries produced to a new pelleted type of zinc oxide

Distribution of zinc oxide sales, 1935-39, by industries, in short tons

Industry	1935	1936
Rubber.....	57,734	72,888
Paints.....	25,289	33,141
Ceramics.....	4,028	6,100
Floor coverings and textiles.....	7,179	7,177
Other.....	5,407	7,488
	90,637	126,894

Leaded zinc oxide.—The manufacture of (97 or more percent) of the leaded zinc oxide has become increasingly popular in recent years, reaching a record high level in 1939, exceeding the previous record in 1936 and 1937 by 6 percent. The total production of 7,700 tons of basic lead sulfate used to produce this product; this tonnage is excluded from the total to avoid duplication in reporting metal tonnages.

Distribution of leaded zinc oxide sales, 1935-39, by industries, in short tons

Industry	1935	1936
Paints.....	29,632	40,166
Rubber.....	36	32
Other.....	308	324
	29,976	40,512

Lithopone.—Lithopone statistics are reported on the regular lithopone content of high-strength lithopone sold as such. Before 1936 the figure was standard-strength plus high-strength production. Paint, varnish, and lacquer has consumed the most lithopone sold in recent years. Sales advanced 10 percent in 1939, but the quantities employed in floor coverings and textiles, the two largest uses, were less than the total. On the basis of somewhat incomplete comparison of the quantities shown in the report on floor coverings and textiles indicates that 14,000 tons of felt-base floor coverings and the rest for other uses (oilcloth, shade cloth, artificial leather, etc.) in 1939 included 2,407 tons for printing ink. It was reported in midyear that a 12,000 tons capacity had been completed at the H. H. H., the second plant of the type in the country.

Distribution of lithopone sales, 1935-39, by industries, in short tons

Industry	1935	1936	1937	1938	1939
Paints, etc.	124,615	122,461	122,915	101,924	113,905
Floor coverings and textiles	19,440	23,085	20,194	15,400	17,420
Rubber	4,435	4,908	4,383	3,148	3,189
Other	10,999	7,865	7,279	5,274	8,146
	159,489	158,319	154,771	125,746	142,759

The use of ordinary-strength lithopone in the manufacture of titanated lithopone, which usually contains 15 percent TiO_2 , has increased rapidly since the output of this product was begun. It declined, however, in 1938 and fell rather sharply in 1939, when 13,700 tons were used for this purpose compared with 17,000 tons in 1938 and 19,400 in 1937. These figures are included in Bureau of Mines totals for lithopone.

Zinc sulfide.—Production of zinc sulfide was reported by four plants in 1939, as in 1938, but since one producer dominates the industry, the Bureau of Mines cannot publish representative statistics. Most of the zinc sulfide is mixed with regular lithopone to make high-strength lithopone. Two patents on zinc sulfide were issued recently: United States Patent 2,175,273, purported to be an improved process for production of zinc sulfide, and United States Patent 2,187,130, which claims that zinc sulfide-containing pigments are rendered stain resistant by incorporating in them a minor quantity of relatively insoluble metallic thiosalt, such as thiocyanate, thiosulfate, and xanthate.

Zinc chloride.—Complete data on sales of zinc chloride are not reported to the Bureau of Mines, but returns from producers responsible for more than two-thirds of the output indicate the following distribution of sales by uses in 1939:

	Percent		Percent
Soldering flux	33	Oil refining	4
Dry-cell batteries	22	Others	9
Wood preserving	19		
Vulcanized fiber	13		100

Zinc sulfate.—The trend in sales of zinc sulfate was upward from 1932 to 1937, and a new high record was established in 1937. Sales fell in 1938 but in 1939 virtually equaled the record of 1937. Of the total sales in 1939 (10,157 tons), 3,897 tons were reported as sold to the rayon industry, 2,168 tons for agricultural purposes, 1,309 tons for chemical manufacture (including the medicinal trade), 583 tons to paint and varnish manufacturers, 556 tons to electrogalvanizers, and 172 tons for glue manufacture; 1,472 tons were undistributed. A break-down of the 1,472 tons under "undistributed" undoubtedly would increase the tonnages under some or all of the uses itemized.

RAW MATERIALS USED IN MANUFACTURE OF LEAD AND ZINC PIGMENTS AND 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

LEAD AND ZINC PIGMENTS

processes. In 1939, 93 percent of the lead from pig lead and 7 percent from ore. In 1939, 64 percent from ore, 123 percent from secondary materials.

Metal content of lead and zinc pigments produced in 1938-39, by sources, in short tons

Source	Lead in pigments ¹
Domestic ore	12,025
Metal	163,815
Secondary material ²	176,840

¹ Includes also lead recovered in zinc oxide and leaded zinc oxide.
² Revised figures.
³ Zinc ashes, skimmings, drosses, and old metal.

The following tables give the source of the metal in each pigment and salt. Pig lead is directly or indirectly, in the manufacture of lead, and orange mineral and is used also lead sulfate. Zinc oxide is the only pigment in which zinc is used. Ore is employed in the manufacture of zinc oxide, lithopone, zinc sulfate, and basic zinc carbonate. The proportion of the zinc in lithopone and United States is derived from secondary materials. There has been a decided increase in the quantity of secondary materials in the manufacture of zinc oxide since 1933. The quantity of zinc in the manufacture of French process

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

Pigment	1938			Total lead in pigments
	Domestic ore	Pig lead	Secondary material	
White lead	175,115	26,608	60,609	262,332
Red lead	2,830	91	739	3,660
Litharge	9,195	753	12,025	21,973
Orange mineral	12,025	163,815	176,840	341,680
Basic lead sulfate	12,025	163,815	176,840	341,680
Leaded zinc oxide	12,025	163,815	176,840	341,680

¹ Revised figures.

Zinc content of zinc pigments and salts produced by domestic manufacturers, 1938-39, by sources, in short tons

Pigment or salt	1938				1939			
	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
	Domestic ore	Slab zinc	Secondary material		Domestic ore	Slab zinc	Secondary material	
Zinc oxide.....	37,080	15,713	7,456	60,238	40,126	17,117	16,429	82,671
Leaded zinc oxide.....	18,502			18,502	21,050	5		21,055
Lithopone.....	12,597	47	11,282	23,906	13,064	47	12,709	27,410
Zinc sulfide.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Zinc chloride.....	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Zinc sulfate.....	931		1,395	2,326	1,157		1,674	2,831

¹ Data not available.

PRICES

The total values reported by producers for lead and zinc pigments and zinc salts are given in the tables in the first part of this report. The average values received for all important lead pigments increased from 1 percent for litharge to 25 percent for white lead in oil. On the other hand, while the average value for leaded zinc oxide rose 7 percent, that for zinc oxide remained unchanged and that for lithopone dropped 8 percent. The range of market quotations, as reported by the Oil, Paint and Drug Reporter, appears in the following table. Quoted prices for white lead were unchanged from November 1938 throughout 1939. Quotations for other lead pigments in general followed price changes in pig lead, moving upward after the middle of the year and standing at their highest levels at the end of the year. Prices for zinc pigments apparently were not influenced by price changes for the metal. Quotations for lead-free zinc oxide were stationary throughout 1938 and 1939; those for the 5-35 percent leaded grade ranged from 6.25 to 6.38 cents in 1939 compared with 5.90 to 6.38 cents in 1938. Quotations for lithopone and zinc sulfide showed a downward trend in the latter part of the year against the trend for most commodities. The average value reported by producers for zinc sulfate in 1939 was unchanged from 1938, but quotations for this product had a narrower range in 1939, both the low and high quotations coming between the extremes reported for 1938.

LEAD AND ZINC PIGMENTS AND SALTS

Range of quotations on lead pigments and zinc pigments (or delivered in the East), 1936-39, in cents per pound

Product	1936
Basic lead sulfate, or sublimed lead, less than carlots, barrels.....	6.25-6.75
White lead, or basic lead carbonate, dry, carlots, barrels.....	6.50-7.25
Litharge, commercial, powdered, barrels.....	6.00-8.50
Red lead, dry, 85 percent or less, less than carlots, barrels.....	7.50-9.50
Orange mineral, American, small lots, barrels:	
Ex-white lead.....	10.50-11.25
Ex-red lead.....	
Zinc oxide:	
American process, lead-free, bags, carlots.....	5.00-5.25
American process, 5 to 35 percent lead, barrels, carlots.....	5.13-5.38
French process, red seal, bags, carlots.....	5.50-5.75
French process, green seal, bags, carlots.....	6.00-6.25
French process, white seal, barrels, carlots.....	6.50-6.75
Lithopone, domestic, 5-ton lots, bags.....	4.25-4.50
Zinc sulfide, less than carlots, bags, barrels.....	9.25-11.75
Zinc chloride, works:	
Solution, tanks.....	2.00
Fused, drums.....	4.25-5.75
Zinc sulfate, crystals, barrels.....	2.65-3.95

FOREIGN TRADE

Imports of lead and zinc pigments remained about the same in 1938 and 1939, and exports almost doubled in value in 1939. Exports over imports amounted to \$1,351,500, or less than half the annual average for 1925-29. Lead and zinc salts gained 16 percent in 1939, of lead arsenate, the only salt reported separately.

The following table shows the value of value imported and exported in 1938 and 1939.

Value of foreign trade of the United States in lead and zinc pigments and salts, 1938-39

	1938	1939
Imports		
Lead pigments:		
White lead.....	\$3,970	79
Red lead.....	123	271
Litharge.....	5,533	
Orange mineral.....		9,085
Other lead pigments.....		
Zinc pigments:		
Zinc oxide.....	73,487	
Lithopone.....	207,121	
Zinc sulfide.....	4,798	
Lead and zinc salts:		
Lead arsenate.....		285,406
Other lead compounds.....		
Zinc chloride.....	12,659	
Zinc sulfate.....	19,718	
Zinc sulfide.....	14,321	
Grand total.....	48,898	344,089

¹ Data not available.

² Figures on imports and exports compiled by M. B. Price, of the Bureau of Foreign and Domestic Commerce.

Lead pigments and salts.—Imports of these commodities are insignificant. The most important item is the group of lead compounds, which include lead acetate, lead nitrate, and others, and imports of these compounds rose from 85 short tons in 1938 to 104 in 1939. Imports of suboxide of lead increased from 16 tons in 1938 to 20 in 1939.

Lead pigments and salts imported for consumption in the United States, 1935-39

Year	Short tons					Total value
	Basic carbonate white lead	Red lead	Litharge	Orange mineral	Lead compounds	
1935.....	6	1		2	302	\$38,228
1936.....	32	2		5	185	\$37,878
1937.....	34		(?)	5	213	\$53,984
1938.....	20	1	1	2	85	\$22,644
1939.....	11	2		1	104	\$28,248

¹ Includes also—1935: Lead pigments, n. s. p. f., \$478 (4,405 pounds); 1936: Lead pigments, n. s. p. f., \$19 (33 pounds), sublimed lead (basic sulfate) \$9 (15 pounds), and suboxide of lead, n. s. p. f., \$5,264 (39,010 pounds); 1937: Lead pigments, n. s. p. f., \$8 (100 pounds), sublimed lead (basic sulfate), \$2 (10 pounds), and suboxide of lead, n. s. p. f., \$9,398 (65,453 pounds); 1938: Lead pigments, n. s. p. f., \$108 (2,336 pounds), and suboxide of lead, n. s. p. f., \$5,335 (31,834 pounds); 1939: Lead pigments, n. s. p. f., \$690 (5,270 pounds), and suboxide of lead, n. s. p. f., \$5,020 (40,445 pounds).

² Less than 1 ton.

The principal exports are white lead and litharge, and these two items made proportionately large gains in 1939. Exports of red lead and lead arsenate also rose in 1939. The total value for exports of the items listed was \$875,235 in 1939 compared with \$605,075 in 1938. Exports of white lead, red lead, and litharge comprised 3 percent or less of domestic sales of these pigments.

White lead was exported principally to the Netherlands, Philippine Islands, and Canada, whereas the principal recipients of red lead and litharge were Canada, the Philippine Islands, and Argentina.

Lead pigments and salts exported from the United States, 1935-39

Year	Short tons				Total value
	White lead	Red lead	Litharge	Lead arsenate	
1935.....	2,337	750	1,280	578	\$608,734
1936.....	1,862	810	1,388	414	\$609,890
1937.....	1,236	934	1,482	521	\$77,815
1938.....	1,411	806	1,694	511	\$605,075
1939.....	2,024	1,324	2,077	856	\$75,235

White lead, red lead, and litharge exported from the United States to various destinations, in short tons

Destination	White lead			
	1936	1937	1938	1939
Countries:				
Argentina.....	120	80	97	
Brazil.....	12	28	72	
Canada.....	74	126	220	
Mexico.....	181	44	71	
Netherlands.....	387	83	222	
Netherlands West Indies.....	2	5	5	
Panama.....	453	206	108	
Philippine Islands.....	170	272	385	
Others.....	486	383	231	
	1,862	1,236	1,411	2,024
Continents:				
North America.....	754	479	448	
South America.....	218	170	221	
Europe.....	707	232	279	
Asia.....	174	338	450	
Africa.....	9	18	13	
Oceania.....	(¹)	1	(¹)	(¹)

¹ Less than 1 ton.

Zinc pigments and salts.—Imports of zinc increased in 1939, while those of lithopone and zinc sulfide ranks as the most important zinc pigments. Imports of this commodity represented only 1 percent of domestic sales in 1939. Imports of zinc oxide (dry) amounted to 3 percent of domestic sales in 1939, a gain over the 645 tons received in 1938.

Zinc pigments and salts imported for consumption in the United States, 1935-39

Year	Short tons			
	Zinc oxide		Lithopone	Zinc sulfide
	Dry	In oil		
1935.....	1,932	59	4,603	
1936.....	694	96	4,781	
1937.....	660	95	5,801	
1938.....	579	66	5,932	
1939.....	1,485	66	2,641	

Exports of zinc oxide trebled in 1939 and were valued at \$1,485,000, compared with \$479,000 in 1938. Exports of lead-free zinc oxide by domestic producers amounted to \$1,485,000 in 1939, compared with \$479,000 in 1938. Exports of zinc oxide by domestic producers amounted to 3 percent of sales of domestic producers in 1939, a gain over the 645 tons shipped to Canada, Mexico, Cuba, Chile, and other scattered nations in 1938.

Zinc pigments and salts¹ exported from the United States, 1935-39

Year	Short tons		Total value	Year	Short tons		Total value
	Zinc oxide	Lithopone			Zinc oxide	Lithopone	
1935.....	1,140	2,372	\$302,368	1938.....	1,163	1,734	\$339,415
1936.....	1,330	2,538	419,987	1939.....	3,485	4,845	925,468
1937.....	2,953	2,671	609,954				

¹ Zinc salts not separately recorded.

Zinc oxide and lithopone exported from the United States, 1936-39, by destinations, in short tons

Destination	Zinc oxide				Lithopone			
	1936	1937	1938	1939	1936	1937	1938	1939
Countries:								
Argentina.....	55	48	85	104	35	63	28	89
Brazil.....	39	32	6	285	(1)	(1)	(1)	55
Canada.....	704	1,683	514	898	1,812	1,740	1,219	2,775
Chile.....	20	12	13	69	(1)	(1)	(1)	189
Cuba.....	80	207	48	84	186	258	115	244
Mexico.....	14	57	9	105	103	185	146	361
Philippine Islands.....	15	415	141	281	16	5	11	20
Others.....	403	599	340	1,659	380	420	216	1,113
	1,330	2,953	1,163	3,485	2,538	2,671	1,734	4,845
Continents:								
North America.....	882	1,972	659	1,168	2,104	2,184	1,483	3,408
South America.....	130	149	117	614	57	90	41	369
Europe.....	99	148	85	693	218	217	132	153
Asia.....	52	467	169	844	25	24	13	287
Africa.....	6	57	3	175	4	1	1	22
Oceania.....	161	160	140	191	130	155	64	616

¹ Less than 1 ton.

GOLD, SILVER, COPPER, AND

(MINE REPORT)

By CHAS. W. HEND

SUMMARY OUT

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Gold recovered from Alaska ores and fine ounces valued at \$23,685,795, an 664,973 ounces valued at \$23,274,055 in the total gross value of the gold, silver, Copper was produced in 1939 only as a b the output of recovered metal fell to 256 pounds in 1938, when it came mostly from

All tonnage figures are short tons and do not include moisture.

The value of metal production herein at the following prices.

Prices of gold, silver, copper, lead,

Year	Gold ¹	Silver ²
	Per fine ounce	Per fine ounce
1935.....	\$35.00	\$0.00
1936.....	35.00	35.00
1937.....	35.00	35.00
1938.....	35.00	35.00
1939.....	35.00	35.00

¹ Price under authority of Gold Reserve Act of Jan. 31, 1934, Jan. 18, 1937, to Jan. 31, 1934, was \$20.67+ (\$20.671835) per fine ounce.
² 1935-37: Yearly average weighted Treasury buying price for newly mined silver.
³ Yearly average weighted price of all grades of primary metal.
⁴ \$0.64646464.
⁵ \$0.67878787.

The following tables show the mine copper, and lead in Alaska in 1935-39 recovered metals; the output of gold and operation; and the output of gold, silver, and cyanidation mills (with or without) in 1939, by regions.